

PREDIKTORI PRIHVAĆANJA ONLINE UČENJA MEĐU SVEUČILIŠNIM STUDENTIMA: ANALIZA TEMELJENA NA RUDARENJU PODATAKA

PREDICTORS OF ONLINE LEARNING ACCEPTANCE AMONG UNIVERSITY STUDENTS: AN ANALYSIS BASED ON DATA MINING

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Prethodno priopćenje

Sažetak: Razvoj informacijskih i komunikacijskih tehnologija snažno se odražava na cjelokupno obrazovanje. Kao rezultat toga, online učenje zauzima sve važnije mjesto i u nastavnom procesu na visokoškolskim ustanovama. Cilj je ovog rada utvrditi kakav je stav hrvatskih sveučilišnih studenata o online učenju i identificirati najvažnije prediktore njegovog prihvaćanja. Istraživanje je provedeno putem online upitnika, a analiza se temeljila na stablima odlučivanja, jednoj od najpopularnijih metoda rudarenja podataka. Prema rezultatima, većina studenata ima pozitivan stav o online učenju, a razina ICT znanja i vještina izdvaja se kao najznačajniji prediktor prihvaćanja. Za studente koji su svoja ICT znanja i vještine ocijenili s vrlo dobrim sljedeći najbolji prediktor je status, a za one sa slabijim kompetencijama to je spol.

Ključne riječi: online učenje, prediktori, prihvaćanje, rudarenje podataka, stabla odlučivanja, sveučilišni studenti

Preliminary communication

Abstract: The development of information and communication technologies has a strong impact on the entire education. As a result, online learning occupies an increasingly important place in the teaching process at higher education institutions. The aim of this study is to determine the attitudes of Croatian university students toward online learning and to identify the most important predictors of its acceptance. The survey was conducted via an online questionnaire and the analysis was based on decision trees, one of the most popular data mining methods. According to the results, most students have a positive attitude toward online learning, and the level of ICT knowledge and skills stands out as the most significant predictor of acceptance. For students who rated their ICT knowledge and skills as very good, the next best predictor is the enrolment status, whereas for those with poorer competencies, it is gender.

Keywords: acceptance, data mining, decision trees, online learning, predictors, university students

1. INTRODUCTION

Traditional teaching in higher education is usually frontal, since it mainly consists of an oral presentation provided by a professor (lecturer) to students (listeners). By its nature, traditional teaching is determined by space and time. It is often characterized by one-way communication, resulting in little or no interaction between students and professor. The higher the number of students there are in a class, the lower is the probability of interaction.

Advances in information and communication technologies (ICT) have strongly affected all levels of education. As a result, the concept of online learning was developed. Bakia et al. [1] defines online learning as instructional environments supported by the Internet which comprises a wide variety of programs that use the Internet to provide both access to instructional materials and facilitate interaction among teachers and students. Online learning is not a one-way linear path from teacher to student, but cyclical process in which learners connect

to a network to discover and share new information, modify their beliefs on the basis of such learning, and then connect again to a network to share these realizations and search for new information [2, 3]. Over the past few years, more and more students are opting for online learning, as an alternative to traditional classroom courses. A survey conducted by Sloan Consortium [4, 5], based on responses from U.S. universities and colleges, reveals that the number of students taking at least one online course increased from 5,6 million in 2010 to 6,7 million in 2012.

As the popularity of online learning among students grows, so do their expectations. Students primarily demand that online education is as effective as traditional face-to-face learning. According to Young [6] effective online learning consists of seven items: adapting to student needs, providing meaningful examples, motivating students to do their best, facilitating the course effectively, delivering a valuable course, communicating effectively, and showing concern for student learning. It follows from the aforesaid that

successful design and implementation of online courses requires knowing the extent to which students accept online learning, and understanding how they perceive different aspects of online learning. Therefore, the aim of this study is to determine the extent to which Croatian university students accept online learning, and the variables that are the most important predictors of their perception of online learning. With the purpose of identifying the predictors of online learning acceptance, data mining was used.

2. PREVIOUS RESEARCH

Online learning and its implementation in higher education is the subject of many studies. Some previous research about students' attitudes toward online learning is presented further in the text.

Many studies show that students are satisfied with their experience in an online environment. In a survey conducted by Kim, Liu, and Bonk [7] over 100 students enrolled in a top-ranked online MBA program were interviewed to investigate their perceptions of the benefits and challenges in online learning. Over 70% of respondents described their online learning experience in a positive manner. They used such words as excellent, good, rewarding, effective, satisfied, and enlightening. Some of those surveyed described their online learning experience as new, unique, and eye-opening. In addition, about 93% of the students agreed or strongly agreed that they were satisfied with the quality of online courses. In contrast, Palmer and Holt [8] found that nearly 45% of students were at least generally satisfied with wholly online delivery, while about one-third of respondents rated their experience as less than neutral. Their sample consisted of students enrolled in a wide range of wholly online units at Deakin University in Australia.

According to Horzum [9], satisfaction with an online learning program can be defined as fulfilment and pleasure level of the students about different aspects of learning service which they received. Why do students accept online learning and perceive their experience with it positively? A possible answer is offered by Sit et al. [10], who explored students' views of an online learning initiative within a post-registration degree in nursing in Hong Kong. Most of the respondents in the research agreed that through online learning they learned to take responsibility for their own study, they were able to work through the learning material when it is convenient to them, and it was easy to navigate the subject material. The students also considered that the face-to-face resource sessions were valuable when supplemented with online learning. Smart and Cappel [11] conducted a survey among students of the Michigan Virtual University. The ability to apply simulations to realistic problem-solving situations, good user interaction, quality of information and explanations presented, and ability to learn more about teams were perceived as strengths of the online learning units.

Online learning undoubtedly has an advantage over traditional learning, especially because students are not limited by time and space. In an online environment, they can acquire new knowledge anytime and anywhere. This

is confirmed by the study of Rodriguez, Ooms, and Montañez [12], conducted on a sample of American students. The authors asked respondents what they liked most about online courses. Approximately 48% of students who had experience with online courses answered that it was the flexibility of study time, and about 24% of them said that it was because they had less need to go to the campus. The answers of students who had no experience with online courses are also interesting. Nearly 39% of them answered that they like online learning because it is not necessary to attend lectures.

Compared with traditional classes, online learning has an innovative course design, which is suitable for many students, so they are more successful in their studies. Song et al. [13] confirmed that students consider the course design as the most important factor in the success of an online course. In this sense, the authors concluded that there is a need for effective instructional design for online courses.

Sulaiman [14] explored the online learning conveniences from students' perception. His sample consisted of students from the University Malaysia Sabah. The study showed that students feel that learning through online is really convenient and easy. One of the participants said that it is convenient for learners because they just have to click to get any kind of information instantly, which suggests that online learning is more flexible and enjoyable than learning in a traditional way.

However, it cannot be categorically stated that students prefer online learning over traditional education [15, 16]. A study by Young and Norgard [17], which was conducted on a sample of 233 American students, shows that 42% of the respondents felt they learned more in online courses than in face-to-face courses, while 58% think the opposite. Nevertheless, 57% of the surveyed students preferred online courses to face-to-face courses, whereas 43% disagreed with this statement. About 68% of the respondents stated that online courses require more study time. The research also revealed that 46% of the students agreed that online courses are more difficult than traditional classes. Zhan and Mei [18] examined the effects of academic self-concept and social presence on students' learning achievement and satisfaction in face-to-face and online version of the same course. Their sample included undergraduate students enrolled in a digital design course in a major university in Southeast China. The authors found that face-to-face students perceived significantly higher social presence than online students. The study also confirmed that there is significant difference between face-to-face and online students on the effect of social presence on learning achievement and satisfaction. In contrast, no significant difference was found with respect to academic self-concept. The effect of social presence on students' learning achievement and satisfaction were stronger in online than in traditional learning environment.

It should be noted that online learning is not suitable for everyone. Although many students perceive online learning as a positive experience, they agree that studying in an online environment can often be difficult and frustrating. The lack of motivation and absence of

social interaction are cited as the main disadvantages of online learning among students.

In comparison with previous research, this study goes a step further and seeks not only to determine the level of acceptance of online learning among Croatian university students, but also to identify the factors that influence its acceptance.

3. PARTICIPANTS AND METHODS

The study was conducted through an online survey. The responses of 902 students from the Josip Juraj Strossmayer University in Osijek were used in the analysis. Among them, there were 538 (59,6%) females and 364 (40,4%) males. The youngest participant was 17 and the oldest was 45. The average age of the surveyed students was 21,97, with a standard deviation of 3,3 years. The sample comprised of 754 (83,6%) full-time students and 148 (16,4%) part-time students. There were 258 (28,6%) first-year students, 214 (23,7%) second-year students, (21,4%) third-year students, 124 (13,7%) fourth-year students, 105 (11,6%) fifth-year students, and 8 (0,9%) sixth-year students. With respect to the field of study, there were 62 (6,9%) students from natural sciences, 220 (24,4%) students from technical sciences, 91 (10,1%) students from biomedicine and health, 56 (6,2%) students from biotechnical sciences, 351 (38,9%) students from social sciences, 91 (10,1%) students of humanities, 13 (1,4%) students of arts, and 18 (2%) students from interdisciplinary study programmes.

In addition to the descriptive statistics, decision trees were applied in the analysis. Decision trees are data mining methods which are used for classification-type problems, and for predicting a target variable based on multiple input variables. They are created using an appropriate algorithm, which defines how to split data into smaller, more homogenous groups. Decision trees consist of nodes that are connected by branches. Decision nodes represent points where data are divided according to some criteria. Leaf nodes are nodes that terminate a branch. Each decision and leaf node has only one incoming branch. Decision tree starts with a root node, which does not have any incoming branches.

The advantage of decision trees is their simplicity and interpretability of results, the possibility to handle both nominal and numeric input attributes, as well as relatively low requirements in terms of computing resources. On the other hand, most of the algorithms require that the values of the target variable are discrete. One of the drawbacks of decision trees is their instability, since small variations in the training set can significantly affect the model. Furthermore, decision trees generate a large number of rules that can become excessively large unless pruning techniques are used to make them more comprehensible. [19, 20, 21]

There are many decision tree algorithms. The chi-square automatic interaction detector (CHAID) was applied in present study. CHAID relies on the chi-square test to determine the most significant variable of each node. This algorithm was primarily designed for categorical target variables. However, it can also deal

with continuous target variables by discretizing them. [22, 23]

4. RESULTS

Table 1 shows the distribution of respondents according to their attitude toward online learning.

Table 1 Students by attitude toward online learning

Attitude	Frequency	Percentage
Negative	131	14,5
Neutral	196	21,7
Positive	575	63,7

Almost two thirds of respondents positively perceive online learning, while a little more than a fifth of the surveyed students have a neutral attitude toward this form of education. The least of respondents evaluated online learning negatively. On the basis of these results, it can be concluded that students from the Josip Juraj Strossmayer University of Osijek generally support online learning.

The survey also examined how students evaluate their equipment, i.e. how satisfied they are with the available technology, since it is required for participation in online learning. The obtained results are given in Table 2.

Table 2 Students by satisfaction with their equipment

Satisfaction level	Frequency	Percentage
Completely dissatisfied	28	3,1
Somewhat dissatisfied	19	2,1
Neither satisfied or dissatisfied	38	4,2
Somewhat satisfied	173	19,2
Completely satisfied	644	71,4

The vast majority of students believe that they have adequate equipment. Only 5,2% of the respondents were dissatisfied with their equipment.

Table 3 Students by the level of ICT knowledge and skills

Level of ICT knowledge and skills	Frequency	Percentage
Insufficient	13	1,4
Sufficient	24	2,7
Good	111	12,3
Very good	295	32,7
Excellent	459	50,9

The results in Table 3 indicate that most of the students believe that they have the necessary ICT knowledge and skills, which is also one of the preconditions for effective participation in online learning. More than half of the surveyed students rated their ICT knowledge and skills as excellent. In contrast, very few respondents stated that they are insufficiently educated and trained in the use of digital technology. More precisely, only 4,1% of students included in the

sample rated their ICT knowledge and skills as sufficient and insufficient.

The attitude of students toward online learning was defined as the target variable in the CHAID analysis. In order to get a clearer picture, students who expressed neutral attitude toward online learning were excluded from the analysis. Gender, age, enrolment status, year of study, field of study, level of satisfaction with equipment, and level of ICT knowledge and skills were defined as input variables. Data analysis was performed using SPSS statistical software package.

Figure 1 shows a tree diagram of the model. From the tree diagram, it can be seen that the level of ICT knowledge and skills is the best predictor of online learning acceptance.

For students who rated their ICT knowledge and skills as good, sufficient or insufficient, the next best predictor is gender. Among male students in this group, only 27% of them accept online learning, while 47% of female students positively perceive this form of education.

For students who rated their ICT knowledge and skills as very good, the next significant predictor is the enrolment status. About 77% of full-time students with very good ICT knowledge and skills accept online learning. Among part-time students the percentage is considerably higher. Namely, almost 95% of part-time

students with very good ICT knowledge and skills have a positive attitude toward online learning.

For students with excellent ICT competencies, the level of ICT knowledge and skills is the only significant predictor. In this group 92,9% of students accept online learning.

The classification table indicates that 62 students who negatively perceive online learning and 534 students who have a positive attitude toward online learning were correctly classified. On the other hand, 69 students who have a negative attitude toward online learning and 41 students who positively perceive online learning were classified incorrectly. Therefore, the decision tree generated by the CHAID algorithm to a greater extent correctly classified the students who accept online learning. Overall, 84,4% of the students were correctly classified.

Table 4 Classification table

Observed	Predicted		
	Negative attitude	Positive attitude	Percent correct
Negative attitude	62	69	47,3
Positive attitude	41	534	92,9
Overall percentage	14,6	85,4	84,4

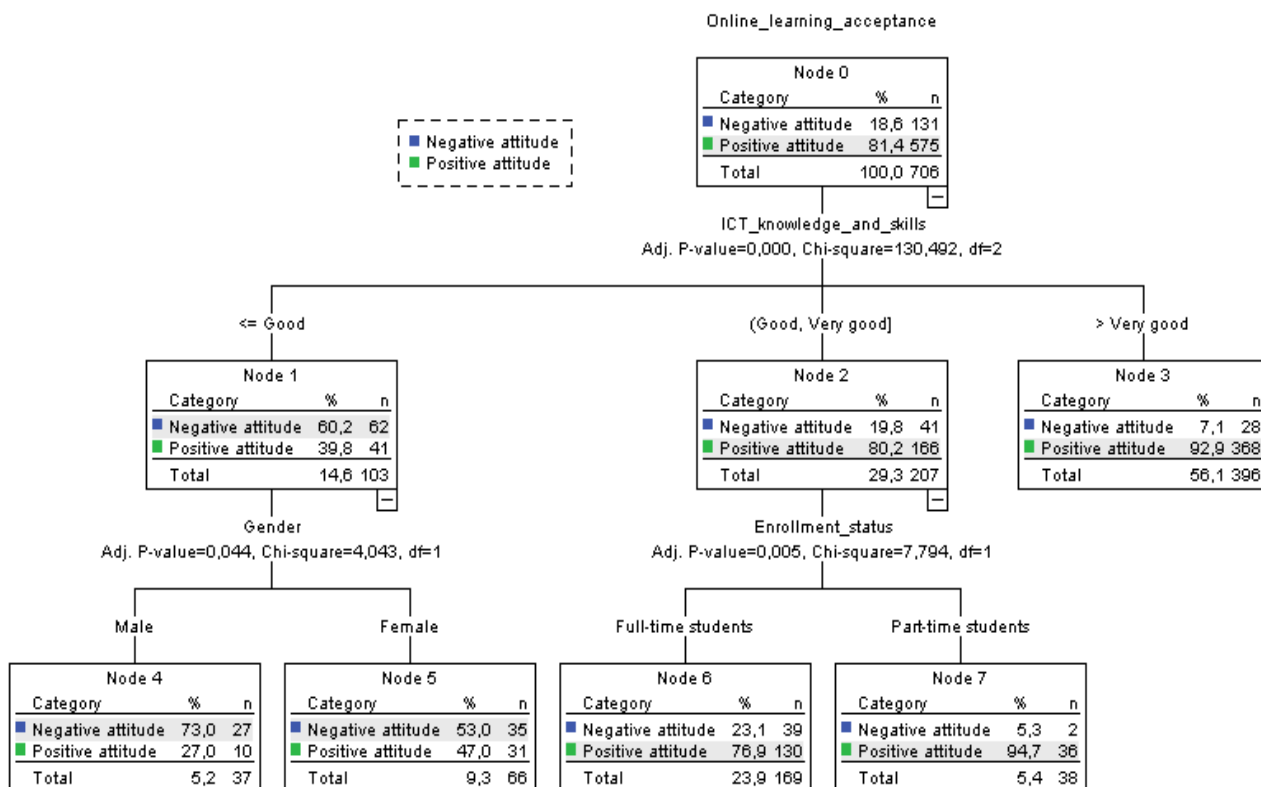


Figure 1 Tree diagram of the model

In accordance with the previous results, the risk estimate for the two-level CHAID tree is 0,156. This indicates that the risk of misclassifying is 15,6%, which can be considered satisfactory.

5. CONCLUSION

Online learning is increasingly emerging as an alternative to traditional education. Especially young people, who grow up with digital technologies, tend to accept online learning. It is difficult to predict with certainty how education will change in the next years and decades, but there is no doubt that online learning will play a very important role.

The primary intention of this study was to determine the perception of Croatian university students toward online learning and to identify which variables are most important in predicting acceptance of online learning. Based on the responses of students from the Josip Juraj Strossmayer University in Osijek, it can be concluded that online learning is mostly positively perceived. The CHAID algorithm was applied to determine the variables that best predict online learning acceptance and most significantly contribute to the classification of students. According to the results, the level of ICT knowledge and skills is the best predictor of online learning acceptance. For students who rated their ICT knowledge and skills as excellent, it is the only significant predictor. The study also revealed that for students who rated their ICT knowledge and skills as very good, the next best predictor is the enrolment status, whereas for those with poorer competencies, it is gender.

Taking into account the trends in the development of higher education, it is necessary to examine various aspects of online learning. Without such information, it is not possible to improve the teaching process and to define an effective strategy of education. In the coming time, scientists and experts who deal with education will be faced with even more dilemmas. Research like this can be of great help to them. Therefore, such studies should be continuously conducted.

6. REFERENCES

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