Role of Personal Factors in Academic Success and Dropout of IT Students: Evidence From Students and Alumni

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Abstract –**Aims of the study were three fold: to identify the factors which are able to explain academic success of IT students, to explore differences in perception of current students and alumni and to explore differences between genders. In order to achieve the research goals, neural networks and t-test were applied. The study was based on three sets of factors related to academic success, academic failure and dropout. The results indicate gender differences and differences between students' and alumni responses, especially in their perception of academic failure. Age, students' status and rank position at enrollment have been shown as the most important determinants of academic success.**

Keywords –**Academic success, academic failure, dropout, alumni, gender differences.**

1. Introduction

Education is of strategic importance for the development of knowledge society. The analysis of academic success is very important for the economy of a country, its presence in the competing and challenging market, but also for education system which is a drive for modern economies. Analysis of academic success is also important for higher

education institutions, since „strategic planning of study programme implies extension or reduction of the scope or depth of studying material as well as modification of the structure of pedagogical and educational process, depending on the students' success" [14]. Enhancing academic success has been one of the major challenges in higher education in the last two decades [1-3], [5, 9, 12, 14, 16].

Despite the large number of studies and topic continuity over longer period, previous researches had contradictory findings related to the factors influencing academic success.

Researchers studying the factors associated with academic success showed that it is likely for academic success to be influenced by a wide variety of factors. Summarizing the literature concerned with academic success, it becomes evident that several demographic factors are related to it. A large number of students' characteristics are known to be significantly associated with academic success. Several studies have shown that personality factors predict academic success. Lammers et al. [9] examined several variables that may affect academic success, namely, study habits, age, gender, classification, study time, and employment status. Slanger et al. [15] researched motivational factors related to academic success. Their findings indicate correlation of academic difficulty and dropout proneness to cumulative grade point average (GPA). Graunke&Woosley[3] indicated that demographic variables such as sex, ethnicity and transfer status are significantly correlated with GPA. Sugahara and Boland [16] asked Accounting Schools students in Japan to list five factors that they think are most important in contributing to students' success and five factors that they think are most likely to lead to students' failure. It is yet unclear whether the findings obtained in particular context (e.g. Japanese accounting students) also apply to e.g. Croatian environment and IT context. Identified problems are the starting point of our researchand are addressed in these paper. The aim of the present study is therefore

to investigate the relations between student characteristics and academic success in the Croatian IT context. It should be noted that most of these prior studies have primarily been focused on perspective of current students. Our study also extends prior research in one other way: we are taking into account alumni perspective and comparing it to thestudents` perception according to the three sets of factorsrelated to academic success, academic failure and dropout.

2. Research methodology

Three types of data mining approaches were conducted in this study. The first approach is descriptive which is concerned with the nature of the dataset such as the frequency table and the average values with standard deviations. In addition, t-test is conducted to determine possible differences between students and alumni, and between genders. The third type of data mining approach, i.e. predictive data mining, is conducted by using four different methods: discriminant analysis, regression analysis, decision trees and neural networks. Among the four methods the neural network models have shown the best results and thus are presented in the paper.

a. T - test

Gender and student-alumni group differences in the perception of success, failure and retention factors were tested using a t-test. Included in each linear model were the nine factors of success, nine factors of failure and ten factors related to retention. Factors are listed in the Table 1. All statistical analyses were conducted using SAS JMP. Statistical significance was set at $p < 0.05$.

b. Neural networks

In the academic success prediction literature the traditional approaches use discriminant analysis, logistic regression or multiple regression. Interest among researchers for applying data mining techniques (neural networks and decision trees) to this domain has been growing. Several previous research papers demonstrated better success of data mining techniques over traditional statistical approaches and indicated their significant potential in providing useful predictive models [2, 5,11,12].

Artificial neural networks (ANN) offer many advantages over conventional statistical methods [2, 5]. Artificial neural networks are non-linear mapping systems with a structure loosely based on principles observed in biological nervous systems. The ANN uses the data to develop an internal representation of the relationship between the variables, and does not make assumptions about the nature of the distribution of the data. Another advantage is that while traditional approaches are not adaptive, artificial neural networks read just their weights as new input data becomes available [2, 5]. The model we used in this paper is based on a special case of a feed-forward neural network known as a multi-layer perception (MLP). Regarding the network topology used here, our findings are that one hidden layer is enough to predict academic success with a very high accuracy and reliability. Number of nodes in hidden layer was 18 ((number of input variables+number of output variables)/2) Kfoldcrossvalidation was used as validation method.

3. Research results

Results are presented in three parts. First, the means and standard deviations of the variables used in the analyses are reported in subsection 3.1. Neural network analyses were conducted to investigate which student characteristics are associated with academic success. Predictors were: age, gender, student status, rank position, study programme, factors of academic success, factors of academic failure and academic dropout factors. Academic success (measured with grade point average, GPA) was dependent variable. Results are presented in subsection 3.2.

The t-test results in subsections 3.3. and 3.4. showthe student-alumni and gender differences in perception of factors which are determinants of academic success, failure or dropout. However, the analysis of the differences has not controlled effects of other determining factors such as how age, study programme and other factors will affect student`s success.

3.1. Data description

Data for the research was collected through a questionnaire survey conducted during the summer semester of academic year 2014-2015 among current students and alumni of one faculty which is part of the University of Zagreb. All study participants have been enrolled in study programs focused on the information technology (IT). Survey questionnaire was based on Sugahara and Boland's [16] questionnaire which was further adjusted according to our research goals with extended set of questions related to the alumni students. After eliminating outliers and incomplete data, the sample comprised 516 respondents: 354 current students and 162 alumni. Table 1.shows all variables included in the

questionnaire and respective descriptive statistics for each of the variables. Variables are presented and annotated as follows: demographic variables (red color), success factors (blue color), factors of failure (orange color) and dropout factors (green color). All variables are sorted by mean values. Variables defining success (gray color) are positioned at the end of the table. For the each factor in three groups (academic failure, success and dropout) respondents were asked to grade importance of each factor with points from 0 to 10.GPA is in the range from 2.00 to 5.00, since grades are from 1 (lowest) to 5 (highest) in Croatian system.

Sample comprised of 41,67% of females and 58,33% males. Most of the respondents are (were) enrolled in graduate study of informatics (37,38%), followed by undergraduate study of economics (23,36%) and professional study programme (20,79%). Average age of respondents is 25 years.

Table 1. Variables description and descriptive statistics (gray - sociodemographic characteristics, blue - success factors, orange - failure factors, green - retention factors, red – variables defining success)

Study programme

Undergraduate study of Informatics	7,9%
Undergraduate study of Economics	23,36%
raduate study of Informatics	37,38%
Graduate study of Economics	7%
Professional study programme	20,79%
Postgraduate study	3,57%

Age
Mean = 25,29, st.dev = 7,23

Gender
Female = 215, Male = 301

Student status

Value	Probability
Switched from full time to part time	7,20
Part time student	10,70
Part time student (employed)	6,23
Full time student	75,87

Rank position when enrolling the study programme

Value	Probability
After two hundred	5,305
First ten	17,878
First two hundred	16,896
First fifty	34,774
First hundred	25,147

Student or alumni
Alumni 162
Students 354

Persistence
Mean = 8,78 st.dev = 1,66

Availability of learning materials
Mean = 8,51 st.dev = 1,78

Motivation and well-defined objectives
Mean = 8,40 st.dev = 1,75

Demotivation to learn and carry out responsibilities
Mean = 7,85 st.dev = 2,13

Feeling that gained knowledge is valued in the profession
Mean = 7,85 st.dev = 2,25

Positive and stable environment and conditions for learning
Mean = 7,63 st.dev = 1,97

Laziness
Mean = 7,59 st.dev = 2,61

Interaction with peers and teachers
Mean = 7,16 st.dev = 2,06

Wrong choice of study programme
Mean = 7,04 st.dev = 2,54

Study programme is too hard
Mean = 6,75 st.dev = 2,5

Preparation for learning
Mean = 6,65 st.dev = 2,32

Poor responsibilities management
Mean = 6,51 st.dev = 2,57

Previous knowledge and talent
Mean = 5,93 st.dev = 2,12

Management of time and responsibilities
Mean = 5,93 st.dev = 2,22

Lack of time and learning organization
Mean = 5,61 st.dev = 2,84

Too little effort
Mean = 5,46 st.dev = 3,06

Financial problems and poor conditions for learning
Mean = 5,32 st.dev = 2,84

Poorly organized study programme
Mean = 5,00 st.dev = 2,85

Poor preparation for classes
Mean = 4,98 st.dev = 2,57

Personal issues
Mean = 4,96 st.dev = 2,62

Inability to balance study and other commitments (family, work, ...)
Mean = 4,67 st.dev = 3,04

Other liabilities (family, business, sports, social engagement, etc.)
Mean = 4,60 st.dev = 2,58

Various trials which young people are subject to
Mean = 4,09 st.dev = 3,07

Subject matter is too hard
Mean = 4,03 st.dev = 2,92

Unavailable learning materials
Mean = 4,00 st.dev = 3,04

Inadequate environment and conditions for learning
Mean = 3,61 st.dev = 2,81

Health issues
Mean = 3,12 st.dev = 2,59

Health problems
Mean = 2,01 st.dev = 2,68

How do you rate your success as a student
Mean = 6,39, st.dev = 2,13

GPA

Value	Probability
2,00 - 2,30	2,390
2,31 - 2,60	4,582
2,61 - 2,90	11,355
2,91 - 3,20	22,908
3,21 - 3,50	21,116
3,51 - 3,80	15,339
3,81 - 4,10	11,554
4,11 - 4,40	5,179
4,41 - 4,70	3,386
4,71 - 5,00	2,191

Distribution of factors in Table 1.shows that success factors have been ranked higher according to the average value. This indicates that students recognize success factors more as those that influence academic success. On the other hand, students recognize less factors related to academic failure as those which should influence it. Six out of eleven of the dropout factors have been recognized by students as those which influence more academic dropout: *Demotivation to learn and carry out responsibilities, Positive and stable environment and conditions for learning, Laziness, Wrong choice of study programme, Study programme is too hard and Poor responsibilities management*.

Interesting to note is that health issues and problems are recognized by students as the ones with least impact among academic failure factors as well as academic dropout factors. In addition, students recognized motivation as one of the key elements in both academic success and academic dropout factors. Another factor, which is closely connected in two groups, is time management that is recognized similar as factor of academic success and academic failure.

Opposite results related to difficulty of study programme (*Study programme is too hard* among academic dropout factors and *Subject matter is too hard among* academic failure factors) indicate that students are more likely to quit the subject than cope with tough challenges. Same can be concluded for the learning environment (*Inadequate environment and conditions for learning* and *Positive and stable environment and conditions for learning*).

3.2. Factors determining success

In order to get a better insight into the importance of the input variables (demographic variables, academic success factors, academic failure factors and dropout factors) for output variable (GPA), we have performed sensitivity analysis in which the impact of certain input variable of the model on the output variable has been analyzed. For the purposes of this study SAS JMP software package was used in neural network modelling.

According to Figure 1.four factors that influence GPA the most are related to sociodemographic characteristics. Study program that is enrolled by student is related to findings in chapter 3.1. where we noted connection between quitting the study programme that is too hard and persisting when facing hard challenges. With further analysis of the data gathered by students' administration office we confirmed results which indicate that there is significant statistical differencebetween students' GPA enrolled in different study programmes.This indicates that more successful students tend to enroll one study programme while less successful students enroll another one. We canclosely connect *Rank position when enrolling thestudy programme* to the *Study programme* factor since it is related to the input quality of students' that enroll specific study programmes and is presented as the fourth factor in the Figure 1. This indicates that universities can partially predict student academic achievement by analysing their enrolling rank and their preference of study programme. This results are in line with findings from previous study of Klicek, Oreski and Divjak [8]. They identified enrollment ranking as significant factor of academic success in an early stage of study process.Age as the second factor is an interesting factor to analyse. We conducted correlation analysis to determine if there is any connection between age and GPA. The correlation analysis showed positive correlation (*r=0,51, p<0,001*) between mentioned two factors. This could indicate that older students tend to focus more on the GPA despite that the focus could prolong their study for several years.
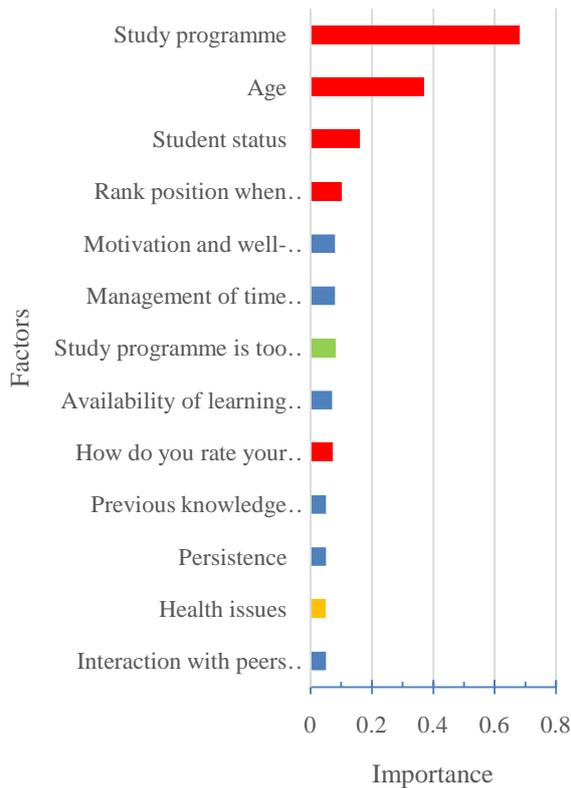
Figure 1. Importance of factors for GPA (red - sociodemographic characteristics, blue - success factors, orange - failure factors, green - retention factors)

Student status factor can be related to the time management factor mentioned in chapter 3.1. According to the data received from students' administration office full time students are more successful than part time students. This is closely related to available study time and time management where full time students have more study time available than part time students.

3.3. Differences between current students and alumni in perception of factors

Table 2.summarizes the survey responses and shows differences in perception of factors between students and alumni. The F statistic and level of significance are presented in first two columns. Significance of the difference is presented in column Sig. (2-tailed) followed by mean difference. The order of variables is by mean difference, with the highest difference presented first. Only statistically significant differences are presented in table 2.

Table 2.T-test for student alumni differences(gray–variables defining success, blue - success factors, orange - failure factors, green - retention factors)

Factors	Stud./Alumni	Levene's Test for Equality of Variances		t-test for Equality of Means					
		F	Sig.	t	df	Sig. (2-tailed)	Mean diff.	Std. Error diff.	Mean
How do you rate your success as student	S	18,96	0	-9,68	513	<0,001	-1,82	0,188	5,844
	A			-10,6	372,71	<0,001	-1,82	0,171	7,664
Inability to balance study and other commitments (family, work,.)	S	1,651	0,199	4,173	512	<0,001	1,2	0,288	5,039
	A			4,26	306,68	<0,001	1,2	0,282	3,839
Subject matter is too hard	S	0,168	0,682	3,917	514	<0,001	1,083	0,276	4,359
	A			3,959	301,88	<0,001	1,083	0,273	3,276
Lack of time and learning organization	S	0,85	0,357	3,782	514	<0,001	1,018	0,269	5,922
	A			3,719	283,43	<0,001	1,018	0,274	4,904
Availability of learning materials	S	9,969	0,002	5,973	513	<0,001	0,988	0,165	8,814
	A			5,454	241,2	<0,001	0,988	0,181	7,826
Poorly organized study programme	S	0,447	0,504	2,746	511	0,006	0,748	0,272	5,235
	A			2,723	289,75	0,007	0,748	0,275	4,487
Positive and stable environment and conditions for learning	S	0,385	0,535	3,727	510	<0,001	0,699	0,187	7,840
	A			3,659	283,48	<0,001	0,699	0,191	7,141
Previous knowledge and talent	S	2,443	0,119	2,527	514	0,012	0,534	0,211	6,092
	A			2,675	337,48	0,008	0,534	0,2	5,558
Management of time and responsibilities	S	2,1	0,148	2,509	512	0,012	0,457	0,182	8,073
	A			2,444	278,06	0,015	0,457	0,187	7,616

We find that students' average scores are higher than those of alumni`s for all variables except evaluation of own success. According to the highest and most significant difference between students and alumni related to the evaluation of their own success interesting to note is that alumni evaluate themselves statistically significantly higher than students. This could be related to alumni's perception of their own success since they have finished university and many of them are employed. On the other hand, most students perceive their own success only through academic success (GPA, competitions, etc.).

Students and alumni have more diverse opinion related to academic failure factors and more coherent opinion related to academic success factors.One factor that stands out from the rest of the results is *Management of time and responsibilities*. It has much lower statistical significant difference than two closely related factors (*Inability to balance study and other commitments* and *Lack of time and learning organization*) which both have much higher statistical significant difference between students' and alumni's opinion.

3.4. Gender differences in perception of factors

After conducted analysis of gender differences we can conclude that both genders are consistent in their answers. Male survey participants place more value on factors related to time management and motivation, such as *Too little effort, Laziness* and *Various trials which young people are subject to*. Since time management and motivation characterize entrepreneurial behavior, our results are in

accordance with the results of Kedmenec et al. [7], who found that in Croatian context male students have higher entrepreneurial intentions than female students. Female survey participants primarily place more value on factors related to health, such as *Health issues* (one of the academic success factors) and *Health problems* (one of the academic dropout factors). In line with this, Lammers, Onweugbuzie and Slatefound [9] found that female students were more likely to complete assignments several days before they were due to provide enough time to make necessary revisions, and were less likely to loaf when they should have been studying. In addition, according to Jansen and Bruinsm[6] females are more effective in the first and second year of higher education. This suggests that gender differences exist in academic performance. According to findings from several other studies (e.g., [1, 8, 10]), our research confirmed that good pre-university knowledge yielded higher achievements in the study. This suggests that prior educational achievements obtained before enrolling in higher education already can provide a basis for students' academic success and based on this, study success could be fairly accurately predicted.Compared with the previous literature, students in the present study had a tendency to rely on their own abilities and blame themselves for failure, rather than claiming this on others. This is contrary to results of Guney [4]. Guneyemphasised lecturer influence as the strongest factor for students' success. However, our findings are consistent with prior research (e.g. [13]) showing that age has strong effects on academic achievement.

Table 3.T-test for gender differences(blue - success factors, orange - failure factors, green - retention factors)

Factors	Female/M	Levene's Test for Equality of Variances		t-test for Equality of Means					Mean
		F	Sig.	t	df	Sig. (2-tailed)	Mean diff.	Std. Error diff.	
Health issues	F	5,615	0,018	4,91	508	<0,001	1,119	0,228	3,778
	M			4,792	414,119	<0,001	1,119	0,234	2,659
Management of time and responsibilities	F	4,088	0,044	4,544	512	<0,001	0,762	0,168	8,380
	M			4,61	478,507	<0,001	0,762	0,165	7,618
Health problems	F	8,697	0,003	3,07	513	0,002	0,731	0,238	2,437
	M			3,009	425,79	0,003	0,731	0,243	1,706
Too little effort	F	3,99	0,046	-2,49	509	0,013	-0,68	0,273	5,061
	M			-2,45	429,058	0,015	-0,68	0,278	5,741
Laziness	F	19,78	0	-2,77	512	0,006	-0,644	0,232	7,219
	M			-2,69	402,017	0,007	-0,644	0,239	7,863
Availability of learning materials	F	4,319	0,038	3,657	513	<0,001	0,574	0,157	8,851
	M			3,672	467,471	<0,001	0,574	0,156	8,277
Various trials which young people are subject to	F	4,612	0,032	-1,70	511	0,088	-0,47	0,275	3,817
	M			-1,73	480,654	0,083	-0,47	0,271	4,287

4. Conclusion

Aim of the study was to investigate the relationships between a large number of factors and academic success, failure and dropout for undergraduate and graduate students of informatics or economics study programme. We have tried to gain more insight into which factors are consistent contributors to academic success, failure and dropout, and investigate if there are any gender differences in perception of the factors, or differences between current students and alumni.

Previous researches focused on the personal factors in academic success didn't focus on the alumni. With alumni as a part of the survey we provide a new dimension to the research of academic success factors. Since there are no papers we could compare our alumni results with, there are several open questions for future research: is experience of alumni gained through work environment cause of their lower evaluation of factors related to academic success when compared to students; are conducted changes in higher education which are focused on the quality of study programmes reason for students to evaluate factors related to the academic success higher than alumni? Those are just some of the open questions raised after conducting the survey and analyzing the results.

The results of conducted study show that factors which determine academic success are study programme, age, student status and rank position when enrolling the study programme.

Further results were focused on differences in perception of factors between current students and alumni. The results show that the greatest differences are among factors of academic failure. This issue hasn't been widely researched and we don't have any data we could compare our results with.

Third results were related to differences in perception of factors between genders. The results indicate consistency among gender responses. Male survey participants place more value on factors related to time management and motivation. On the other hand, female survey participants primarily place more value on factors related to health.

In future research certain questions could be directed towards further analysis of age factor, especially in correlation with duration of study which is necessary for a student to complete a study programme. This could answer the question if students which finish study programme faster also have higher GPA. Additional factors could be taken into consideration, especially ones related to academic success, such as time required to finish a study programme.

Because of the different sets of factors used in similar researches it is challenging to decide which factors should be taken into consideration when conducting a survey. Further challenges are faced when determining survey sample. Because of all the challenges one must be careful with generalizations and survey result interpretations. Because of this we didn't want to make any strong conclusions, but mostly focused on indications and open interpretations of the study results.

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