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# Evaluation of information and communication technology sector in the teaching process and strategic collaboration between universities and industry

**Biljana Novković Cvetković**[1] | **Milan Gligorijević**[2] | **Dalibor Petković**[3] | **Srđan Jović**[4] | **Miloš Milovančević**[5] | **Vlastimir Nikolić**[6]

[1]Department of Pedagogy and Psychology, Pedagogical Faculty in Vranje, University of Niš, Vranje, Serbia

[2]Department of Informatics, University of Criminal Investigation and Police Studies, Belgrade, Serbia

[3]Department of Mathematics and Technics, Pedagogical Faculty in Vranje, University of Niš, Vranje, Serbia

[4]Department of Mechanics, Faculty of Technical Sciences, University of Prishtina, Kosovska Mitrovica, Serbia

[5]Chair of Management in Mechanical Engineering, Faculty of Mechanical Engineering, University of Niš, Niš, Serbia

[6]Department of Mechatronics and Control, Faculty of Mechanical Engineering, University of Niš, Niš, Serbia

**Correspondence**
Dalibor Petković, Pedagogical Faculty in Vranje, University of Niš, Partizanska 14, Vranje 17500, Serbia.
Email: dalibortc@gmail.com

**Funding information**
Faculty of Mechanical Engineering, University of Niš, Serbia

**Abstract**

The main purpose of the study was to evaluate the information and communication technology (ICT) sector in the teaching process based on teachers' attitudes and the strategic collaboration between universities and industry. The most common issue faced by the graduated students is to find a desired job at the end of the course of study. The main obstacle in finding a desired job is not enough ICT knowledge, which is not adequately learned at universities. On the other hand, the ICT teaching process at universities could be slow because many teachers do not have the right attitude toward ICT application in the learning process. In this study, a survey was performed among ICT working students and ICT teachers as well to reveal the relationship between the skills required for a job and the skills being taught at universities; whether the employability skills of fresh graduates increase hiring opportunities. The sample of examinees for this study consisted of the ICT sector in the European Union as well as ICT teachers based on the World Bank database. The proposed model was analyzed using structural equation modeling. It was found that the relationship between the academic program and job market along with ICT skills affected the employability factor. Hence the relationship between the academic program and job market significantly affects the employability factor. In effect, more focus on designing the academic curriculum is needed.

**KEYWORDS**

educational course, employability, ICT skills, information-communication technologies (ICT)

## 1 | INTRODUCTION

Industry based on information and communication technology (ICT) is the single most rapidly changing and growing industry currently. Every day, new ICT initiatives are being developed. It has become crucial to ensure that there are skilled, knowledgeable, and qualified professionals keeping pace with ICT developments. Some initiatives are needed to determine the relationship between the skills required for a job and the skills being taught in universities. Identifying those critical skills and developing methods to assess them at the university level is important. Understanding those skills will help us to develop fair and valid assessments ensuring that the students of today will be efficient employees of the future. Universities need to be in sync with the growing ICT sector by constantly introducing specialized courses.

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Use of ICT in teaching is one of the key issues for improving the school educational system. There is a growing necessity for the use of ICT in teaching due to the large discrepancy between scientific-technological achievements and work demands on one side, and the quality of the educational process on the other. Taking into account current trends, there is a growing number of studies related to the use of ICT in the teaching process. Such studies have the aim of contributing to the improvement of the use of ICT in a teaching process, as well as using, as much as possible, their potentials in the curriculum process.[1–7]

ICT generally has a positive impact on teaching and learning situations but compared with ideal expectations, the impact of ICT on teaching and learning must still be considered to be limited.[8] The main obstacles of ICT teaching are insufficient teachers' skills, low motivation, and lack of confidence in the use of new technologies, as well as limited access to ICT in schools.[9] The International Computer and Information Literacy study was the first international educational study,[10,11] and the purpose of the study was to examine the computer and information literacy of students relevant for the use of ICT. Modern society is characterized by the digitalization of all areas of people's life and work. The "explosion" of new knowledge is a characteristic of the information society in which information has become of primary value[12] and in which archiving, processing, and exchange of information[13] are based on modern technologies and information age methods. The main initiator of the development of the information society[14] is computer technology and the fast development of telecommunications. All of these scientific-technological and social changes are ongoing fast nowadays, and consequently, systems of every country are striving toward improvement and keeping up with the information age. ICT presents a pillar of the economy and an initiator of social changes in the 21st century, and by ICT, they imply transfer and use of all sorts of information.[15,16] The notion of ICT accentuates the role of communications and integration of telecommunications, computer technology, and audio-visual systems that enable users to approach, memorize, transfer, and manipulate information.[17]

Job readiness and employability are factors interdependent on each other. Job readiness in simple language means being able, with little or no outside help, to find, acquire, and keep an appropriate job, whereas employability is defined as a set of achievements and skills, understanding, and personal attributes that make graduates more likely to gain employment and be successful in their chosen occupations. These two factors serve as a platform for graduates while making a career choice. The expectations for competent ICT engineers and specialists have dropped as fresh graduates do not show the desired skills, smartness, and caliber needed at the career level.[19] A consistent relationship between universities and corporates can provide a stable platform for working on missing links.[20]

It becomes a top priority for the industry to engage with universities beyond research funding and to create a situation where both parties can work together not only to meet their individual goals but to steer social and economic growth. Likewise, universities would fail to justify their roles, if they are not able to produce the adequate knowledge and skill base required in the job market or entrepreneurial settings. Universities have been the front-runners in the strategic partnerships with industry, for which they are the core of research activities as well as knowledge-share. However, to deliver to their potential, it is vital for universities to take a step forward, facilitate the clear and precise communication with industry, and understand the job market needs to create a pool of skilled and knowledgeable academics.[21] The key purpose of collaboration between corporations and universities is to keep the computing graduate programs up-to-date with advancing technologies, prepare graduates to work in diverse organizational cultures, and develop their generic and technology-specific competencies, which will improve the satisfaction level of employers.[22]

Juhdi et al[23] agreed that the graduates are well equipped with technical skills, such as in ICT, management, engineering, and marketing, but they lack in certain aspects, such as the ability to communicate, skills to solve problems, and poor interpersonal skills. To achieve a good and quality education for everyone, ICT needs to be integrated into the educational system. ICT is of key importance at all levels of the educational system. At each stage of cognitive activity, research and practical applications in all branches of knowledge, ICT performs both the functions of the tools and the objects of knowledge. ICT innovations not only provide a revolutionary development in this branch of knowledge but also have a direct impact on the scientific and technological progress in all areas of society. Thus, ICT is a class of innovative technologies for the rapid accumulation of intellectual and economic potential of strategic resources, ensuring sustainable development of society.[24]

In the new teaching paradigm, the student is the center of the educational process. By using ICT in this process, the psychological tension of the student is being reduced because there is a transition from subjective teacher-student relationship onto a teacher-computer-student relationship, work efficiency is increased,

creativity is encouraged, and a possibility is provided to expand at home the knowledge acquired at school. Under such conditions, the student is not just subject but is also the priority subject, the goal of the educational system, rather than just a means for reaching certain external goals.

The starting ground in the research about teacher's attitudes toward the use of ICT in teaching is that there are those who consider that introducing innovations can also be seen as a general attitude toward modernization of the teaching process, having in mind that apart from social motives, a man is also motivated by his attitudes toward various activities. Taking into account the fact that attitudes present a relatively durable tendency of an emotional, value, and action relationship toward people and events, attitudes have a dynamic effect, that is, they act as motives and influence an individual's behavior in a society. Attitudes are relatively stable characteristics of a person with various possibilities and tempo of their changing. An important characteristic of attitudes is that they represent a tendency toward action. No other psychological characteristic has such an influence on individual's behavior as much as attitudes. Thus, also teachers establish their own relation toward innovations in teaching and behave according to their own attitudes.[25] For all the aforementioned, getting to be familiar with teachers' attitudes enables us to quite successfully foresee their behavior during the process of implementation of ICT in teaching.

In this study, a survey was performed among ICT working students as well as ICT teachers as well to reveal the relationship between the skills required for a job and the skills being taught at universities; whether the employability skills of fresh graduates increase hiring opportunities. Based on the rapid development of ICT, the main aim of this paper is to present the teachers' attitudes toward ICT application in the teaching process. Statistical evaluation is performed to determine the ranking of the influential factors on the teachers' attitudes toward ICT application in a teaching process.

## 2 | METHODOLOGY AND DATA

The purpose of the study is to provide a qualitative and comprehensive insight into the present situation in the area of the use of ICT in a teaching process. The goal of the study is to determine the level of the presence of ICT in education as well as the attitude of teachers toward the implementation of ICT. The purpose and goal of the research impose the tasks of the study: to determine the attitudes and opinions of teachers toward the use of ICT in teaching. In relation to the aforementioned, a hypothesis has been set that the examinees show a positive attitude toward the use of ICT in teaching.

Another task had been set to examine the difficulties that teachers are facing during the use of ICT in the teaching process. The study is based on the descriptive scientific-investigation method. The technique of interviewing was applied and the technique of scaling for questioning regarding the teachers' attitudes. To determine the eventual differences regarding the teachers' attitude toward individual information-communication technologies, a discriminant analysis was applied.

The sample of examinees for this study consisted of the ICT sector in the European Union as well as ICT teachers based on the World Bank database. The group of the stratified sample was combined with the group of convenience sample, thus providing the possibility to categorize the examinees into subgroups (stratums) and to conduct the selection of examinees within the stratum, by applying the sample of convenience character.

The teachers were presented with a list of various ICTs, and they had to reveal their attitudes and opinions toward certain types of ICT and their use in a teaching process. The teachers' attitudes regarding the use of certain ICTs in teaching is studied by the mode of interviewing of general attitudes, that is, with a scale for the examining of attitudes. For interviewing regarding the direction and intensity of the attitudes on the use of ICT, the teachers were offered a four-stage estimation scale, so that for each type of ICT they replied how often they apply it in their work.

By collecting the answers of each of the examinees for all types of ICTs, the cumulative numerical value (cumulative index) was also determined for the scale, in general, as an individual gross result for each of the teachers for the entire scale, and in that manner was determined the direction and intensity of the teachers' general attitude toward the use of ICT in teaching. Afterward, by a statistical method, not only the distribution of answers of all of the teachers for each of the ICTs but also the individual gross result as a cumulative value (cumulative index) of the direction and intensity of attitude for each of the teachers and for the scale of attitudes towards the use of certain ICTs in teaching, in general, was established.

A study of the job market was done through the World Bank Database. A summarized table in Supporting Information Appendix A shows the specialized skills and training programs expected for specific jobs. The job titles enlisted are a few examples indicating the specialization expected at companies alongside a bachelor degree. The motivation behind this study was the skills and academic credibility expected by the employer's and the academic

**TABLE 1** Intensity of teachers' attitude toward the use of ICT in teaching

| Intensity of teachers' attitude toward the use of ICT in teaching | Scale value | Number | Percentage, % |
|---|---|---|---|
| Never | From 1.0 | 9 | 0.00000 |
| Very little | From 1.1 to 2.0 | 15 | 5.10204 |
| Sometimes | From 2.1 to 3.0 | 36 | 12.24490 |
| Often | From 3.1 to 4.0 | 129 | 43.87755 |
| Very often | From 4.1 to 5.0 | 114 | 38.77551 |

Abbreviation: ICT, information and communication technology.

programs offered at universities. The analysis draws attention to the shortage of training programs and certification options available at a university level.

A survey was done through the distribution of a set of questionnaires among ICT working students. This study was conducted both in the public and private sectors. The items included in the questionnaire were designed and created specifically to measure the scope of the study. The first factor is the relationship between the educational course and the job market, which contains five items within it. The second factor is Employability. The third factor is computational skills that contain three items within it. The last factor is finding a job. It is assumed in our proposed model that the relationship between the academic program, Employability, and computational skills has a direct influence on finding a job. Besides this , several items have been modified to meet the requirements of this study.

## 3 | RESULTS

The obtained result was interpreted in such a way that a larger gross result shows a more positive relation or a more positive general attitude toward the use of ICT in teaching, and a lower result shows a more negative general attitude toward the use of certain ICTs in teaching. Such obtained results were classified into categories of their intensity of general attitude toward the use of ICT in a teaching process as follows: never, very little, sometimes, often, and very often (Table 1).

More precise indicators of the intensity of teachers' attitude toward the use of ICT in teaching are shown through descriptive statistics in Table 2.

Obtained results show that there are differences among teachers in the direction and intensity of their attitudes toward the use of certain types of ICT in teaching because the answers were not distributed according to a normal distribution but are significantly different. Such conclusions indicate a much larger percentage of teachers with positive rather than a hesitating or negative attitude, as shown by the obtained skewness and kurtosis values for each of the ICTs and for the scale as a whole, which can be seen from the results in Table 2.

More precise indicators of the intensity of teachers' attitude toward the use of particular ICTs in teaching are shown through descriptive statistics in Table 3.

**TABLE 2** Descriptive statistics: Estimation scale, SIP-1, for overview of teachers' attitude toward the use of ICT in teaching

| ICT | Mean | Standard deviation | Skewness | Kurtosis |
|---|---|---|---|---|
| Computer | 4.612245 | 0.842141 | −3.20557 | 12.08009 |
| Internet | 4.500000 | 0.941098 | −2.41184 | 6.47012 |
| E-learning | 2.918367 | 1.203012 | 0.01580 | −0.55005 |
| Video projector | 3.163265 | 1.285470 | −0.04598 | −0.96302 |
| Web technologies | 4.346939 | 1.002747 | −2.33431 | 6.58719 |
| Building information modeling (BIM) projector | 4.469388 | 0.895999 | −2.35822 | 7.09589 |
| Tablet devices | 4.081633 | 1.228280 | −1.75875 | 3.05435 |
| Multimedia interactive classroom | 3.346939 | 1.438871 | −0.62481 | −0.38531 |
| Social networks | 4.224490 | 1.131588 | −1.64586 | 2.55029 |
| Educational software | 3.540816 | 1.432211 | −0.77740 | −0.16889 |
| Multimedia interactive board | 3.418367 | 1.287298 | −0.55725 | −0.21859 |
| General attitude | 4.163265 | 0.830649 | −0.85319 | 0.26470 |

Abbreviation: ICT, information and communication technology; SIP-1, scale invariance property.

**TABLE 3** Teachers' attitudes toward the use of particular ICTs in teaching

| ICT | AM | Very often 5 | Often 4 | Sometimes 3 | Very little 2 | Never 1 | No answer 0 |
|---|---|---|---|---|---|---|---|
| Computer | 4.61 | 216<br>73.46939 | 63<br>21.42857 | 3<br>1.02041 | 6<br>2.04082 | 3<br>1.02041 | 3<br>1.02041 |
| Internet | 4.50 | 204<br>69.38776 | 57<br>19.38776 | 18<br>6.12245 | 9<br>3.06122 | 3<br>1.02041 | 3<br>1.02041 |
| Building information modeling (BIM) projector | 4.47 | 189<br>64.28571 | 72<br>24.48980 | 24<br>8.16327 | 3<br>1.02041 | 3<br>1.02041 | 3<br>1.02041 |
| WEB technologies | 4.35 | 165<br>56.12245 | 96<br>32.65306 | 18<br>6.12245 | 6<br>2.04082 | 3<br>1.02041 | 6<br>2.04082 |
| Social networks | 4.22 | 168<br>57.14286 | 66<br>22.44898 | 30<br>10.20408 | 24<br>8.16327 | 0<br>0.00000 | 6<br>2.04082 |
| Tablet devices | 4.08 | 141<br>47.95918 | 90<br>30.61224 | 36<br>12.24490 | 12<br>4.08163 | 3<br>1.02041 | 12<br>4.08163 |
| Educational software | 3.54 | 102<br>34.69388 | 63<br>21.42857 | 60<br>20.40816 | 45<br>15.30612 | 9<br>3.06122 | 15<br>5.10204 |
| Multimedia interactive board | 3.42 | 72<br>24.48980 | 78<br>26.53061 | 72<br>24.48980 | 54<br>18.36735 | 9<br>3.06122 | 9<br>3.06122 |
| Multimedia interactive classroom | 3.35 | 78<br>26.53061 | 78<br>26.53061 | 48<br>16.32653 | 66<br>22.44898 | 6<br>2.04082 | 18<br>6.12245 |
| Video projector | 3.16 | 60<br>20.40816 | 60<br>20.40816 | 69<br>23.46939 | 81<br>27.55102 | 21<br>7.14286 | 3<br>1.02041 |
| E-learning | 2.92 | 33<br>11.22449 | 63<br>21.42857 | 78<br>26.53061 | 93<br>31.63265 | 21<br>7.14286 | 6<br>2.04082 |

Abbreviations: AM, arithmetic mean; ICT, information and communication technology.

## 3.1 | Attitude of teachers toward the use of ICT in teaching in relation to the work experience variable

For the purposes of checking and testing the adequacy of the starting hypothesis "that there is no significant difference in the teachers' attitude toward the application of ICT in teaching in relation to the work experience variable," a survey was done to find out whether there are statistically significant differences in the teachers' attitudes regarding their work experience and general attitudes toward particular ICTs presented through cumulative values (cumulative index), see Table 4.

Obtained results show that statistically significant differences were determined among the teachers with less and more years of work experience, on certain types of ICT which are being used in teaching. Such conclusions can be made on the basis of the Pearson chi-square ($\chi^2$) test, where $\chi^2 = 39.0440$, with a variation of 9°, statistically significant at the level of 0.01 ($P = 0.000011$), which undoubtedly indicates that there are significant differences toward the use of ICT in teaching among the teachers with different work experience.

## 3.2 | Obstacles that teachers are facing when applying ICT in teaching

In Table 5, the results of the difficulties that teachers face in their work during the use of ICT in teaching are presented. The teachers were offered a list of given

**TABLE 4** Teachers' work experience and cumulative index of teachers' attitude toward the use of ICT in teaching

| Work experience | Teachers' attitude toward the use of ICT in teaching: Never | Sometimes | Often | Very often | Σ |
|---|---|---|---|---|---|
| <10 y | 6<br>11.11% | 3<br>5.56% | 24<br>44.44% | 21<br>38.89% | 54 |
| 10-20 y | 3<br>2.94% | 18<br>17.65% | 30<br>29.41% | 51<br>50.00% | 102 |
| 20-30 y | 6<br>7.41% | 0<br>0.00% | 42<br>51.85% | 33<br>40.74% | 81 |
| >30 y | 0<br>0.00% | 9<br>23.08% | 21<br>53.85% | 9<br>23.08% | 39 |
| Total | 15<br>5.43% | 30<br>10.87% | 135<br>48.91% | 114<br>41.30% | 276 |

Abbreviation: ICT, information and communication technology.

**TABLE 5** Obstacles for using of ICT in teaching

| Obstacles | Scale value | Number | Percentage, % |
|---|---|---|---|
| Lack of pedagogical-didactic support for the application of ICT in teaching | From 1 to 5 | 9 | 3.06 |
| Willingness of the teacher to use ICT in teaching | From 1 to 5 | 42 | 14.28 |
| Insufficient skills of the teachers for the use of ICT in teaching | From 1 to 5 | 141 | 47.95 |
| Availability and quality of the necessary equipment | From 1 to 5 | 78 | 26.53 |
| Lack of Internet access | From 1 to 5 | 24 | 8.16 |

Abbreviation: ICT, information and communication technology.

difficulties and a scale value from 1 to 5 through which they expressed their attitudes.

### 3.3 | Analysis of results—Testing reliability

In this section, the research findings derived from the statistical analysis are presented. Cronbach's alpha test is applied to figure out the reliability and consistency of the data set (Table 6). Cronbach's alpha is used to assess the instrument's reliability. The value of the reliability coefficient ($\alpha$) for the relationship between the educational course and the job market of the questionnaire is 0.675, whereas for Employability, $\alpha$ is 0.933. In addition, for Computational Skills, $\alpha = 0.701$. For the dependent variable of finding a job, $\alpha = 0.875$, as illustrated in Table 7.

According to Table 7, corrected item-total correlations for all items are in between 0.2 and 0.816, which indicates that there exists a significant correlation between all items and presents a very high internal consistency for all items in each factor. Table 8 shows the factors used in the IT employee model.

In Table 5, means and standard deviations for continuous variables are also shown. Besides that, correlation analysis is used in the present study to measure the correlations that exist between the study factors, except the Finding Job factor that does not have any significant correlation with other factors. Moreover, a Pearson correlation examines the relationship between two scale-level variables.

With reference to Table 9, for the *Relationship between academic program and the Job Market* factor, observations range from 1.00 to 5.00, with an observation average of 2.822 (SD = 0.82074). For the *Employability* factor, observations range from 1.00 to 5.00, with an observation average of 2.8131 (SD = 0.9956). For the *Computational Skills* factor, observations ranged from 1.00 to 5.00, with an observation average of 2.6492 (SD = 0.94071). For the *Finding Job* factor, observations range from 1.00 to 5.00, with an observation average of 3.4156 (SD = 0.81686).

According to Table 9, all study factors (A, B, and C) are correlated with each other. For example, the *Relationship between academic program and the Job Market* has a positive significant correlation with the *Employability* factor at a significant level (0.01) with ($r = 0.271$; $P < 0.000$). In addition, *Relationship between academic program and the Job Market* has a positive significant correlation with *Computational Skills* at a significant level (0.01) with ($r = 0.268$; $P < 0.000$). Furthermore, *Employability* has a positive significant correlation with *Computational Skills* at a significant level (0.01) with ($r = 0.517$; $P < 0.000$).

## 4 | DISCUSSION

The analysis of the distributed results of the teachers' attitudes toward the use of ICT in teaching shows that teachers generally have a positive attitude toward the use of ICT in teaching but it should be taken into account that examinees most often estimate that they "often" use ICT, as declared by 43.88% of interviewed teachers and 38.78% of teachers who "very often" use ICT in their work.

Use of computers and the Internet was recognized as a significant aspect for improving the quality of teaching (as is evident that 73.50%, that is, 69.39% of teachers use them "very often," as opposed to 1.02%, that is, 1.02% who "never" use them. The Internet is an extremely important social and communications tool and is changing our daily lives at home and at work. The third most frequently used method of ICT is the use of the BIM projector, followed by web technologies, social networks, and tablet devices. Using of educational software, electronic multimedia classroom, multimedia interactive board, and e-learning is the rarest because the smallest number of teachers showed a positive attitude toward their use, which implies insufficient knowledge and skillfulness of teachers for the use of ICT.

In the category of teachers who claimed that they often use ICT, it is evident that more teachers with

**TABLE 6** Corrected item-total correlation and Cronbach's alpha

| Item-total statistics | Scale mean if item deleted | Scale variance if item deleted | Corrected item-total correlation | Cronbach's alpha if item deleted |
|---|---|---|---|---|
| Relation between the program and the job market of the questionnaire ($\alpha = 0.675$) | | | | |
| 18. I presented at a conference during my degree | 11.119 | 11.673 | 0.368 | 0.654 |
| 16. I took industrial placement during my degree | 11.517 | 11.998 | 0.41 | 0.631 |
| 15. My training at the university were up to date | 11.447 | 11.869 | 0.484 | 0.602 |
| 20. The university is in line with market needs | 11.265 | 11.843 | 0.421 | 0.627 |
| 17. My department had strong relationship with industry | 11.222 | 11.303 | 0.468 | 0.605 |
| Employability ($\alpha = 0.933$) | | | | |
| 27. I have to constantly update my knowledge in order to keep up with the market needs | 36.789 | 170.986 | 0.645 | 0.929 |
| 6. I have good general IT skills | 36.712 | 166.615 | 0.74 | 0.926 |
| 1. I have a clear understanding of my job | 37.007 | 165.181 | 0.698 | 0.928 |
| 9. I can use my initiatives | 36.709 | 168.543 | 0.743 | 0.926 |
| 13. My field of work is/will be applied and multidisciplinary | 36.913 | 173.529 | 0.642 | 0.929 |
| 5. I can cope with time pressure | 36.813 | 166.837 | 0.738 | 0.926 |
| 8. I have good problem solving skills | 36.773 | 165.512 | 0.798 | 0.924 |
| 11. I have negotiating skills | 36.612 | 167.299 | 0.707 | 0.927 |
| 14. I have good theoretical understanding of my domain | 36.836 | 167.742 | 0.725 | 0.927 |
| 7. I have good communication and interpersonal skills | 36.662 | 163.956 | 0.805 | 0.924 |
| 10. I can work within a team | 36.759 | 161.177 | 0.816 | 0.923 |
| 12. I have organizational skills | 36.866 | 165.626 | 0.746 | 0.926 |
| 23. I became familiar with human-computer interaction principles during my degree | 36.836 | 177.325 | 0.476 | 0.934 |
| 22. I learnt how to design and develop software packages during my degree | 36.886 | 185.517 | 0.228 | 0.94 |
| Computational skills ($\alpha = 0.701$) | | | | |
| 2. I am a good computer programmer | 5.363 | 4.009 | 0.505 | 0.602 |
| 3. I have full understanding of network and telecommunication | 5.248 | 4.305 | 0.444 | 0.677 |
| 4. I have full understanding of database systems | 5.284 | 3.942 | 0.576 | 0.512 |
| Finding a Job, the reliability coefficient ($\alpha = 0.875$) | | | | |
| 19. I find it difficult to find a suitable job | 17.0556 | 17.581 | 0.585 | 0.869 |
| 21. I had to/will have to learn a lot of state of the art technologies that were not covered in my course in order to become employed | 17.2386 | 16.104 | 0.77 | 0.837 |
| 26. Organizations are reluctant to employ new graduates | 17.1569 | 16.743 | 0.727 | 0.845 |
| 28. Obtaining a professional certificate would be more useful than getting a degree in finding the job I want | 16.915 | 17.521 | 0.679 | 0.853 |
| 25. Most of my classmate have found a job within 6 mo of their graduation | 16.8954 | 17.943 | 0.63 | 0.861 |
| 24. Having a degree is necessary to find a job in my field | 17.2059 | 16.708 | 0.682 | 0.853 |

*Note.* Cronbach's alpha for all items $\alpha = 0.885$

less work experience had a more positive attitude, in comparison with the teachers with more work experience. 38.89% of teachers with experience up to 10 years of work experience said that they "very often" use ICT in teaching, 50.00% of teachers who have from 10 to 20 years of work experience, 40.74% of the ones who have from 20 to 30 years of work experience, and 23.08% of teachers who have over 30 years of work experience.

What the majority of the teachers (47.95%) perceive as a difficulty for successful implementation of ICT is the lack of teachers' skills for using ICT in teaching. Teachers do not feel comfortable to use methodology that they have not mastered yet. In

**TABLE 7** Rotated component loadings of the four components

| | Relation between the educational course and the Job Market | Employability | Computational Skills | Finding Job |
|---|---|---|---|---|
| A3 | 0.840 | | | |
| A4 | 0.660 | | | |
| A5 | 0.756 | | | |
| B1 | | 0.693 | | |
| B10 | | 0.840 | | |
| B11 | | 0.848 | | |
| B12 | | 0.784 | | |
| B13 | | 0.527 | | |
| B14 | | 0.288 | | |
| B2 | | 0.798 | | |
| B3 | | 0.754 | | |
| B4 | | 0.794 | | |
| B5 | | 0.694 | | |
| B6 | | 0.794 | | |
| B7 | | 0.843 | | |
| B8 | | 0.745 | | |
| B9 | | 0.768 | | |
| C1 | | | 0.769 | |
| C2 | | | 0.755 | |
| C3 | | | 0.836 | |
| D1 | | | | 0.817 |
| D2 | | | | 0.891 |
| D3 | | | | 0.735 |
| D4 | | | | 0.763 |
| D5 | | | | 0.705 |
| D6 | | | | 0.705 |

addition to that, most of the teachers have insufficient knowledge of the English language, and computer programs in the Serbian language are poorly translated and clarified. Furthermore, there are not enough adequate training courses that deal with the practical use of technology in the teaching of particular subjects. Availability and quality of necessary equipment (sufficient number of computers and specialized classrooms, reliability of the programs and computer networks, the Internet, modern equipment, etc) is also of great importance, and it is in the second place among the interviewed teachers. In the third place is the willingness of teachers to use ICT in teaching. It is certainly easier and safer to hold onto the traditional method rather than involve in challenges brought about by the use of ICT in teaching. The lack of Internet access as well as the lack of pedagogic-didactic support for the use of ICT in teaching is seen as an obstacle only by a small number of teachers.

We conducted this survey on ICT students to establish the relationship between universities, and the results were deduced based on a questionnaire designed especially for them. The four major factors considered for this were Relationship between the academic program and the Job Market, Employability, Computational Skills and their direct influence on Finding a Job. We assumed in our proposed model that the Relationship between the academic program, Employability, and Computational Skills have a direct influence on Finding a Job.

**TABLE 8** Factors used in the IT employee model (ITEM)

| | |
|---|---|
| Relation between Program and Job market | |
| A3 | I have full understanding of network and telecommunication |
| A4 | I have full understanding of database systems |
| A5 | I can cope with time pressure |
| Employability | |
| B1 | I have a clear understanding of my job |
| B2 | I am a good computer programmer |
| B3 | I have full understanding of network and telecommunication |
| B4 | I have full understanding of database systems |
| B5 | I can cope with time pressure |
| B6 | I have good general IT skills |
| B7 | I have good communication and interpersonal skills |
| B8 | I have good problem solving skills |
| B9 | I can use my initiatives |
| B10 | I can work within a team |
| B11 | I have negotiating skills |
| B12 | I have organizational skills |
| B13 | My field of work is/will be applied and multidisciplinary |
| B14 | I have good theoretical understanding of my domain |
| Computational Skills | |
| C1 | I have a clear understanding of my job |
| C2 | I am a good computer programmer |
| C3 | I have full understanding of network and telecommunication |
| Finding a Job | |
| D1 | I have a clear understanding of my job |
| D2 | I am a good computer programmer |
| D3 | I have full understanding of network and telecommunication |
| D4 | I have full understanding of database systems |
| D5 | I can cope with time pressure |
| D6 | I have good general IT skills |

## 5 | CONCLUSION

Acquiring of ICT competence by future teachers mostly depends on the information literacy of the teachers themselves. Teaching processes based on ICT expand the field of cognitive tasks, enables the transition to the systematic management of a teaching activity, and changes its structure and dynamics. To achieve this, the operational-technical aspect of teaching ought to be rearranged, the spatial and time limits of interaction should be changed, and a system of self-regulation in working with information technologies should be formed.

ICT can promote international collaboration and networking in education and professional development. There is a range of ICT options—from multimedia delivery through video conferencing to websites—which can be used to meet the challenges teacher educators face today.

Universities are laden with the task of curriculum upgradation for allowing the graduates to face the challenges at the career entry level efficiently. Corporations can also play a larger role in minimizing the difference between "skills required in an actual corporate environment" and "skills being taught at the universities". This can be done by collaborating with the academia and by creating a streamlined communication channel between the two entities.

We concluded that the relationship between the academic program and job market significantly affects the Employability factor. Through our survey, we propose that the collaboration between universities and the corporate sector will have a significant effect on increasing the employability of IT graduates. Some introductory changes include more attention on curriculum upgradation and introducing IT specialized courses at universities. Universities can design training programs, and optional outside campus training options can be introduced. The corporates can recommend suggestions and ideas about current market needs and universities can work on the plan.

Despite all the suggestions, this idea and collaboration can be proved successful only when graduates take their course study seriously and attend the training programs and courses regularly. Only with a sense of responsibility and realization, can the graduates refine their computational skills and achieve success at their respective careers. With time, a gradual change in the employability issue will be seen through small amendments.

**TABLE 9** Means, standard deviations, and correlations for Job Finding (Factor D)

| Factor | Mean | Standard deviation | Factor A | Factor B | Factor C | Factor D |
|---|---|---|---|---|---|---|
| A. Relation between the educational course and the job market | 2.822 | 0.82074 | ($\alpha = 0.675$) | | | |
| B. Employability | 2.8131 | 0.9956 | 0.271 | ($\alpha = 0.933$) | | |
| C. Computational Skills | 2.6492 | 0.94071 | 0.268 | 0.517 | ($\alpha = 0.701$) | |
| D. Finding Job | 3.4156 | 0.81686 | 0.024 | 0.021 | −0.064 | ($\alpha = 0.875$) |

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## ORCID

*Dalibor Petković* http://orcid.org/0000-0003-1680-1163

## REFERENCES

1. Shewbridge C, Ikeda M, Schleicher A. (2006). *Are students ready for a technology-rich world?: What PISA studies tell us.* Paris, France: OECD.
2. Al-Hazimi A, Zaini R, Al-Hyiani A, et al. Educational environment in traditional and innovative medical schools: a study in four undergraduate medical schools. *Education for Health-Abingdon-Carfax Publishing Limited*. 2004;17(2):192-203.
3. Hermans R, Tondeur J, van Braak J, Valcke M. The impact of primary school teachers' educational beliefs on the classroom use of computers. *Computers & Education*. 2008;51(4): 1499-1509.
4. Balanskat A, Blamire R, Kefala S. *The ICT impact report* (Vol. 1). Brussels, Belgium: European Schoolnet; 2006:1-71.
5. Coll C, Rochera MJ, Mayordomo RM, Naranjo M. Continuous assessment and support for learning: An experience in educational innovation with ICT support in higher education. *Electron J Res Educ Psychol*. 2007;5(3):783-804.
6. Korte, WB, Hüsing, T. (2006). Benchmarking access and use of ICT in European schools 2006: Results from Head Teacher and A Classroom Teacher Surveys in 27 European countries. empirica, 1, 0.
7. Apple MW. The new technology. *Computers in the Schools*. 1991;8(1-3):59-82.
8. Shirazi F, Ngwenyama O, Morawczynski O. ICT expansion and the digital divide in democratic freedoms: An analysis of the impact of ICT expansion, education and ICT filtering on democracy. *Telematics and Informatics*. 2010;27(1):21-31.
9. Balanskat A, & Blamire R (2007). *ICT in schools: Trends innovations and issues in 2006-2007*. Brussels, Belgium: European Schoolnet. Consultado en http://insight.eun.org/shared/data/pdf/ict_in_schools_2006-7_final.pdf el.
10. Fraillon J, Ainley J, Schulz W, Friedman T. *Preparing for life in a digital age: The IEA International Computer and Information Literacy Study international report.*. New York, NY: Springer
11. Jung, M, Carstens, R. (2015). International Computer and Information Literacy Study: ICILS 2013 User Guide for the International Database. International Association for the Evaluation of Educational Achievement, Herengracht 487, Amsterdam, 1017 BT, The Netherlands.
12. Molnár G. Modern ICT based teaching and learning support systems and solutions in higher education practice. In *Proceedings of the 10th International Scientific Conference on Distance Learning in Applied Informatics.* 2014; 421-430.
13. Tedesco R, Cesarini M, Guinea S, Sbattella L. *Innovative learning and teaching scenarios in Virtual Campus. In EdMedia+ Innovate Learning*. Association for the Advancement of Computing in Education (AACE); 2004:180-187.
14. Elster D. Learning communities in teacher education: The impact of e-competence. *Int J Scie Educ*. 2010;32(16):2185-2216.
15. Celebic G, Rendulic DI. *ITdesk. Info–project of computer e-education with open access*. Zagreb, Croatia: Open Society for Idea Exchange (ODRAZI).
16. Celebic G, Rendulic D. *Basic Concepts of Information and Communication Technology Handbook*. Zagreb, Croatia: Open Society for Idea Exchange (ODRAZI); 2011.
17. Carnoy M. Globalization, educational trends and the open society. In *Proceedings of the OSI Education Conference*. 2005; 2-31.
18. Hagan D. Employer satisfaction with ICT graduates. Proceedingsof the Sixth Australasian Conference on Computing Education. Vol 30. Sydney, NSW, Australia: Australian Computer Society, Inc; 119:123.
19. Llorens-Garcia A, Llinas-Audet X, Sabate F. Professional and interpersonal skills for ICT specialists. *IT Professional*. 2009;11(6):23-30.
20. Garrido, M, Sullivan, J, Gordon, A. (2010, December). Understanding the links between ICT skills training and employability: an analytical framework. In Proceedings of the 4th ACM/IEEE International Conference on Information and Communication Technologies and Development, ACM, p. 15.
21. Edmondson G, Valigra L, Kenward M, Hudson RL, Belfield H. *Making industry-university partnerships work: Lessons from successful collaborations*. Science Business Innovation Board AISBL; 2012;1–52.
22. Rainsbury E, Hodges DL, Burchell N, Lay MC. Ranking workplace competencies: Student and graduate perceptions. *Asia-Pac J Cooper Educ*. 2002;3:9-18.
23. Juhdi N, Jauhariah A, Yunus S. A study on employability skills of university graduates. *Bus Wallpaper*. 2007;2(1):1-6.
24. Bilyalova A. ICT in teaching a foreign language in high school. *Procedia Soc Behav Sci*. 2017;237:175-181.
25. Novkovic-Cvetkovic B, Stanojevic D. Educational needs of teacher for introduction and application of innovative models in educational work to improve teaching. *Int J Cognit Res Sci, Eng Educ*. 2017;5(1):49-56.

## SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of the article.

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