Gender Differences in the Achievements of Architecture, Civil Engineering and Geodesy Students

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Abstract:

This paper analyses gender differences of the success candidates who applied for the entrance exam in the Faculty of Architecture, Civil Engineering and Geodesy, University of Banja Luka during 2012, 2013 and 2014. The success of candidates according to gender in relation to the desired study programs was especially observed. The length of study of enrolled candidates who graduated was also analysed in relation to gender and study programs. It was concluded that success in the entrance exam and success in high school are statistically significantly related to success in studies, as well as the length of study. Women in architecture and civil engineering studies are just as successful as men, while in the study of geodesy women are more successful than men. The results of this research are presented using statistical analysis.

Keywords:

gender differences, entrance exam, length of study, average grade

1 Introduction

The University of Banja Luka which was founded on 7 November 1975 and which is comprised of 17 faculties, nowadays is the leading higher education institution in the Republic of Srpska, and the second largest in the whole of Bosnia and Herzegovina. Since 2007, the University has been integrated, with the faculties functioning as its organizational units. At all faculties of the University of Banja Luka potential students have to pass an entrance exam.

In recent years it has been observed there is a higher interest for enrolment at the technical departments of the universities in Bosnia and Herzegovina [1] [2] [3].

There is a similar situation in the neighbouring countries, such as Serbia and Croatia. At some technical faculties in the neighbourhood potential students pass an entrance exam (for example Sarajevo, Belgrade, Zagreb), while at some, candidates do not have to take the entrance exam (for example Ljubljana). At the Faculty of Civil Engineering in Sarajevo, as well as at the Faculty of Architecture, Civil Engineering and Geodesy in Banja Luka a potential student can gain points based on his/her high-school GPA, grades in specific subjects, and the entrance exam. Besides that, the Faculty evaluates other achievements during the secondary education that are relevant to the field of potential studies [4] [5]. The Faculty of Civil Engineering at the University of Belgrade takes into account the secondary school GPA, as well as the success from the entrance exam [6]. The secondary school GPA contributes with 40% to the maximum of

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gained points, while the entrance exam consisting of mathematics only, adds 60%. The candidates that have been awarded with one of first three positions in the national or international contests in mathematics are granted with waiver for the entrance exam. The Faculty of Civil engineering at the University of Zagreb foresees the admission based on achievements in the secondary school GPA, and the state high-school graduation exam.

Additional achievements like one of first three places on the national contest in mathematics and/or physics can secure the direct admission to the potential candidates [7]. At the University of Ljubljana, undergraduate studies in civil engineering can be enrolled at the Faculty of Civil and Geodetic Engineering. The admission procedure is not carried out at the University, but centrally through national admission facilitated by the Government (state high-school exam). The common documents, pre-university education certificates and Slovenian language proficiency proof are prerequisites, and applicants are required to take tests of ability, capacity and skills, which is accordingly designed for each field of study [8].

The analysis of student's academic success is very important for higher education institutions from the aspect of strategic planning of enrolment policy, change and improvement of curriculum of study programs [9] [10] [11]. In the last few decades, there has been a growing interest in research of student's success in higher education in relation to gender [12] [13] [14] [15]. It has been observed that females more often choose professions related to social studies, such as education and social sciences, while males choose professions related to engineering [16]. In [17], the authors came to the conclusion that for females, motivation, the advisory role of parents and their level of education are important when choosing engineering studies. According to the 2011 BiH Household Budget Survey, fewer males than females study in the fields of general education (8% compared to 13% for females), social sciences, business, law (10% compared to 23%), and services (17% compared to 25%). By contrast, 54% of males studied engineering and construction, compared to only 19% of females [12].

From the USAID report for Bosnia and Herzegovina – Gender Analysis for Bosnia and Herzegovina: 2019, the percentage of female students enrolled at universities per field of study for the 2016/17 school year is as follows: Health and Social Welfare (73%), Education (67%), Humanities and Arts (64%), Social Sciences, Business and Law (60%), Engineering, Manufacturing and Construction (only 38%) [13].

In [18] it is concluded that the academic success of students is related to the results of the high-school GPA and success in the entrance exam. It has been noted that there is not enough research in Bosnia and Herzegovina that examines the connection between the high-school GPA, qualification exam, the success in studies and the length of engineering studies in relation to gender.

In this paper the Faculty of Architecture, Civil Engineering and Geodesy (FACEG) in Banja Luka has been observed. By the beginning of academic year 2020/2021 a total of 3989 students were enrolled in the undergraduate studies at the FACEG, whereas a total of 1784 students graduated. Most of the candidates who enrol in the FACEG are from construction high-schools and Gymnasiums, and candidates from Gymnasiums achieve the best results in the entrance exam [1]. Since 2006 in Bosnia and Herzegovina, as well as at the FACEG in Banja Luka, students have begun to study according to the Bologna system, in which studies last 4 years (8 semesters).

The objective of this paper is to assess how the high-school GPA of candidates who applied for the entrance exam affects the achieved results in the entrance exam in the FACEG, as well as both the length of studies and success during the studies of enrolled candidates who graduated in relation to gender.

2 Sample and Organization of Research

The sample of our study consists of 682 candidates (311 females, and 371 males) who applied to sit for the entrance exam at the FACEG in 2012, 2013 and 2014, (Only the first admission deadline was taken into consideration). A total of 677 candidates sat for the entrance exam, and 5 candidates did not. A total of 362 candidates passed the entrance exam, and 336 candidates were enrolled. By the end of 2020, a total of 160 students graduated (96 females, and 64 males). In general, candidates take the entrance exam for one of the three study programs: Architecture (A), Civil Engineering (CE), and Geodesy (G). They can get the maximum of 50 points for the entrance exam, and based on the average grade from high-school they can also get the maximum of 50 points. To enrol in FACEG, candidates must score at least 15 points for the entrance exam.

More precisely, the paper aims to answer the following research questions (RQs):

- RQ1: Is there a difference by gender according to the number of registered candidates for the entrance exam and the high-school GPA, in relation to the desired study programs?
- RQ2: Is there a difference by gender of candidates who passed (did not pass) the entrance exam in relation to study programs?
- RQ3: Is there a difference by gender in the number of points won for the entrance exam and a total number of points (with the high-school GPA) of registered candidates in relation to study programs?
- RQ4: Is there a difference by gender in the number of total points of enrolled (not enrolled) candidates in relation to study programs?
- RQ5: Is there a difference in the number of graduate female (male) students in relation to study programs?
- RQ6: Is there a difference by gender in the duration of study for graduate students in relation to study programs?

For the statistical analysis we used the SPSS v.24 analytical-statistical software package, employing descriptive statistics in order to present and summarize data, nonparametric tests (χ^2, Kruskal-Wallis and Mann-Withney), and parametric tests (Anova and Tukey HSD) [19] [20]. The variables observed in this study do not have a normal distribution.

3 Results

3.1 RQ1

The highest average grade (40,51) during a high-school education was achieved by registered candidates for the study program of civil engineering, followed by the candidates for the study program of geodesy (38,99) and the lowest average grade (37,82) was held by candidates enrolled for the study program of architecture. During the high-school, girls were on average more successful, by 3,01 points in CE, 1,61 in G and 3,28 in A, compared to boys (Table 1).

By applying the χ^2 test, a highly statistically significant difference ($p < 0,001$) was obtained in the number of registered candidates according to gender in relation to study programs. By testing the number of registered candidates according to gender and two study programs, a highly statistically significant difference was obtained between A and CE ($p < 0,001$) and between A and G ($p = 0,007$) and a statistically significant difference ($p = 0,044$) between CE and G (Table 1). By testing success in high-school education, using the Anova test, a highly statistically significant difference ($p < 0,001$) in relation to study programs was obtained. By testing the success in high-school education, using the Tukey HSD test, according to gender and two study programs, a highly statistically significant difference between A and CE ($p < 0,001$)

was obtained, and no statistically significant difference between A and G was obtained (p = 0,137), nor between CE and G (p = 0,057) (Table 1).

By testing the high-school success of female candidates in relation to the desired study programs, using the Anova test, a highly statistically significant difference was obtained (p = 0,009). Using the Tukey HSD test, by testing the success in high-school education of female candidates registered in A and CE, a highly statistically significant difference (p = 0,007) was obtained, whereas a statistically significant difference (p = 0,044) of female candidates registered in CE and G was not obtained. No statistically significant difference (p = 0,748) of female candidates registered in A and G was obtained. Using the Anova test a highly statistically significant difference (p = 0,001) was obtained by testing the high-school success of male candidates in relation to desired study programs. By the use of the Tukey HSD test, by testing the success in high-school education of male candidates registered in A and CE, a highly statistically significant difference (p < 0,001) was obtained, and a statistically significant difference (p = 0,021) for male candidates registered for A and G was obtained. No statistically significant difference was obtained (p = 0,320) for male candidates registered in CE and G (Table 1).

Table 1: Registered candidates and their gender-based high-school success in study programs

	A	**CE**	**G**	**p**
female (♀)	133	60	118	Total: < 0,001$^{\nabla}$
male (♂)	105	115	151	A & CE: < 0,001$^{\nabla}$ A & G: 0,007$^{\nabla}$ CE & G: 0,044$^{\nabla}$
Mean (♀ & ♂)	37,82	40,51	38,99	Total: < 0,001‡
Median (♀ & ♂)	37,66	41,06	39,17	A & CE: < 0,001† A & G: 0,137† CE & G: 0,057†
♀ – Mean	39,27	42,49	39,89	Total (♀): 0,009‡
♀ – Median	40,19	42,99	40,83	A & CE: 0,007† A & G: 0,748† CE & G: 0,042†
♂ – Mean	35,99	39,48	38,28	Total (♂): 0,001‡
♂ - Median	35,11	40,00	38,75	A & CE: < 0,001† A & G: 0,021† CE & G: 0,320†

$^{\nabla}$ χ^2 test, ‡ Anova, † Tukey HSD.

Based on obtained results it is noticeable that in the observed three generations, more female candidates applied for the study of architecture, and more male candidates applied for the study of civil engineering and geodesy and during the high-school, girls were on average more successful compared to boys, in all three study programs. The best high-school GPA was achieved by civil engineering candidates, and the lowest one was in the study of architecture, for both male and female candidates (Table 1).

3.2 RQ2

By applying the χ^2 test, by testing the number of female candidates who did or who did not pass the entrance exam in relation to study programs, a highly statistically significant difference was obtained (p = 0,002), and by mutual testing of two study programs, a highly statistically significant difference was obtained between female candidates who have or have not passed the entrance exam in A and CE (p = 0,004) and in CE and G (p = 0,001).

By testing male candidates who passed or who did not pass the entrance exam in relation to study programs, a statistically significant difference was obtained ($p = 0,037$), and by mutual testing of two study programs, a statistically significant difference ($p = 0,011$) was obtained between male candidates who have or have not passed the entrance exam in CE and G (Table 2). By testing all candidates who passed the entrance exam in relation to gender and study programs, a statistically significant difference was obtained ($p = 0,011$), and by mutual testing of two study programs, a highly statistically significant difference ($p = 0,003$) was obtained between students who have passed the entrance exam in A and CE in relation to gender. A highly statistically significant difference ($p < 0,001$), was obtained by testing all candidates who did not pass the entrance exam in relation to gender and study programs, and by mutual testing of two study programs a highly statistically significant difference was obtained between candidates in relation to gender in A and CE ($p < 0,001$) and between candidates in relation to gender in CE and G ($p = 0,009$) (Table 2). Table 2 shows that 57,25% (75) female candidates passed the entrance exam in the study program of architecture, 80% (48) in the study program of civil engineering and 53,39% (63) in the study program of geodesy. Also, 46,08% (47) of male candidates passed the entrance exam in the study program of architecture, 57,39% (66) in the study program of civil engineering and 41,72 % (63) in the study program of geodesy. Thus, we can see that females have a better pass rate in all three study programs.

3.3 RQ3

The highest average score in the entrance exam (22,68) was achieved by candidates registered for CE, followed by candidates registered for A (21,43), and the lowest average score was achieved by candidates registered for G (15,8). During the high-school education female candidates were on average 5,25 points more successful in CE, 1,39 in A and 6,04 in G compared to male candidates (Table 2). By testing the number of points scored in the entrance exam, using the Anova test, a highly statistically significant difference was obtained ($p < 0,001$) in relation to all study programs. Using the Tukey HSD test, a highly statistically significant difference was obtained, by testing the number of points scored in the entrance exam of candidates registered for A and G ($p < 0,001$) and candidates registered for CE and G ($p < 0,001$). Also, by applying the Anova test, a highly statistically significant difference ($p = 0,004$) was obtained by testing female candidates at all study programs. Applying the Tukey HSD test, a highly statistically significant difference ($p = 0,003$) was obtained by testing female candidates in CE and G. By testing male candidates, using the Anova test, a highly statistically significant difference ($p < 0,001$) was obtained between all study programs, and by applying the Tukey HSD test, a highly statistically significant difference was obtained between A and G candidates ($p < 0,001$) and between CE and G ($p < 0,001$) candidates (Table 2).

By testing the total number of points scored, using the Anova test, in relation to study programs, a highly statistically significant difference was obtained ($p < 0,001$), and by mutual testing of two study programs, using the Tukey HSD test, a highly statistically significant difference between candidates of CE and G ($p < 0,001$) was obtained. Also, a statistically significant difference between candidates of A and CE ($p = 0,035$) and between candidates of A and G ($p = 0,010$) were obtained. The total number of points ~~won~~ scored by female candidates differs ~~a~~ highly statistically significantly ($p = 0,002$) in relation to study programs, and by mutual testing of two study programs, a highly statistically significant difference between CE and G ($p = 0,001$) candidates and statistically significant difference ($p = 0,016$) between A and CE candidates were obtained. In male candidates, a highly statistically significant difference was found in relation to study programs ($p < 0,001$), and by mutual testing of two study programs a highly statistically significant difference between CE and G candidates was found ($p < 0,001$), and a statistically significant difference between candidates of A and G ($p = 0,035$) was obtained (Table 3).

Table 2: The entrance exam results by study programs and gender

	A	CE	G	p
♀ – yes ♀ – no	75 56	48 12	63 55	Total (♀): 0,002$^{\nabla}$ A & CE: 0,004$^{\nabla\nabla}$, A & G: 0,540$^{\nabla}$ CE & G: 0,001$^{\nabla\nabla}$
♂ – yes ♂ – no	47 55	66 49	63 88	Total (♂): 0,037$^{\nabla}$ A & CE: 0,096$^{\nabla}$ A & G: 0,493$^{\nabla}$, CE & G: 0,011$^{\nabla}$
Yes: ♀ & ♂				Total: 0,011$^{\nabla}$ A & CE: 0,003$^{\nabla}$ A & G: 0,069$^{\nabla}$ CE & G: 0,221$^{\nabla}$
No: ♀ & ♂				Total: < 0,001$^{\nabla}$ A & CE: < 0,001$^{\nabla}$ A & G: 0,056$^{\nabla}$ CE & G: 0,009$^{\nabla}$
Mean (♀ & ♂) Median (♀ & ♂)	21,43 21,45	22,68 21,00	15,80 12,00	Total: <0,001‡ A & CE: 0,587†; A & G: < 0,001†; CE & G: <0,001†
♀ – Mean ♀ – Median	22,04 22,70	26,13 25,00	19,19 17,00	Total (♀) = 0,004‡ A & CE: 0,112†; A & G: 0,199†; CE & G: 0,003†
♂ – Mean ♂ – Median	20,65 20,00	20,88 19,00	13,15 10,00	Total (♂) = < 0,001‡ A & CE: 0,989†; A & G: < 0,001†; CE & G: < 0,001†

$^{\nabla}$ χ^2 test, $^{\nabla\nabla}$ χ^2 test with correction according to Yates, ‡ Anova, † Tukey HSD

The highest total number of points was achieved by candidates of civil engineering, and the lowest number was scored by candidates of geodesy**.** Female candidates registered for study program of civil engineering are statistically better in total number of points scored than candidates registered for geodesy and architecture. The same result was obtained for male candidates. The lowest total number of points was achieved by candidates in the study program of geodesy (Table 3).

Table 3: Total points scored according to study programs according to gender

	A	CE	G	p
Mean (♀ & ♂)	59,11	63,20	54,78	Total: < 0,001‡
Median (♀ & ♂)	58,00	63,50	52,05	A & CE: 0,035†; A & G: 0,010†; CE & G: < 0,001†
♀ – Mean	61,30	68,62	59,08	Total (♀): 0,002‡
♀ – Median	61,61	67,81	57,23	A & CE: 0,016†; A & G: 0,554†; CE & G: 0,001†
♂– Mean	56,34	60,36	51,43	Total (♂): < 0,001‡
♂- Median	55,87	60,17	49,25	A & CE: 0,134†; A & G: 0,035†; CE & G: < 0,001†

‡ Anova, † Tukey HSD

3.4 RQ4

By applying the χ^2 test, in order to test the number of female candidates who are or who are not enrolled in studies in relation to study programs, a statistically significant difference ($p = 0,037$) was obtained and by mutual testing of two study programs, a statistically significant difference was obtained between female candidates who are enrolled in A and CE ($p = 0,026$) and in CE and G ($p = 0,029$). By applying the χ^2 test, in order to test the number of male

candidates who are or who are not enrolled in studies in relation to desired study programs, a statistically significant difference (p = 0,023) was obtained and by mutual testing of two study programs, a highly statistically significant difference was obtained between male candidates who are or who are not enrolled in CE and G (p = 0,009). Also, a statistically significant difference was obtained between male candidates who are or who are not enrolled in A and CE (p = 0,043) (Table 4).

By testing all candidates enrolled in the study in relation to gender and study programs, a highly statistically significant difference was obtained (p = 0,005), and by mutual testing of two study programs, a highly statistically significant difference was also obtained (p = 0,001) between candidates in relation to gender who are enrolled in A and CE. A highly statistically significant difference (p = 0,002) was obtained by testing all candidates who were not enrolled in the study in relation to gender, and by mutual testing of two study programs, a highly statistically significant difference between candidates in relation to gender in A and CE was obtained (p = 0,001). In addition, a statistically significant difference (p = 0,03) between candidates in relation to gender in study programs of A and G (Table 4). The highest average total number of points (74,19) was achieved by, candidates enrolled in CE program, followed by candidates enrolled in G (70,18), and the lowest average number of points was scored by candidates enrolled in A (69,86). Female candidates were on average 2,38 points more successful in CE, 3,98 in A and 6,86 in G compared to male candidates (Table 4). By testing the total number of points scored by enrolled candidates, using the Anova test, in relation to all study programs a statistically significant difference was obtained (p = 0,012). A statistically significant difference was obtained, using the Tukey HSD test, by testing the total number of achieved points ~~of~~ by enrolled candidates of A and CE (p = 0,02) and candidates enrolled in CE and G (p = 0,031). Also, by applying the Anova test, a highly statistically significant difference (p = 0,003) was obtained by testing male candidates and all study programs, and by applying the Tukey HSD test, a highly statistically significant difference (p = 0,005) was obtained in CE and G candidates, and a statistically significant difference (p = 0,03) between A and CE candidates. No statistically significant difference in the number of total points scored according to study programs was found among female candidates (Table 4).

Table 4 shows that 53,44% (70) of female candidates enrolled in the study program of architecture, 71,67% (43) in the study program of civil engineering and 53,39 % (63) in the study program of geodesy. Also, 40,20% (41) of male candidates have been enrolled in the study program of architecture, 53,91% (62) in the study program of civil engineering and 37,75 % (57) in the study program of geodesy.

Thus, we can see that a larger number of female candidates enrolled in all three study programs. The best average in the total number of points, for enrolled candidates, was achieved by candidates in the study program of civil engineering, followed by candidates enrolled in the study program of geodesy and the lowest total number of points was scored by candidates who have been enrolled in the study program of architecture. Females were on average 2,38 points more successful in the study program of civil engineering, 3,98 in the study program of architecture and 6.86 in the study program of geodesy, compared to males.

3.5 RQ5

By applying the χ^2 test, in order to test the number of female students who did and did not graduate and study programs, no statistically significant difference was obtained (p = 0,077), and by mutual testing of two study programs, a statistically significant difference was obtained (p = 0,043) among female students who have or have not graduated in A and G. No statistically significant difference was obtained by testing A and CE, and CE and G graduate~~d~~ students. By testing male students who did or who did not graduate at all study programs and by mutual

testing of two study programs, no statistically significant difference was obtained in any of the cases (Table 5).

Table 4: Number of enrolled students and total points won according to study programs and gender

	A	CE	G	p
♀ – yes ♀ – no	70 61	43 17	63 55	Total (♀): 0,037$^{\nabla}$ A & CE: 0,026$^{\nabla\nabla}$, A & G: 0,994$^{\nabla}$ CE & G: 0,029$^{\nabla\nabla}$
♂ – yes ♂ – no	41 61	62 53	57 94	Total (♂): 0,023∇ A & CE: 0,043$^{\nabla}$, A & G: 0,695$^{\nabla}$ CE & G: 0,009$^{\nabla}$
Yes: ♀ & ♂				Total: 0,005$^{\nabla}$ A & CE: 0,001$^{\nabla}$, 0,221$^{\varphi}$; A & G: 0,105$^{\nabla}$ CE & G: 0,083$^{\nabla}$
No: ♀ & ♂				Total: 0,002$^{\nabla}$ A & CE: 0,001$^{\nabla}$, 0,252$^{\varphi}$; A & G: 0,030$^{\nabla}$ CE & G: 0,064$^{\nabla}$
Mean (♀ & ♂) Median (♀ & ♂)	69,86 69,23	74,19 74,19	70,18 68,91	Total: 0,012‡ A & CE: 0,020†; A & G: 0,976†; CE & G: 0,031†
♀ – Mean ♀ – Median	71,33 72,84	75,60 77,38	73,44 73,18	Total (♀) = 0,175‡ A & CE: 0,154†; A & G: 0,561†; CE & G: 0,628†
♂ – Mean ♂ – Median	67,35 65,00	73,22 73,07	66,58 64,85	Total (♂) = 0,003‡ A & CE: 0,030†; A & G: 0,942†; CE & G: 0,005†

$^{\nabla}\chi^2$ test, $^{\varphi}$ Phi. $^{\nabla\nabla}\chi^2$ test with correction according to Yates, ‡ Anova, † Tukey HSD.

Table 5: Number of graduated students according to study programs and gender

	A	CE	G	p
♀ – yes	35	20	41	Total (♀): 0,077$^{\nabla}$
♀ – no	18	8	7	A & CE: 0,0807$^{\nabla\nabla}$ A & G: 0,043$^{\nabla\nabla}$, CE & G: 0,238$^{\nabla\nabla}$
♂ – yes	16	25	23	Total (♂): 0,817$^{\nabla\nabla}$
♂ – no	12	14	13	A & CE: 0,747$^{\nabla\nabla}$ A & G: 0,771$^{\nabla\nabla}$, CE & G: 1,000$^{\nabla\nabla}$

$^{\nabla}\chi^2$ test, $^{\nabla\nabla}\chi^2$ test with correction according to Yates

Female students of the study program in geodesy were more successful in graduation.

3.6 RQ6

By testing the duration of ~~the~~ study of graduate students, using the Kruskal Wallis test, in relation to study programs, a highly statistically significant difference was obtained ($p < 0,001$), and by mutual testing of two study programs, using the MannWhitney test, a highly statistically significant difference was obtained between A and G students ($p = 0,008$) and between CE and G students ($p < 0,001$).

The duration of study of female students differs highly statistically significantly ($p = 0,002$) in relation to study programs, and by mutual testing of two study programs a highly statistically significant difference between CE and G female students ($p = 0,002$) was obtained, and a

statistically significant difference was obtained between A and G female students (p = 0,010). In male students, there is no statistically significant difference in the duration of study between all and individual study programs (Table 6).

Students of geodesy completed their dies in a shorter period of time, compared to students of architecture and civil engineering. The female students of geodesy had the shortest duration of ~~the~~ study (5 years). The civil engineering studies take the longest period of time (5,66 years), and female students study longer than male students on average (5,79 compared to 5,56 years), but this difference in not statistically significant. It is noticeable that studies in all three study programs last significantly longer than four years.

The high-school success is highly statistically significantly related to: the number of points won in the entrance exam for all students (r = 0,287, p < 0,001) and for G students (r = 0,401, p = 0,001); the total number of points (r = 0,710, p < 0,001) for all students according to all study programs: A (r = 0,707, p < 0,001), CE (r = 0,538, p < 0,001) and G (r = 0,774, p < 0,001) and the duration of study for all students (r = - 0,364, p < 0,001) and for G students (r = -0,494, p < 0,001), and ~~a~~ it is statistically significantly related to the study duration for A students (r = - 0,297, p = 0,034) and CE students (r = - 0,341, p = 0,022).

The number of points achieved by students in the entrance exam is highly statistically significantly related to: the total number of points for all students (r = 0,878, p < 0,001) and according to all study programs: A (r = 0,794, p < 0,001), CE (r = 0,594, p < 0,001), G (r = 0,891, p < 0,001) and for CE students in the duration of study (r = 0,356, p = 0,004). The total number of points achieved by students is highly statistically significantly related to the duration of study for all students (r = 0,221, p = 0,005) and according to all study programs.

The high-school success is highly statistically significantly related to: the number of points won in the entrance exam for geodesy students; the total number of points won for all students according to all study programs and the duration of study for all students and for students of geodesy, architecture and civil engineering, separately.

The number of points achieved by students in the entrance exam is highly statistically significantly related to: the total number of points for all students and according to all study programs and for civil engineering students in the duration of study. The total number of points achieved by students is highly statistically significantly related to the duration of study for all students and according to all study programs.

Table 6: The duration of studies counted in days for graduate students according to study programs and gender

	A	**CE**	**G**	**p**
Mean (♀ & ♂)	1976,00	2067,11	1851,72	Total: < 0,001§§
Median (♀ & ♂)	1990	2055	1722,5	A & CE: 0,230§; A & G: 0,008§; CE & G: < 0,001§
♀ – Mean	1975,26	2112,90	1830,66	Total (♀): 0,002§§
♀ – Median	2005	2040	1661	A & CE: 0,227§; A & G: 0,010§; CE & G: 0,002§
♂ – Mean	1977,63	2030,48	1889,26	Total (♂): 0,200§§
♂ - Median	1952,5	2066	1741	A & CE: 0,438§; A & G: 0,361§; CE & G: 0,079§

§§ Kruskal Wallis Test, § Mann-Whitney Test.

4 Discussion

Education system plays an important role in reproducing traditional gender roles and stereotypes. In Bosnia and Herzegovina, gender stereotypes continue to play a significant role in political, economic, and private life [12].

According to BHAS data provided in [21], participation of female students enrolled in the school year 2015/2016 ~~is~~ was as follows: 47,95% in pre-school education, 48,55% in primary schools, 49,91% in secondary schools, 54,20% of female students were enrolled in higher education institutions and 58,73% of them graduated. Females made 59,58% of Masters of Science and Specialists and 45,4% of Doctors [22].

Female make majority in healthcare (pharmacy, dentistry, medicine) and language studies. Compared to this, only 10% of female students are educated in fields such as mechanical and electrical engineering, and less than 25% of them are involved in areas such as physical education, road traffic, criminology and mining. Areas in which number of males and females is approximately the same are the law, economics, architecture and biotechnical science. Such differences in choosing occupations also have a direct impact on the labour market and there is a need to trigger changes in the gender-stereotyped professions, thus enabling equal gender representation in the labour market [22].

In a study conducted at Technion (Israeli Institute of Technology-TECH), a research university that offers diploma only in STEM areas, for the period (1998-2008) the following results were obtained: the lowest number of female candidates enrolled in the studies of Mechanical Engineering (10%) and Electrical Engineering (14%), 23% of female students enrolled in civil engineering and environmental studies. The largest percentage of females were in studies: Medical Laboratory Science (76%), Quality Engineering and Biology (73%), Biotech and Food Engineering (70%), Landscape Architecture (68%) [23].

The results of a study conducted at the University of Banja Luka on a sample of 745 students from 14 different study programs, showed differences in the average grade between narrow~~er~~ scientific fields but without significant effect of gender. However, there has been a significant interaction between gender and the scientific field: males achieved a higher average grade in biology, chemistry and psychology, while females had higher grades in philology, economics and computer electrical engineering. So, among the students of the University of Banja Luka, there are certain differences in success by gender, but they do not indicate typical gender-stereotypical patterns of gender differences [24].

The obtained results of this research are significantly compatible with the results obtained in [12]- [17], [22]- [24]. In the period (2016-2020) (five years), 7457 females and 4759 males were enrolled at the University of Banja Luka [25]. In the same period, 3976 females and 1985 males completed their studies. From the Table 7 it is noticeable that most females are enrolled at the Faculty of Medicine (1280), the Faculty of Philosophy (924), the Faculty of Natural Sciences (773), while most males are enrolled at the Faculty of Electrical Engineering (756) and at the Faculty of Mechanical Engineering (495). Most females graduated at the Faculty of Philosophy (856), the Faculty of Natural Sciences (503) and the Faculty of Economics (495), while the most male students graduated at the Faculty of Electrical Engineering (215).

Table 7: Number of enrolled and graduated students at the University of Banja Luka in the period 2016-2020

Faculty	Enrolled students			Graduated students		
	♀	♂	Total	♀	♂	Total
Academy of Arts	231	181	412	141	96	237
Faculty of Architecture, Civil Engineering and Geodesy	343	230	573	192	189	381
Faculty of Economics	725	375	1100	435	161	596
Faculty of Electrical Engineering	367	756	1123	72	215	287
Faculty of Mechanical Engineering	166	495	661	42	111	153
Faculty of Medicine	1280	426	1706	214	72	286
Faculty of Agriculture	210	227	437	222	178	400
Faculty of Law	544	315	859	327	177	504
Faculty of Natural Sciences	773	325	1098	503	184	687
Faculty of Mining	45	61	106	12	27	39
Faculty of Technology	410	109	519	170	39	209
Faculty of Security Sciences	219	310	529	25	70	95
Faculty of Political Sciences	499	213	712	375	162	537
Faculty of Physical Education and Sports	85	249	334	26	54	80
Faculty of Philology	573	139	712	325	49	374
Faculty of Philosophy	924	162	1086	856	98	954
Faculty of Forestry	63	186	249	39	103	142
University of Banja Luka	7457	475	1221	3976	198	5961

5 Conclusion

Based on the obtained results, we conclude the following: in engineering studies more female students apply for the study of architecture than for the study of civil engineering and geodesy, but during the high-school, female students were on average more successful compared to male students, in all three study programs. The highest number of points at the entrance exam and the total number of points, was achieved by candidates of civil engineering, and the lowest number of points was scored by students of geodesy. In total number of points female students were more successful in all three study programs, compared to male students. The best GPA in the total number of points, for the enrolled candidates, was achieved by the candidates in the study program of civil engineering, male candidates achieved the best average total number of points in the study program in civil engineering, while in female candidates there was no statistically significant difference in the average total number of points by study programs. Students of geodesy completed their studies in a shorter period of time, compared to students of architecture and civil engineering. Female students of the study program in geodesy were more successful in graduation. From the obtained correlations, we conclude that

success in the entrance exam and success in high-school are statistically significantly related to success in studies, as well as the length of study.

From all the above and obtained results, we can conclude that female students, in engineering studies are just as successful as male student. However, it is noticeable that females in Bosnia and Herzegovina, as well as in other neighbouring countries, enrol much less in engineering studies [12] - [15]. The exception is the study of architecture, which is mostly enrolled by female students, since the architecture is considered to be a combination of engineering and art. In addition, female students earned a higher high-school GPA in engineering programs compared to male students.

Engineering studies need to be more popularized among female population with the aim of breaking down the prejudices. This research should be extended to all technical faculties in Bosnia and Herzegovina (mechanical engineering; electrical engineering; computer science; technology; architecture, civil engineering and geodesy) in the form of a national project in Bosnia and Herzegovina.

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