

## **Alignment of Higher Education Study Programs and Job Market Demand using Machine Learning Techniques – A Case Study on Balkan Countries’ Universities**

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**Abstract**—Nowadays, a great importance is given to the compatibility between the demands of the labor market and the study programs offered by universities. It is an issue which is constantly addressed by different countries of the world. In our research, we address this issue for universities in the region, including Kosovo, Northern Macedonia, and Albania. Three universities are involved in the research, when the comparison of study programs and labor market demands is made through automated tools. This comparison is made for the technology programs which are offered by these universities, also the labor market demands which are extracted from the websites are from the field of technology. Also, at the end of our research we are able to see the analysis which has been done between the study programs from the universities of the region and the job demands of the European market.

**Keywords**—study programs, university, job market, syllabuses

### **1 Introduction**

The need for adapting study programs to the demands of the labor market is ever greater [1–3]. With the advancement of different fields, the need for qualified staff is increasing. In order for the staff to be as prepared as possible when they graduate, it is preferable that the syllabus be drafted in accordance with the demands of the labor market. Different universities use different strategies in this regard. Some of them create industrial boards, where as participants are representatives of different businesses who are able to submit their requests for what students should be prepared at the time of graduation. Based on [4–5], the provision of adequate study programs depends very much on the coordination between universities and the demands of the labor market. According to [6], high unemployment in the region is not only a result of the weak economy, but it is also a result of graduates not receiving adequate knowledge based on the demands of the labor market. Also important is the preparation of students for the European market, given that graduates increasingly target the European market [7]. Our research is based on an automated model which compares the demands of the labor

market and the study programs offered by universities. All universities that are part of our research, offer programs in the field of technology, so we have made such an analysis, to see how much these universities offer adequate programs.

Next, we present the alignment of each syllabus of the universities with job offers in order to present which syllabus has the most similarity with the market requirements.

## 2 Main results

Next, we show the comparison between South East European University syllabuses and labor market requirements.

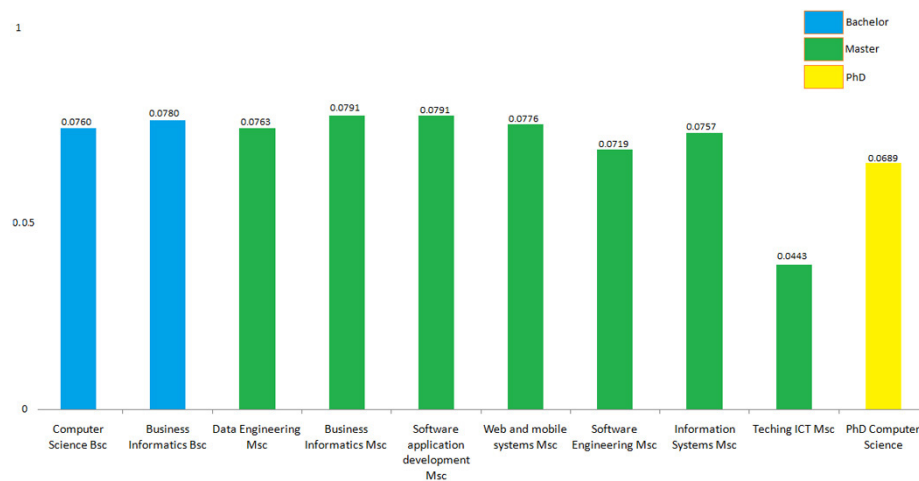


Fig. 1. South East European University syllabuses versus market demands

As we can see in Figure 1, our model compares European market requirements with syllabuses published on the South East European University website.

According to the analyses that are derived from our model, we can see that there is a similarity to almost all syllabuses offered by this university. Starting with the Computer Science program, we have a textual similarity of **0.0760** between the syllabus content and the labor market technology requirements. A similar adjustment is true for the Business Informatics program as we obtained a **0.0780** similarity between this program and the labor market requirements.

Such a comparison is made for other levels of study, masters and PhD. As we can see in Figure 1, for the Data Engineering program offered at the master’s level we have a textual similarity between this program and the labor market requirements of **0.0763**. One more similarity is for the other two programs offered at the master’s level of Business Informatics and Software Application Development, where the similarity of the textual content between these two programs and the labor market requirements is **0.0791**.

For the Web and mobile systems program, we also have a rough textual similarity with other programs, as the textual content of this program with labor market requirements is **0.0776**.

Also, for the Master program in Software Engineering we have a similarity to other programs, whereby the similarity of **0.0719** has been calculated through the use of our model. A great deal of similarity is also gained for the Information Systems program offered at the master’s level, where after calculating the similarity, it turns out to be **0.0757**.

Compared to the programs mentioned above, a smaller similarity has been gained between the textual content of the Master-level Teaching ICT program and the labor market requirements in the field of technology. After calculating the similarity by using our model, this program turns out to have a similarity of **0.0443**, which is smaller compared to other programs offered by the South East European University. Certainly, during this chapter we will be able to identify what words are missing in these syllabuses that directly influence the similarity to be smaller.

PhD studies are also offered at South East European University. Of course, such an analysis has also been necessary for the program offered at this level in the field of technology. After calculations made using our model, the textual similarity between the PhD level computer science and the textual content of labor market requirements turns out to be **0.0689**. Compared to similarities acquired for other levels of study, this program also results in a satisfactory similarity to labor market requirements. Below, we will present the analysis of the programs offered by the University of Pristina for all levels.

### 3 University of Pristina syllabuses versus market demands

Since the purpose of our research has been to analyze the programs for the universities in the region, then such an analysis has certainly been done for the University of Pristina by extracting information from its website. Below, we will present the graph with the analysis of programs and requirements of the labor market to continue with their explanations.

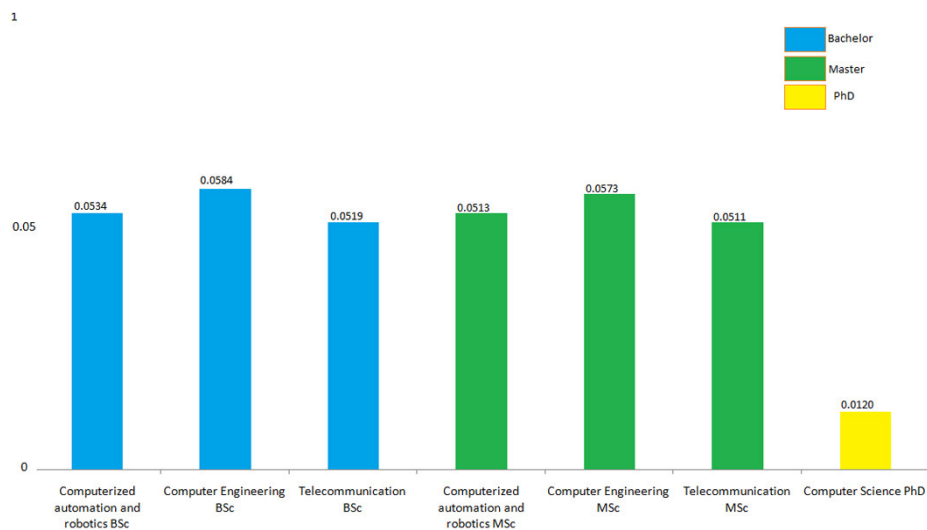


Fig. 2. University of Pristina syllabuses versus market demands

As can be seen in Figure 2, the programs offered by the University of Pristina in the field of technology are Computerized Automation and Robotics and Computer Engineering and Telecommunication for the bachelor degree. The same degree programs are also offered for the master's degree, while the Computer Science program is offered at the PhD level.

The information extracted from this University is derived through automated techniques, and used to analyze the similarity between them and the demands of the labor market.

For the bachelor's degree Computerized Automation and Robotics program, we have gained a similarity of **0.0534**. Also, for the bachelor of Computer Engineering program, we have acquired a textual similarity between this syllabus and the textual content of the labor market requirements of **0.0584**. As for the last program offered at the bachelor level, we have obtained a similarity of textual content between this program and the labor market requirements of **0.0519**.

The same analysis has been done for the programs offered at the master's level, where even for these programs an almost identical textual similarity with the programs offered at the bachelor level has been acquired.

For the master's degree Computerized Automation and Robotics program, a textual similarity was obtained between this program and the textual content of the labor market requirements of **0.0513**. Also, for the Master's Computer Engineering program, we have acquired a similarity between the content of this program and the labor market requirements of **0.0573**. With regard to the Telecommunication program at the master's level, we have acquired a textual similarity between syllabus content and labor market requirements of **0.0511**.

Since PhD studies are offered at the University of Pristina, such analysis has to be done for the studies offered at this level as well.

Compared to the studies offered at the two previous (bachelor and master) levels, PhD studies have a much smaller similarity. According to the analysis done by our automated model, we have obtained a textual similarity between the syllabus content of this program and the textual content of the labor market requirements of **0.0120**. As can be seen if compared to other levels, we have a much smaller similarity. Also, if compared to the similarity gained for the PhD program from South East European University, there is a big difference. Of course, even for this part in the following chapters we will be able to provide the words that are missing in this textual content, which results in us obtaining lower values of adaptation to the demands of the labor market. Below, we will present the next analysis that has been done with the University of Tirana based on the programs offered by this university.

As with the two previous universities, we have referred to the information this university has published on its website in order to provide our insights. According to the published data, this university has the smallest number of study programs in the field of technology at almost all levels.

#### **4 University of Tirana versus market demands**

Below, we will present the graph, which contains the results of the comparison between the programs offered by this university and the labor market requirements.

1

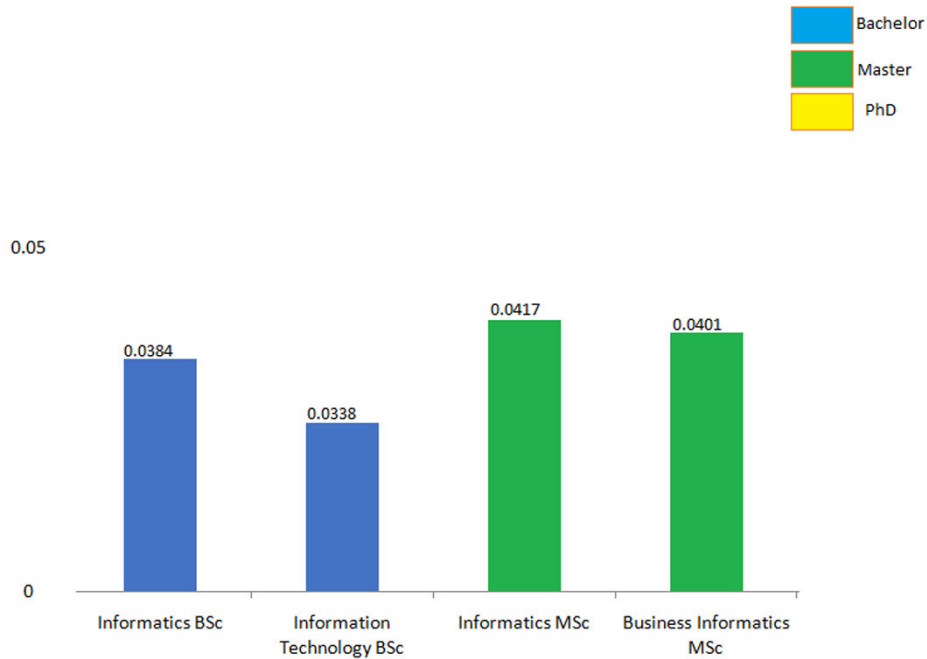


Fig. 3. University of Tirana syllabuses versus market demands

As can be seen in Figure 3, the number of programs published on the website of the University of Tirana is much smaller compared to South East European University and the University of Pristina. However, we have made a comparison between the programs published by this university and the labor market requirements. The results obtained are much smaller compared to the other two universities. As can be seen, the analysis is done only for the two levels, master and bachelor since for the PhD level there is no official data on their website. The bachelor degree from this university offers the Informatics and Information Technology program. For the Informatics program after analyzing our model it turns out that we have a similarity of textual content between the syllabus and the labor market requirements of **0.0384**, which is a much smaller value than the other two universities in the region. Also, for the Information Technology program, we have a similarity of textual content between this program and the labor market requirements in the value of **0.0338**.

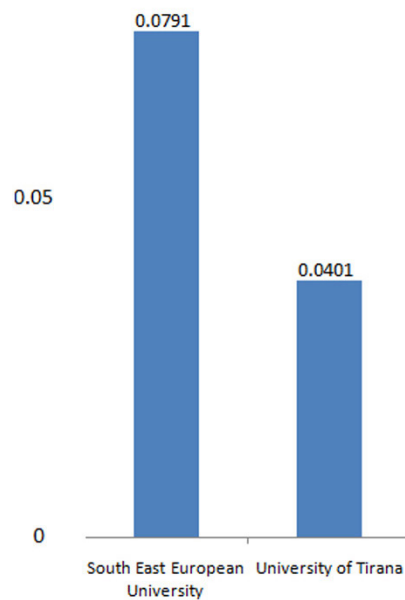
The programs offered at the master’s level stand out better than the programs offered at the bachelor’s level; however, they have a smaller fit than the two universities.

As can be seen in Figure 3, there are two programs offered at this level, Informatics and Business Informatics. Informatics software turns out to have a textual similarity to content with labor market requirements of **0.0417**, whereas for the Business Informatics

program, we have a similarity of textual content between this program and the labor market requirements of **0.0401**.

As we mentioned at the outset, if these programs are compared to the similarities we have acquired for South East European University and University of Pristina, they result in much smaller similarities. If we make a more specific comparison between the Business Informatics programs, which are the same and offered by the two universities, there is a big difference. The following is a graphical comparison of the Business Informatics program.

1



**Fig. 4.** Business Informatics syllabus versus market demands

In Figure 4, we present the comparison between South East European University and University of Tirana for the Business Informatics program because it is offered by both universities.

In Figure 4, we can see that for Business Informatics program, South East European University has a similarity of **0.0791** and University of Tirana **0.0401**. It turns out that there is a huge difference in the textual content of the program offered by the two universities. As with other analyses, the Business Informatics program offered by the University of Tirana will include missing words in this corpus in order to provide recommendations on how to improve these syllabuses.

## 5 Universities versus European market demands

As we have a ready-to-read document containing the bulk of the bidding information in the European market, our model will be ready to analyze and compare it between the text. Below we will present the similar textual results between a study program and labor market offers.

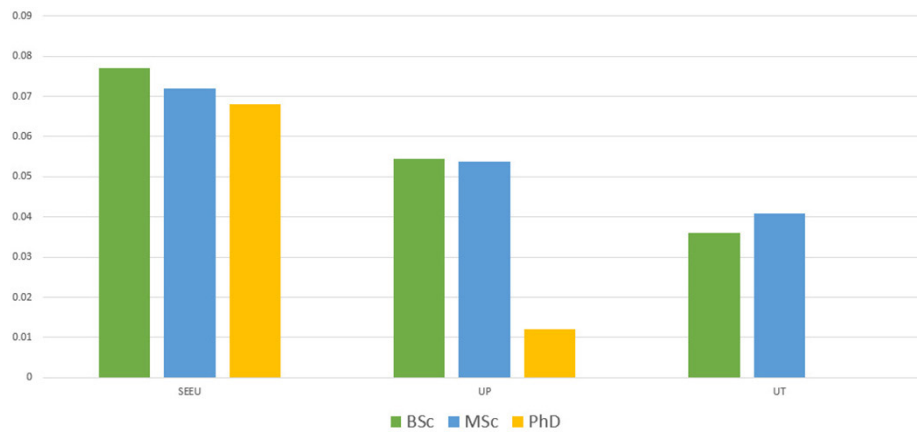


Fig. 5. Universities vs European market demands

In Figure 5, the analysis of the study programs of the universities in the region was presented in comparison to the bids of the field of technology. In the analysis, all the programs in the field of technology at all three levels of study were taken. In Figure 5, it can be seen that the similarity between texts of study programs and job offers in European countries is different. The South East European University has a major adaptation of the text of study and bidding programs compared to the University of Pristina and Tirana. The average Bachelor level for South East European University is approximately **0.08**, for the master level of approximately **0.075** and for doctoral degrees of approximately **0.07**.

At the University of Pristina, the average of the textualization of study and bidding programs in European countries is about **0.055** for both Bachelor and Master levels and **0.015** for doctoral studies.

At the University of Tirana, the average for adapting the text of study and bidding programs to European countries is approximately **0.035** for the Bachelor level, and over **0.04** for the Master's level, while no PhD level has been achieved since there was a lack of syllabuses on the university website.

Therefore, based on the analysis applied by the automated model, the textualization of study programs and job offers for the European market is greater for the South East European University compared to the other two Universities in the region.

## 6 Conclusion

In the fourth chapter, we have presented the form of the automated model algorithm that compares the university curriculum and the requirements of the labor market. We have initially illustrated the website identification form that publishes information on job offers in the field of technology. After identifying the bidding websites, we have identified the documents that hold the university curricula. The explanation of the mathematical calculations applied in our model is their illustrations as mathematical calculations for later on with their application in python languages.

Since the implementation of all the algorithm components that enable the automated modeling work, we have been analyzing the study programs of the most recent bids in the field of technology. The universities under study are as follows: Southeast European University, University of Pristina and University of Tirana. For all of these universities, the text of the study programs in the field of technology has been compared with the text of the bidding texts for European countries. During our analysis, we have compared the text of study programs with job offers, specific offers and programs of some of the world's universities. After the analysis, we noticed that the Southeast European University has a major adaptation of the text of the study programs for the supply of jobs to European countries. Apart from the analysis with job offerings for European countries, the South East European University has a great deal of textual similarity with specific positions in the field of technology and study programs of some of the world's universities.

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