

# Information Technology Skills Level of Students at Electrical Faculty in East Sarajevo

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**Abstract:** *The paper investigates current status of Information Technology (IT) skills level of students studying at the Faculty of Electrical Engineering in East Sarajevo. Competitiveness on the labour market of the future engineers of the Faculty are narrowly related to their level of competences and skills in usage of modern information technologies. This paper is a research that included all students from the first to the fourth year of the study profile Computer Science and Informatics. Totally, eight areas have been identified to be of additional value for the students in the teaching process at the faculty. The focus was on the students' perception of professional IT skills that they have to possess when they start to work for a future employer. Based on the results of the research, amending of current curriculum of the profile Computer Science and Informatics at the Faculty of Electrical Engineering in East Sarajevo has been proposed.*

**Keywords:** *Information Technology skills; On-line survey; Electrical Faculty*

## 1. INTRODUCTION

What an optimal level of *Information Technology* (IT) skills of the first cycle of studies students is, so as the level of required competences to be competitive on the labour market is a question that brings a whole list of answers. One option is to say that optimal level of IT skills is that students have basic knowledge and skills in the field of IT software development or database administration. One of the answers is that systematic approach to improvement of knowledge of students is through the improvement of quality of the study programme on the faculty. According to Vyalikova, Erofeeva, Plekhanova, Pluzhnikova and Saveleva in [1], "Considering the formation of students general Information Communication Technology (ICT) competence from the point of view of the system-and-activity methodological approach, it is possible to characterize it as a system that consists of a number of elements, has connections with the external environment (EIES), is aimed at a certain result (students mastering an adequate level of competence)". From the previous statement, it can be concluded that the main objective is for the students to acquire skills and competences during their university education that will be adjusted to future EIES uttering the requirements for the IT engineers to be professionally enabled for solving problems based on the requests of the end users of IT applications and information systems in general

on a daily basis. Olaisen and Revang in [2], state that "Experts knowledge is accumulated through education and practical experience enabling experts to apply his knowledge in order to be regarded as a professional". Gulatee and Combes in [3], stated that "How students really use technology for learning is very important for schools and universities, as technology is being rapidly incorporated into educational settings". As far as students at the Faculty of Electric Engineering are concerned, it is obvious that they have knowledge related to hardware configurations and developmental software tools of the latest generation. However, the curricula must be adjusted with the accelerated technological development. Primarily, the focus should be on those developmental software tools that are in demand on the labour market in BiH, so as in other eastern European countries. Mole, Dim and Horsfall in [4], claim that, "This also affected education in many fields resulting in the introduction of subject dedicated to ICT in existing university curricula, and has led to reengineering and improvement of education practice to meet industrial needs".

In the interest of creating knowledge-based society, it is of vital importance to plan development of IT professionals through the university curricula in a systematic and unified way in line with the world standards dictated by the

industrial needs. Engineering disciplines require balance between teaching standards and curricula, based on which students enhance their professional IT skills, and daily tasks employers expect them to be enabled to carry out when registered in the labour market as graduate IT engineers.

Dahlstrom and Bichsel in [5], and Tumbleson in [6], claim that, "Users (students) demand digital content on laptops, tablets, and smartphones to enhance learning especially with library resources". Based on this assertion, authors confirmed that improvement of the existing knowledge of IT skills of the students is directly related to improvement of the speed and quality of providing the latest hardware configurations and deployment of web application tools into the learning-teaching processes at the Faculty of Electrical Engineering.

Mestre in [7], and Zang, Watson, and Banfield in [8] states that "The Learning Management System (LMS) offer instructors the ability to create extensive tutorials (content) that can be viewed at a self-paced administration before it becomes outdated". On basis of this statements, one or multiple web-based platforms (e.g. Moodle–open source learning platform) used at the Faculty can be identified. Due to its scalability, it may be used on any hardware configuration available to students. Through experimental analysis, Zhang and Zuo in [9], discovered that the teacher-student interaction is influenced by the interactive environment, personal traits, events of different emotional valences, and the emotional state of students". Naturally, the teacher is required to identify and deal with such parameters through the teacher-student interaction.

Through usage of the IT solutions mentioned above, students' mobility would be ensured, enabling them to master the learning content and new IT skills, even though they are not physically in the classroom. Teacher-student interaction through use of the latest IT web platforms for distance learning will be applied if a student is prevented from attending lectures for justified reasons.

This research aims to identify the basic needs of students and, through their recommendations that are the result of the research, to incorporate them into improved curricula in the future. Authors will identify which IT tools and skills today are most needed to be incorporated into the curriculum in the first cycle of study in the future through using of web-based distance learning platforms. These results would serve as a basis to upgrade the teaching process in other cycles of study, primarily, the second and third cycles on the Faculty.

The purpose of this paper is twofold:

1) Analyses the current state of the digital skills level and perception of requirements for IT improvement, so as enhancement of IT knowledge of the students on the Faculty, where all students

of the first cycle of studies (all four years) have been included. The analysis is given in Section 3.

2) Based on the survey we will give recommendations for the future improvement of current curriculum for the study programme Computing and informatics, as given in Section 3 (Table 1).

This paper is structured as follows: After Introduction, there is a discussion on optimal level of IT skills of the first cycle of studies students, so as the level of required competences to be competitive on the labour market", there is Section 2. where authors identify the precise profile of the participants and areas of knowledge that students have in order to make certain recommendations for the improvement of the whole system of strengthening digital skills and possible update of curriculum against research results. In this section, the Methodology for the implementation of the survey is described. Section 2.1 (Research question), as the usage is concerned, is a starting base to generate the results of the survey outlined in Section 3. Section 3. contains main focus of this survey paper with technical details required for analysis and recommendations for Proposal of IT skills to be included in curricula on the Faculty, which can be compared to similar surveys in this area. Practical analysis of the results described in Section 3 provides us with a visual means to confirm our summary and conclusion outlined in Section 4.

## 2. PARTICIPANTS

Accordance to Bourke, Kirby and Doran in [10], "The first stage in Problem Based Learning (PBL) is to identify what you already know about the problem that you are trying to solve. Ideas will generate from this approach and will be reformulated based on what exactly you need to measure". Based on the above statements, in our research in the first phase we focused on identifying the precise areas of knowledge that students have in order to make certain recommendations for the improvement of the whole system of strengthening IT skills and possible update of curriculum based on the research results.

In brief, The Faculty of Electric Engineering in East Sarajevo is the oldest high school institution in the field of electrical engineering in Bosnia and Herzegovina. The Faculty was founded in 1961 by separating from the former Technical Faculty in Sarajevo, when it began to operate independently within the University of Sarajevo. After a one-year pause in 1992, the Faculty reopened in 1993 within the University of East Sarajevo. Since school year 2004/2005, teaching activities at the faculty are carried out based on the new curriculum which is in line with the Bologna Declaration. According to the Declaration, the studies are organized through three levels of studies: bachelor's (first cycle),

master's (second cycle) and doctoral (third cycle) [11].

The headquarters of the Faculty is located in East Sarajevo and this higher education institution was chosen for our research due to several reasons. As mentioned above, this is the oldest and most prestigious educational institution that is part of a public university and where the responsibility of students to participate in a research is at a very high level. Moreover, the Faculty encourages the use of the latest ICT technologies in everyday teacher-student interaction. Recently, the Faculty has been constantly tracking the needs of students, which is directly related to the requirements of the labour market for IT staff in BiH, in order to attract as many students as possible to decide to attend this Faculty. Of course, this goal would not be met without trying to include in the teaching process as many ICT technologies that have additional value for students in the process of acquiring new skills in this area. Therefore, participants in this research consisted of a range of students, encompassing the all four years of the first cycle students. The total number of participants was 105, of which 37 female students (35,23%) and 68 male students (64,77%). As regards the year of studies, the situation was as follows: 44.8% of participants were in the first year of the Faculty, 22.9% in their second year, 24.8% in the third year and the rest of 7.5% were in the final fourth year. There were 67.7% first and second year students studying based on the general curriculum who participated in this study while there were 32.3% of the third and fourth year participants studying according to the curriculum of the Department of Computing and Informatics. Eighty-eight (88%) per cent of the participants aged between 18-22.

### 2.1. Research question

This research seeks to determinate current status of IT skills level of students. The questions in the research are divided into two groups and asked in a sequenced order. This sequence follows the programme and scientific development of a graduate IT electrical engineer and covers the areas from the use of programming languages and technologies that the student currently uses to the use of modern relational databases. Based on that, the first group of questions, the following section refers to the students' perception of what else they should learn in the faculty in order to improve their IT professional skills. Throughout our study, a quantitative method based on web questionnaires are used. Nancarrow, Pallister and Brace in [12], find that, "Using the Web is cost effective and time efficient, enables the researcher to gain a snapshot of the current state of affairs". Moreover, Braunsberger, Wybenga and Gates in [13], claim that, "Web questionnaire allows a fast turn-around for data collection and has been shown to be a reliable alternative to telephone surveys". Web

questionnaire also provides anonymity for participants allowing them to answer the questions in a friendly environment which would not be the case if the interview method was applied, since authors have a subjective influence on the teacher-student relationship.

In order to analyse the state of affairs as regards IT skills of students who are using the University information system, the following methodology is used:

- Creation of survey questionnaires,
- Filling an on-line survey questionnaire by students,
- An analysis of the response set to cover topics that are of primary importance to our research,
- Collecting and analysing the results obtained from the web questionnaire.

The questions for the questionnaire were developed using the Google Forms tool, which is an online research tool available on the Internet [14]. This tool was chosen because it enables us to collect information from students through personalized quizzes or surveys. Then, it is possible to connect the info to a spreadsheet on Sheets to automatically record the answers. The spreadsheet then populates with the responses from the quiz or survey in real time.

All questions could be answered by one of the four (4) different browsers, Mozilla Firefox version 59.0.1, Google Chrome version 69.1 and Microsoft Edge version 44.18362.449.0. All participants are executed on machines with installed Windows 10 operating system or smart devices with usage of Android or iOS operating system. A questioner is written in Google forms tools that allows on line collecting information from students.

Surveying of the students was conducted at the Electrical Faculty in East Sarajevo from 1 October 2019 to 31 December 2019. The study included all students from each of the four years study curricula of the first cycle of studies.

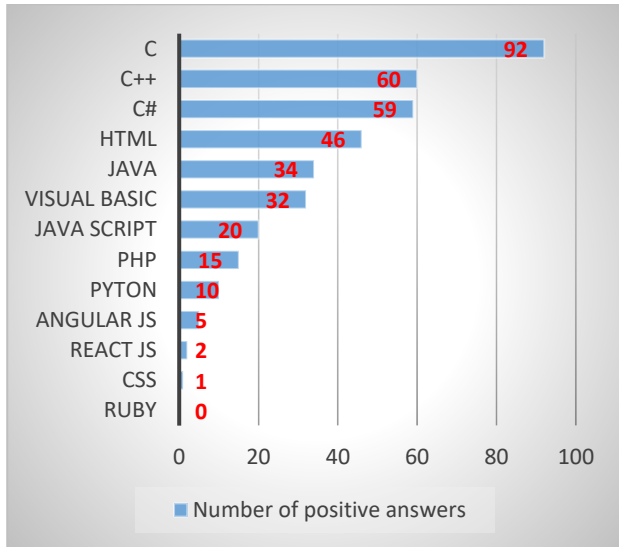
## 3. RESULTS

Survey questions on Information Technology skill level of the students at Electrical Faculty in East Sarajevo provided the following results and addressed the issues from 1 to 4 presented in Figures in Section 3.

A total of 105 students from the Faculty filled in the web questionnaire and the results related to our research are as follows:

The first set of questions referred to the current level of knowledge of students when it comes to IT skills related to the knowledge of programming languages that they could learn in the educational process at the faculty.

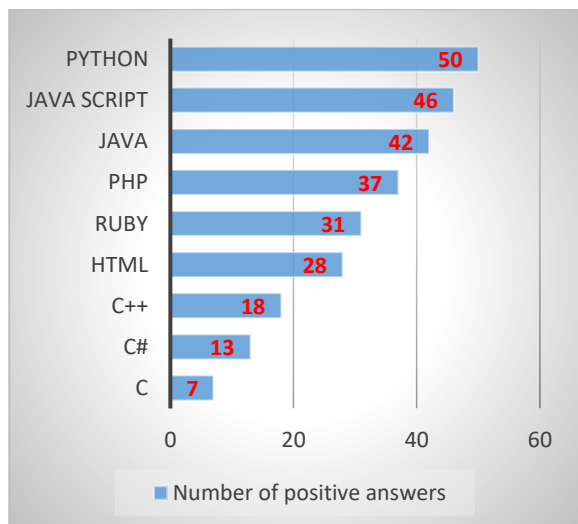
When asked if during their ETF training they mastered the following IT skills in using programming languages and their associated tools, 105 users selected at least one or more of the answers shown in Figure 1.



**Figure 1.** Current knowledge of developer tools

As indicated in Figure 1, the first three places took software tools related to Microsoft developer software tools as part of .NET technology. That is not surprising at all being aware that these tools are mostly used by the teaching staff at the ETF throughout the teaching process as well as during the previous education of the participants.

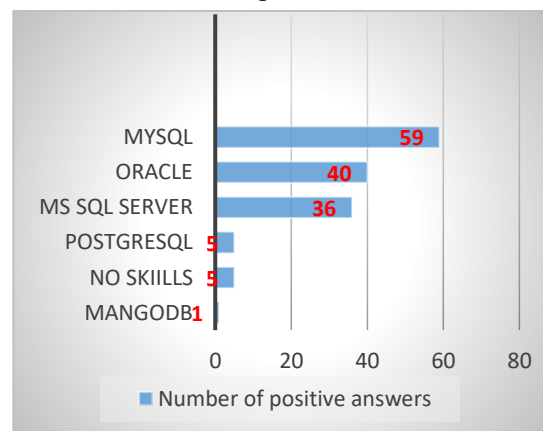
On the other hand, when asked about programming languages and tools they want to improve in the future, and that you have not used so far in the ETF teaching process, the participants answered as shown in Figure 2



**Figure 2.** Developer tools for future improvement of IT skills

If these two Figures are compared, it is obvious that during the ETF classes, students did not acquire those IT skills they expect to be necessary in their future professional work. As indicated on Figure 2, the first three places are Python, Java Scrip and

Java programming languages which are not represented in a large percentage in Figure 1, which represents the mastered IT skills of students through the teaching process at ETF. This result, which I see in Figure 2 with Python in the first place, is completely in line with Belani's claims [15], "Python is a software tool recognized by the IT community as one of the most promising IT skills of the present that an IT professional should have.". Also Belani in [15], state that, "Python can be used for web and desktop applications, GUI-based desktop applications, machine learning, data science, and network servers". Furthermore, this programming language is supported by the IT community and offers several open-source libraries, frameworks, and modules that make application development simpler. Java as a representative (Back-end) and Java script as (Front-end) developer tools are also at the top of the respondents' priorities as software tools that are available to the IT community as open source solutions. Java for example object-oriented programming language does not require a specific hardware infrastructure, is easily manageable, and has a good level of security. Moreover, it is easier to learn Java in comparison to languages such as C and C++ whose skills participants have already mastered, as given in Figure 1, (87.6% mastered C and 57.1% mastered C++.). Therefore, participants are very familiar with the needs of the market as regards IT skills and software tools required in their future professional work, based on data that address market needs and can be accessed online and through their interaction with employers. After the first two sets of questions regarding the developer of programming languages for the development of application solutions, the third set of questions were if they have IT skills in the administration and maintenance of databases. The students also provided multiple answers to the question as shown in Figure 3.



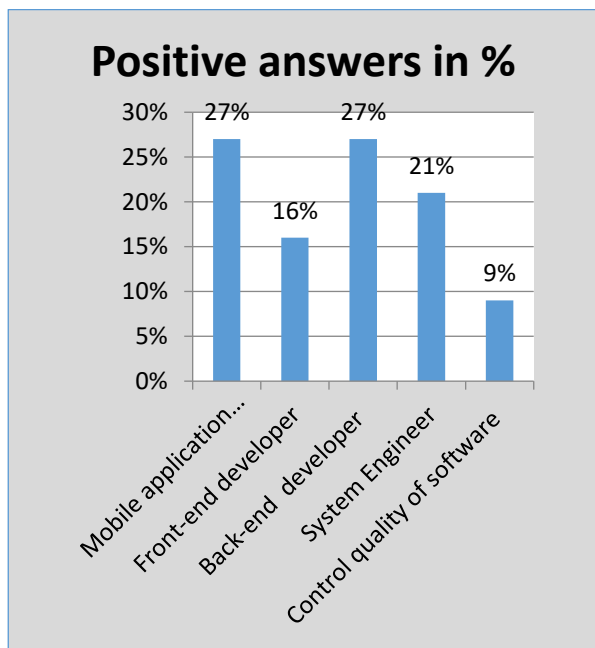
**Figure 3.** Display the knowledge of data base systems

This question was asked for practical reasons, because authors wanted to have an insight into this area of IT, i.e. working with databases. Knowledge of this area in synergy with previously mastered

developer tools programming languages and other IT skills makes an engineer become a full stack of a web developer. A full stack web developer is a person who can develop both client and server software. In order for an engineer to develop modules related to server software, it is mandatory to understand the mechanisms of database operation and their technical and technological abilities. Analysing the obtained answers shown in Figure 3, it is obvious that the majority of responders, namely 59 or (56.2%), have skills related to the MySQL database. It can be noted that, according to the collected results of this research, IT skills in working with other types of databases such as Oracle and MS SQL Server are at a relatively small level, namely Oracle 40 or (38.1%) and MS SQL Server 36 or (34.3%) participants. This fact leads to the conclusion that it is necessary to improve the current curriculum at the Faculty by increasing the number of subjects dealing with database systems in order to increase IT skills in this area.

Finally, after analysing the previous areas, authors came to the final question in this questionnaire, and it asks about the areas of IT professional skills which are considered to be essential in the future professional work within the next five years.

Participant responses are shown in Figure 4.



**Figure 4.** IT skills perspective in next five years

By analysing the data in Figure 4, it is visible that, according to the answer of the respondents, three areas stand out: two areas *Mobile application* and *Back-end developer* took 27% each, while *System engineer* took 21% of the overall participants. The results of the answers to this question coincide with the answers shown in Figure 2, where the participants identified *Developer tools* to be improved and incorporated in the ETF curriculum.

Through data analysis, authors were able to identify eighth (8) new areas for improvement IT skills that are presented in Table 1 as a direct result of the responses of the participants given in Figure 2,3 and 4.

**Table 1.** Proposal of IT skills to be included in curricula of existing courses in ETF

No.	IT skills	Area
1.	Working and developing practical knowledge in Python programming language	Back-end developer
2.	Working and developing practical knowledge Java Script programming language on website's user-facing code	Front-end developer
3.	Working in Java programming language	Back-end Developer
4.	Administration and maintenance of Oracle Relational Database Management System-RDBMS	Database administration-DBA
5.	Administration and maintenance of MS SQL server	Database administration-DBA
6.	Programming with Mobile application developer tools	Mobile App Developer
7.	Learning practical skills of server-side languages in area covered by Back-end technology	Back-end developer
8.	Installing, configuring, testing and maintaining operating systems, application software and system management tools	System engineer

**4. CONCLUSION AND FUTURE WORK**

The constant improvement of the IT skills of the target group, i.e. ETF students, is of very crucial importance in the teaching and pedagogical process of the Faculty. Through this research, the systematic approach to the above process is presented. Using a systematic approach in improving the knowledge of students, authors achieved the goal, which is to identify eight areas in IT skills and provide suggestions for reinforcement of quality of the study programmes at the ETF. These eight areas should be incorporated in the curricula of the courses which are an integral part of the ETF curriculum in order to increase the competitiveness on the market of graduate engineers. Given the current state of student workload within existing courses, it is recommended to introduce certain new optional courses that would cover eight areas of IT skills identified in Section 3. This approach would contribute to the competitiveness of graduate electrical engineers on the labour market and contribute to their better starting position in their future professional work.

With the lessons learned and the areas identified for the improvement of teaching process oriented to target group, and it is the students themselves, the next generation of students would be able to adopt modern IT skills in a simpler and faster way.

This approach will allow them to have simpler and faster mechanisms for acquiring IT skills as a basis for upgrading from some other areas not covered by the research in this paper.

This research work can be extended to more participants with more tools and different comparative parameters as i.e. survey should be executed on students of the second and third cycle of studies at the ETF.

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