Co-funded by the
Erasmus+ Programme
of the European Union

UNIWERSYTET SZCZECIŃSKI
WYDZIAŁ EKONOMII
FINANSÓW I ZARZĄDZANIA

REPORT FROM

2st STUDENT'S SURVEY

ASSUMPTIONS, ANALYSIS AND CONCLUSIONS

Developed by:
Jacek Batóg, University of Szczecin
Barbara Czerniachowicz, University of Szczecin (author of part 4.2 and co-author of part 5)

Proofreading:

Trudy Sutherland (Vaal University of Technology)

"This project has been funded with support of the European Commission. This publication reflects the views only of the authors, and the Commission cannot be held responsible for any use which may be made of the information contain therein"

Szczecin 2021

Content

1. Introduction

The theoretical determinants of the impact of gender inequality on countries' economic growth and development levels, as well as the barriers to effective policy implementation, were presented in a report discussing the results of the first survey of South African partner university students. It also includes reflections on the importance of higher education, with a particular focus on STEM fields oraz gender equality in higher education.

2. Survey objectives and limitations

To realize effective policy focused on reducing gender inequalities we need to provide reliable information on current state of woman at university level. This is one of main reasons to raise the topic in the PEESA III project, providing a base for shaping, developing and strengthening gender equality policy for higher education institutions.

The PEESA III project members are also seeking to understand the reasons why women and men have chosen to study engineering. They also try to develop recommendations for policymakers on how to encourage females and males success in Engineering and related disciplines.

Main goals of the first and second surveys dedicated to students and conducted respectively in 2019 and in 2021 were to present which tools and solutions are conducive to increase the number of women choosing engineering studies, to identify determinants of enrolment rate, and also to determine factors that increase the employability of engineering graduates.

Both surveys were preceded by the process of obtaining of ethical clearances. Granted ethics approvals for 2nd survey are presented in the appendices 4 and 5, while application letters can be found in the appendices 2 and 3.

Before and during the 2nd student's survey, some limitations and barriers appeared. Among the most important were:

- still limited possibilities to draw general conclusions for the whole population of South African's engineering students, but it should be underline that there was sufficient sample to draw several conclusions (n = 985),
- long waiting time to obtain ethical clearances (actually until the end of the data gathering the project team did not receive such approval from TUT, despite many efforts and the provision of additional information requested by the university's ethics committee),
- some missing answers in case of particular questions,
- not fully balanced sample: males (57.46%) and females (42.54%) – but to some extent better balance than in case of the 1st student survey).

3. Questionnaire development and implementation

The questionnaire and survey conducting were implemented by the University of Szczecin team in the close collaboration of representatives of South African partners:

- Lesley Cooke (DUT),
- Hester Jackson (DUT),
- Zakheeya Armoed (DUT),
- Maureen Ramaube (TUT),
- Trudy Sutherland (VUT),
- Luclaire Airey (CPUT).

All tasks and possible problems were consulted on the regular basis with members of Project Board.

The whole process of student's surveying was realised in the following steps:

1. Consultations of the modifications of questionnaire related to the 2nd gender equality survey with SA partners, November-December 2020.
2. Development of the final version of questionnaire, December 2020.
3. Beginning and conducting of the procedure of ethical clearance required by ethical committees at all partner universities in South Africa (November 2020-March 2021).
4. Creation of the on-line survey questionnaire using Microsoft Form, June 2021.
5. Providing a link to the on-line version and request for conducting the gender equality survey dedicated to students at all partner's universities in South Africa (DUT, CPUT, TUT, VAL), June 2021.
6. Preparation of answer's database and statistical and descriptive analyses, August 2021.
7. Writing the final version of the 2nd student survey's report, September 2021.

4. Sample structure and results

4.1. Quantitative analysis

Sample and answers structure

In this report 985 full responses were analysed in detail. Figure 1 presents the structure of the sample according to the name of the university where the respondent is studying.

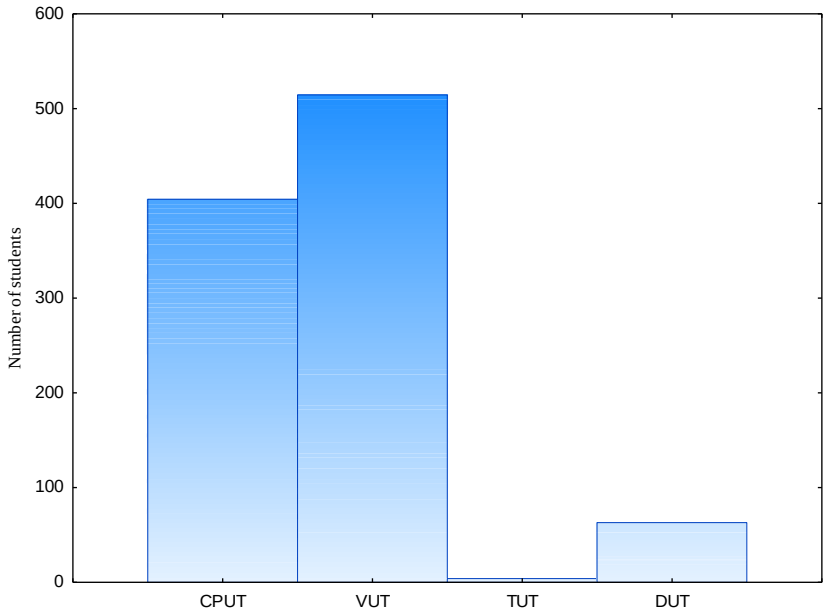


Fig. 1. Sample structure according to the name of the South African partner
Source: own calculations.

The highest number of answers was obtained from VUT students (514), which constitutes for 52.18%. Second largest group were students from CPUT (respectively 404, 41.02%).

The vast majority of students who responded were up to and including 25 years of age, representing 47.41% of all respondents.

The majority of students came from households with an annual income not exceeding R 350 000 (64.97%).

Among the types of parental education, "Secondary school" for mothers (443) and "Elementary/Primary school" for fathers (255) dominated, but in the second case there were 403 not available data. The most numerous group were students whose parents had these levels of education (172). For 77 students alone, both parents had a university degree.

Most student's answers were received from undergraduates (844, 85.68%), 1st year of the study (344, 34.92%), those who graduated public schools (887, 90.05%) and were living in a town/city (urban area) before studying (506, 51.37%).

Table 1 presents contingency table for two variables: Sex and Ethnicity. We can observe that the dominant share of student's ethnicity was African (92.59%) and males (57.46%).

Table 1. Sample structure according to Sex and Ethnicity

	Ethnicity						
	Gender	African	Coloured	White	Indian	Other	Total
Count	Males	520	29	11	5	1	566
Total Percent		52,79%	2,94%	1,12%	0,51%	0,10%	57,46%
Count	Females	392	15	1	10	0	418
Total Percent		39,80%	1,52%	0,10%	1,02%	0,00%	42,44%
Count	Other	0	0	0	0	1	1
Total Percent		0,00%	0,00%	0,00%	0,00%	0,10%	0,10%
Count	All Groups	912	44	12	15	2	985
Total Percent		92,59%	4,47%	1,22%	1,52%	0,20%	100,00%

Source: own calculations.

The relation between Sex and Study field was shown in Table 2. It can be note that only at Chemical field of study women form the majority of students. All the others are dominated by males (apart from Civil and to some extent Industrial). Most answers came from students of Electronic and computer and Mechanical studies (32.79%).

Table 2. Sample structure according to Sex and Study field

Sex	Chemical	Electrical	Mechanical	Civil	Industrial	Electronic and computer	Other
Males	32	106	129	39	40	97	155
	3.25%	10.76%	13.10%	3.96%	4.06%	9.85%	12.48%
Females	61	62	60	34	33	37	192
	6.19%	6.29%	6.09%	3.45%	3.35%	3.76%	13.31%
All Groups	93	168	189	73	73	134	348
	9.44%	17.06%	19.19%	7.41%	7.41%	13.60%	25.79%

Source: own calculations.

Table 3. Contingency table for Sex/Different treatment in assessment and marks

	Different treatment in grading system (1 – not at all, 5 – to a large degree)					
	Gender	1	2	3	4	5
Count	Males	414	39	38	38	33
Total Percent		42,03%	3,96%	3,86%	3,86%	3,35%
Row Percent		**73,14%**	**6,89%**	6,71%	6,71%	5,83%
Count	Females	303	31	41	16	24
Total Percent		30,76%	3,15%	4,16%	1,62%	2,44%
Row Percent		**72,49%**	**7,42%**	9,81%	3,83%	5,74%

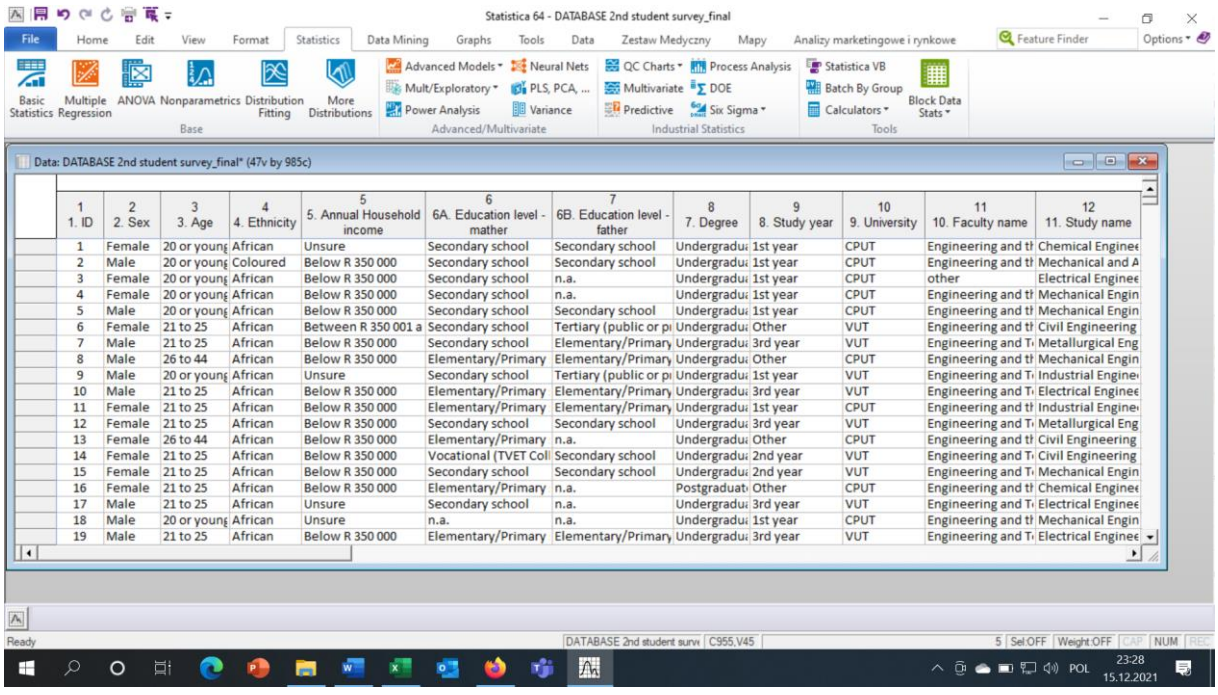
Source: own calculations.

Table 3 includes comparison of two variables: Sex and Different treatment in grading system. It is visible that about 80% of students do not observe any different treatment related to grading system due to their gender. This is really a good proof of equal treatment of students during their assessment process from point of view of their sex at the largest technical universities in South Africa.

Dependence analysis

The relationship of all factors for students enrolment pointed out in the questionnaire points 15.1-15.10, with three student's features: the gender, type of graduate school and place of living before attending the university, was analysed using statistical package STATISTICA 13.3 and the correspondence analysis (CA) method. This statistical tool was comprehensively described in the report related to academic staff (pp.11-12).

Figure 2 presents a part of database.



1 1. ID	2 2. Sex	3 3. Age	4 4. Ethnicity	5 5. Annual Household income	6 6A. Education level - mather	7 6B. Education level - father	8 7. Degree	9 8. Study year	10 9. University	11 10. Faculty name	12 11. Study name
1	Female	20 or young	African	Unsure	Secondary school	Secondary school	Undergradu	1st year	CPUT	Engineering and th	Chemical Enginee
2	Male	20 or young	Coloured	Below R 350 000	Secondary school	Secondary school	Undergradu	1st year	CPUT	Engineering and th	Mechanical and A
3	Female	20 or young	African	Below R 350 000	Secondary school	n.a.	Undergradu	1st year	CPUT	other	Electrical Enginee
4	Female	20 or young	African	Below R 350 000	Secondary school	n.a.	Undergradu	1st year	CPUT	Engineering and th	Mechanical Engin
5	Male	20 or young	African	Below R 350 000	Secondary school	Secondary school	Undergradu	1st year	CPUT	Engineering and th	Mechanical Engin
6	Female	21 to 25	African	Between R 350 001 a	Secondary school	Tertiary (public or pi	Undergradu	Other	VUT	Engineering and th	Civil Engineering
7	Male	21 to 25	African	Below R 350 000	Secondary school	Elementary/Primary	Undergradu	3rd year	VUT	Engineering and Te	Metallurgical Eng
8	Male	26 to 44	African	Below R 350 000	Elementary/Primary	Elementary/Primary	Undergradu	Other	CPUT	Engineering and th	Mechanical Engin
9	Male	20 or young	African	Unsure	Secondary school	Tertiary (public or pi	Undergradu	1st year	VUT	Engineering and Te	Industrial Enginee
10	Male	21 to 25	African	Below R 350 000	Elementary/Primary	Elementary/Primary	Undergradu	3rd year	VUT	Engineering and Te	Electrical Enginee
11	Female	21 to 25	African	Below R 350 000	Elementary/Primary	Elementary/Primary	Undergradu	1st year	CPUT	Engineering and th	Industrial Enginee
12	Female	21 to 25	African	Below R 350 000	Secondary school	Secondary school	Undergradu	3rd year	VUT	Engineering and Te	Metallurgical Eng
13	Female	26 to 44	African	Below R 350 000	Elementary/Primary	n.a.	Undergradu	Other	CPUT	Engineering and th	Civil Engineering
14	Female	21 to 25	African	Below R 350 000	Vocational (TVET Coll	Secondary school	Undergradu	2nd year	VUT	Engineering and Te	Civil Engineering
15	Female	21 to 25	African	Below R 350 000	Secondary school	Secondary school	Undergradu	2nd year	VUT	Engineering and Te	Mechanical Engin
16	Female	21 to 25	African	Below R 350 000	Elementary/Primary	n.a.	Postgraduat	Other	CPUT	Engineering and th	Chemical Enginee
17	Male	21 to 25	African	Unsure	Secondary school	n.a.	Undergradu	3rd year	VUT	Engineering and Te	Electrical Enginee
18	Male	20 or young	African	Unsure	n.a.	n.a.	Undergradu	1st year	CPUT	Engineering and th	Mechanical Engin
19	Male	21 to 25	African	Below R 350 000	Elementary/Primary	Elementary/Primary	Undergradu	3rd year	VUT	Engineering and Te	Electrical Enginee

Fig. 2. Sample part of the database
Source: own elaboration.

15.1. Family and relatives influence

- *Type of graduate school*

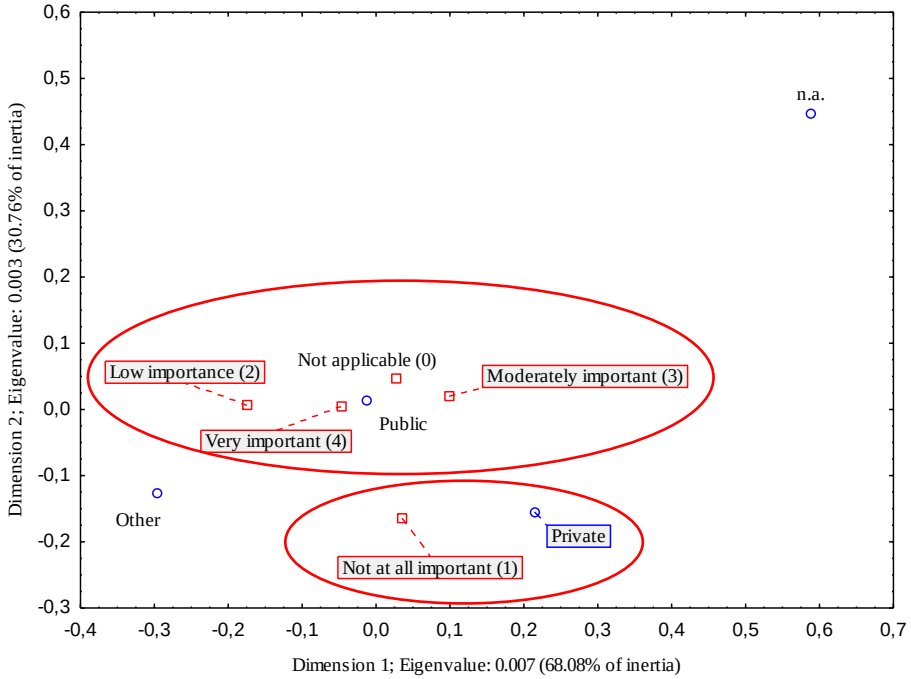


Fig. 3. The relationship between type of graduate school and the factor "Family and relatives influence"
Source: own elaboration.

Interpretation: the graduates of public schools the opinion of family and relatives was important when they decided about the studying Engineering.

15.5. Teachers' influence

- *Gender*

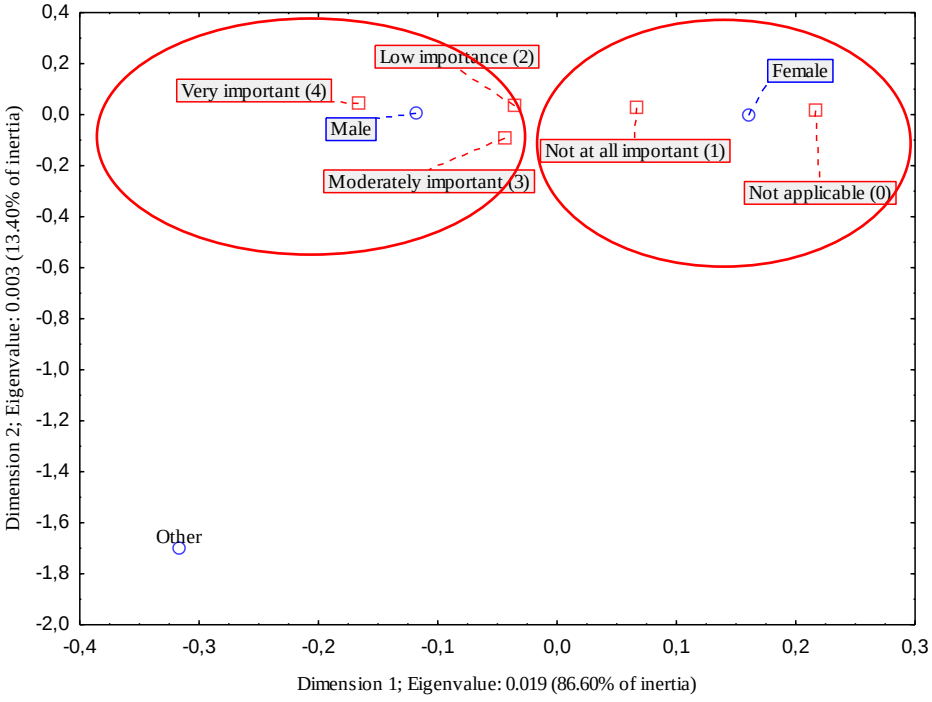


Fig. 4. The relationship between gender and the factor "Teachers' influence"
Source: own elaboration.

Interpretation: teachers' influence is very important for men when they chose Engineering.

➢ *Living place*

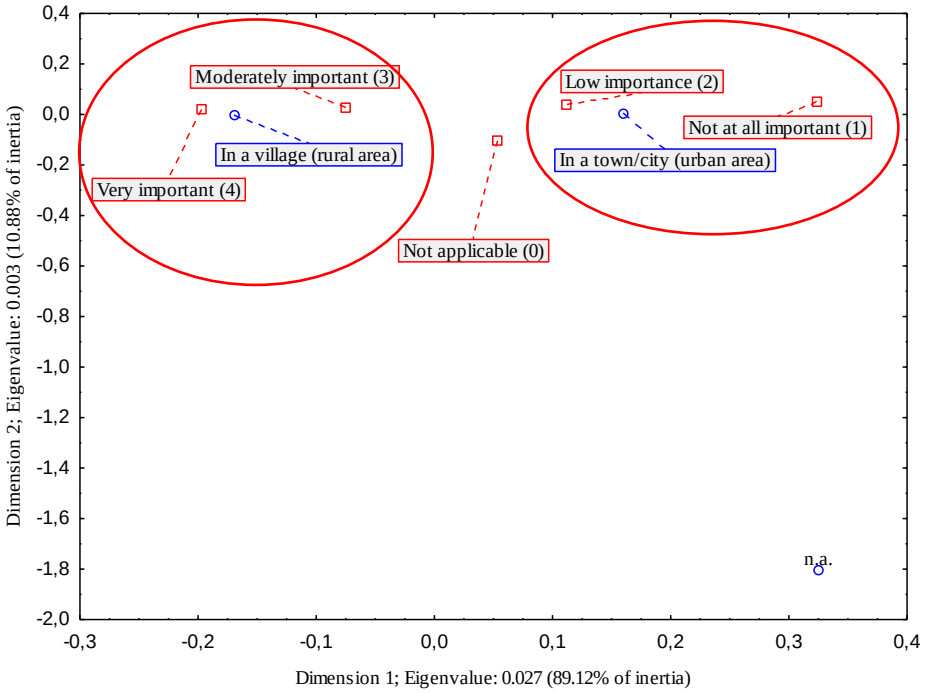


Fig. 5. The relationship between living place and the factor "Teachers' influence"
Source: own elaboration.

Interpretation: teachers' influence was important in terms of choosing the type of study only for these students who were living in a village/rural area.

15.8. Your interest/passion

➢ *Living place*

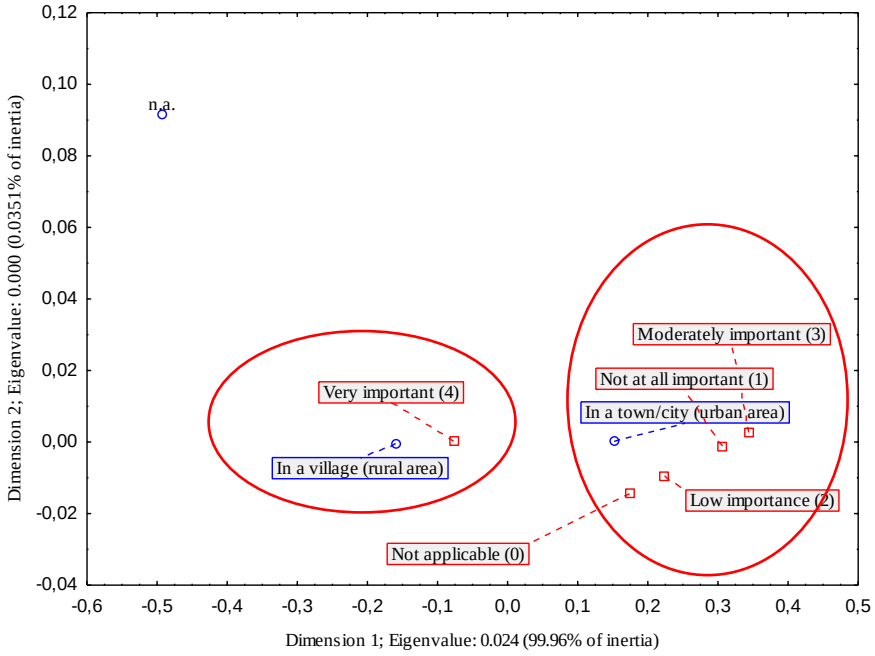


Fig. 6. The relationship between living place and the factor "Your interest/passion"
Source: own elaboration.

Interpretation: when we consider interest/passion of candidates for engineering study, we can observe that especially for these living in the village/rural area, such features are very important determinants to support an enrolment decision.

The same relationship we can observe between living place and the factor "Better job prospects after graduation".

Question 15.10. Future possibilities (earnings, social status)

- *Gender:*

Interpretation: future possibilities are very important for female and moderately important for men when they chose Engineering.

- *Type of graduate school*

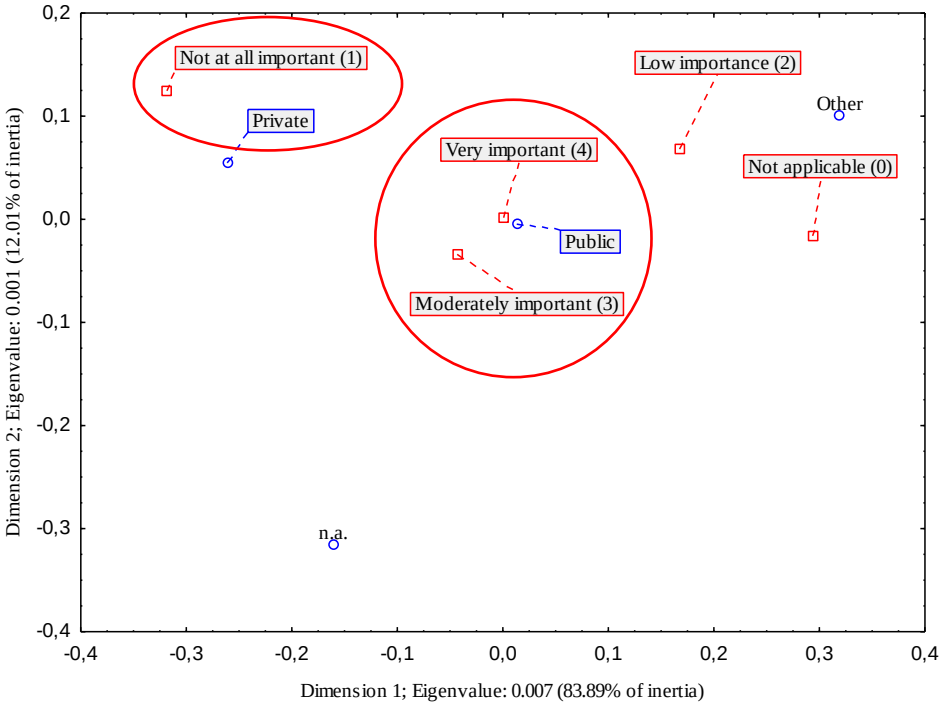


Fig. 7. The relationship between type of graduate school and the factor "Future possibilities (earnings, social status)"
Source: own elaboration.

Interpretation: the graduates of public schools treat future possibilities as an important determinant of their decision about enrolment decision, while for private school graduates such factor has no meaning at all when they chose engineering studies.

The same factor was very important indication to chose Engineering for students living in the village/rural area before enrolment.

To compare the meaning of specific factor that influence (or not) the propensity of enrolment among engineering students the join percentage of two answers „Moderately important" and "Very important" were calculated (see Table 4).

Table 4. The meaning of particular determinant of engineering study enrolment

Factor	„Moderately important" and "Very important" answers (%)
15.1. Family and relatives influence	55.13
15.2. Friends' influence	24.47
15.3. Schoolmates' influence	32.89
15.4. Having an engineer as a family member increase knowledge/interest in engineering	40.30
15.5. Teachers' influence	50.66
15.6. Discussions and workshops with schools and career guidance teachers	65.28
15.7. Your own ability/skills	76.14
15.8. Your interest/passion	82.44
15.9. Better job prospects after graduation	73.30
15.10. Future possibilities (earnings, social status)	63.96

Source: own calculations.

We can assume that three features (15.7-15.9) were the most important for prospect engineering students to choose their university.

The importance of other factors

The importance of chosen variables, assessed by the join percentage of two answers „Moderately important" and "Very important" was presented in Tables 5-7.

Table 5. The meaning of particular determinant of engineering study enrolment

Factor	„Moderately important" and "Very important" answers (%)
17.1. University facilities (e.g. a library, laboratories, sports facilities, dorms)	61.22
17.2. Financial packages and/or scholarships available	60.30
17.3. University reputation	43.25
17.4. Workshops with female during study time – industry or learning environment role models	45.18
17.5. Academic writing workshops for women during study time	50.05
17.6. Other academic workshops during study time (like workshops provided university or gender equality).18	48.12
17.7. Reputation of academic staff	41.52
17.8. Pre-courses to improve math and science (e.g. school programmes, short courses or SETA programmes)	36.55
17.9. Engineering open days (with a specific focus on females)	53.10
17.10. Specific Women in Engineering day	53.81

Source: own calculations.

We can assume that the university facilities and financial packages and/or scholarships available are the most crucial factors from above that influence the potential students to enroll engineering study.

Table 6. The meaning of particular determinant of engineering study enrolment

Factor	„Moderately important" and "Very important" answers (%)
19.1. Identifying, visiting, exhibiting at your school (school career days)	34.31
19.2. Use of social media	25.69
19.3. Recruiting videos showing females in engineering roles	51.57
19.4. Specific mention of bursaries (including bursaries for female students)	58.48
19.5. Engineering related subjects, visits and workshops in school to spark the interest in to Engineering	58.68

Source: own calculations.

We can see that the last three factors are the most important factors from above that encourage potential students to enroll engineering study.

Table 7. Different treatment related to gender

Factor	„Moderately important" and "Very important" answers (%)
21.1. Assessment and marks	80.91
21.2. Peer attitude/fellow student attitude	69.54
21.3. Staff attitude	68.43
21.4. Accommodation access	68.22
21.5. Financial support	64.87
21.6. Advice and mentorship	65.48

Source: own calculations.

Shares of two best valuations ("4"and "5 – to a large degree") for all factors considered above are really high, especially in case of assessment and marks, which was earlier indicated by correspondence analysis.

The distribution of answers designated to the question no. 24 "Generally speaking, are you satisfied with your decision about taking up engineering studies?" shows that 81.22% current students is satisfied with their choice of the engineering study.

4.2. Qualitative analysis

Some of the questions in the survey were related to open questions to which students could express themselves freely. It should be noted that the answer to the descriptive questions was voluntary, so some people answered them selectively. The respondents could answer one or more open questions in the questionnaire, and some students answered very extensively and listed several factors influencing the given area included in the question. Therefore, the interpretation covers all people who raised the problem and it is impossible to sum up the answers and give the percentage share in the answer to the questions. Many of the students' answers indicate an emotional approach to the areas of qualitative questions, so some of them were quoted in the original language version and with the punctuation kept. This may be an added value to this study. The analysis below complements the quantitative analysis of the survey questions. Among 985 students, as many as 766 people answered at least one or more open-ended questions, and 219 did not answer any open-ended question. Interestingly, all the women – 418 people who took part in the survey answered at least one open question in the survey, which shows how important this issue is for women studying Engineering.

Questions 12 and 13

The open-ended questions related to other factors determining the engineering studies was answered by 577 people, i.e. almost 60% of the entire research group participating in the survey, including 235 women, i.e. over 56% of the group of women participating in the study (there were 418 women in total). Table 8 shows the most frequent indications of students, broken down into groups of women and men in terms of motivation to undertake engineering studies.

Table 8. Students' answers related to factors that determine undertaking engineering studies

Factors	Females 235 (40.7%)	Males 342 (59.3%)	Total 577 (100%)
Hobbies or interests, and passion for engineering studies	67 (28.5%)	93 (27.2%)	160 (27.7%)
Influence of the family on the choice of the field of study was indicated by of responses	18 (7.6%)	25 (7.3%)	43 (7.45%)
Favourable financial perspectives, financial freedom and financial aspects	2 (0.8%)	6 (1.75%)	8 (1.4%)
Lack of engineers in South Africa	0	3 (0.88%)	3 (0.5%)
Opportunities and abilities to work in most industries	20 (8.5%)	31 (9.06%)	51 (8.84%)
Better opportunities for life quality	12 (5.1%)	14 (4.1%)	26 (4.5%)
Better job expectations	16 (6.8%)	29 (8.5%)	45 (7.8%)
Future engineering career opportunities	12 (5.1%)	13 (3.8%)	25 (4.3%)

Source: own calculations.

The most important factors motivating the respondents to study engineering, both in the group of women and men, were: "Hobbies or interests and love for engineering studies", "Opportunities and abilities to work in most industries", "Better job expectations", and then "The influence of the family on the choice of studies". Interestingly, in the group of male respondents, the word "hobby" did not appear even once, while as many as 37 men indicated the word "love" in relation to the choice of engineering studies (which constitutes 10.8% of the male group). Among women, the word "love" was used by 14 people (which is about 5.9% of the group of women).

The most inspiring statements about the choice of engineering studies:

- "It was my love for development in our surroundings and finding down new technologies to improve the Civil engineering sector",
- "My passion and drive for technology lead me into perusing this type of study. I went to a technical school and during the time of subject choices I fell in love with engineering and I could see that I have the skill for it. I knew from the first day of learning how to use a centre lathe that this is the career I want to do for the rest of my life",
- "I was good with practical's I knew that because I attended a technical school, so since I loved it I continued with it",
- "Since I was born in a rural area where some area does not have electricity, I always ask myself what can it be done so that these areas can have electricity, what impact can I have to the community and also I have found electricity very interesting in my High school level that's why I decided to go with it",
- "Stemming from the Northern Cape in South Africa, a province rich in minerals (diamonds, iron ore, etc.), studying engineering courses at local TVET colleges seems to be the only way to make a decent living income and one of the little opportunities available to communities in the surrounding mining areas. So I chose to study Industrial Engineering for its phenomenal versatility in any industry in case I don't break ground in the Mining Industry, be it Banking or Logistics. I don't want to feel stagnant with a degree I can't use anywhere else except for one area",
- "I wanted to be make a change to the way I live now. I was interested in designing new building and having to be taught how to calculate how a house or a building material, measurement etc and how I'll make life easier for many people satisfies me",
- "My own abilities, interests and passion and most importantly job prospects after graduation and the earnings",
- "Dream job and all the imagination of being a construction manager. And also having my own construction company. Most importantly I want to be self-employed, so having my own company will make it easier for me. Or owning shares in one of the biggest construction companies is my wish. Also building houses for disadvantaged people is my wish, to do good for poor people, so according for me to do that I knew I must do construction",
- "I love design and infrastructure building", "Black people were never allowed to study during 1994", "I am the first engineer in the family", "I am the first to go to university in my family".

Women also paid attention to aspects of gender balance when answering this question. The following statements were especially inspiring and eye-catching:

- "Gender inequality. Most people don't think women can be Engineers not knowing their capabilities/skills and knowledge",

- “I found a passion for it as soon as i saw that majority of Engineers were male and i wanted to become one to inspire others to believe that there is no such thing as gender roles in any job market”,
- “To eliminate the gender based stereotypes and also to empower myself as a woman and break all the boundaries set in engineering as it is a male dominated industry”,
- “Civil engineering is mostly men dominated and I feel like us women are the key that this field is missing to keep the balance and most people feel like it's a suitable career for men, and also i want to destroy that mindset and show people that us women are also capable and whatever that men can do, we can do it too and most importantly I've always liked the idea of building and designing structures”.

Questions 14 and 15

An important issue raised in the survey were other factors of taking up engineering studies at this particular university where the respondents study. This open-ended question was of interest to 457 respondents. Main conclusions are the following:

– 30 people indicated reputation as an important factor in choosing this particular university,
– 55 students pointed out good examples of graduates and job opportunities, many statements emphasized the possibility of doing internships, financial support, and innovations at universities. These were the main factors influencing the choice of a given university for engineering studies.

Additionally, the responses focused on practical skills and abilities, level of education, knowledge and experience, which was reflected in the responses of 18% of the group. Good resources of the university (equipment, laboratory facilities), location, relations with friends and family were also emphasized. For all the above responses, the shares of responses by gender were very similar.

A few statements of students on the subject of their University:

– “Vaal university of technology has a good reputation of graduates that come into industries. It is one of the Technicon which provides proper structure curriculum in accordance to the SAQA and ECSA of which a technician needs to get into practice. I know many graduates who are doing very well in industries, some are section engineers, operations engineering, etc. VUT is committed in engineering faculty to produce top best technicians as possible”,
– “Because DUT has got a good reputation in engineering and I've never seen DUT graduate who is unemployed so far the delivering great results”,
– “CPUT like other universities of technology give their students first-hand experience as to what is expected of them in the industry. This gives the student practical experience as well as better understanding of their field of study”,
– “CPUT provides practical’s in most module is where we gain knowledge and little experience that focus on only theory part”.

This open-ended question also raised important issues for gender balance, for example:

– “Women empowerment. Well-paying jobs. Various jobs. More careers available”,
– “Female graduate of the University spoke about her time there”.

Question 16

The next question concerned factors related to marketing and student recruitment, and on this basis, students could decide to study at a particular university. Among the answers to this issue, we can find the following statements of students:

- "At school we were told that Engineering industry is in short of workers so we might easily get employment. We were also told that if you are an engineer, you earn a lot of income",
- "Gender equality in engineering",
- "I have chosen to study engineering mainly to better the environment as I would like to be part of the solution of those who come up with ideas in order to make the world better and cleaner in order to widen the lifespan of human beings",
- "Use of social media",
- "Social media with WhatsApp groups sharing the bursaries and other opportunities in the engineering faculty",
- "Females who started their own engineering businesses propelled me to choose this field of study",
- "Open days. Free handouts of application forms",
- "Open day at high school played a very good impact in choosing engineering",
- "When enquiring something from the offices you get helped and given extra information on how to solve your problem",
- "My university provide students with practical's since they are areas or fields of practical's are well designed and has all the needed machinery especially engineering students they tend to graduate with a little bit of experience and knowledge",
- "Exhibition to the school spreading more knowledge and mentioning bursaries, the opportunities that comes with it".

Many interesting statements from students show how important marketing is in the process of recruiting students, it is conspicuous to use modern technologies adapted to new generations of students, but still traditional forms of informing through meetings, open days, university trips, leaflets, etc. are an important element of familiarizing candidates with The university and make the decision to study. Similar statements were made by both women and interviewed men.

Questions 18 and 19

Another important area was related to different treatment related to gender. As many as 178 surveyed students responded to this open question. Most of the men replied negatively that they did not feel any discrimination related to their gender, they did not see such situations in relation to other people. On the other hand, 77 women sent completed, in-depth responses, but as many as 62 women indicated that they did not feel and saw different treatment related to gender. The most common factors were: gender, getting tutors to help, behaviour and empathy. There were several responses about feelings related to different gender treatment during lectures, practices, apprenticeships, job opportunities for women after graduation.

Inspiring statements in this regard concerned:

- “All the factors I felt any different were in a good way”,
- “Being young to be doing this course and the myth of saying most people fail and stay for the longest period at varsity at my age”,
- “During practical sessions I was constantly underestimated but that pushed me to be at the top of my class”,
- “I’ve never felt any different treatment related to my gender”,
- “When doing group works, every girl is expected to lead the group”.

A few difficult statements of students about the treatment cod, worth considering and remedying in the future by universities:

- “Being discriminated because of your body weight”,
- “Being judged/looked down on by male students and lecturers(not all) just because of my gender”,
- “Boys saying what are you doing in Engineering its a course for strong people meaning "boys"”,
- “During metallurgy processes e.g. casting, it's common for the male physical power narrative to be emphasized. It feels like an offence of some sort”,
- “During my first year when a certain lab technician said to the ladies in class its not too late to change from engineering to marketing or food management services course”,
- “Fellow students in group projects expect females to do the paper work and males to do the actual practical work”,
- “I couldn't get a mentor because most lecturers were male, in fact, in all my years of study, I only got ONE female lecturer, therefore it was difficult to approach the men because some would tell us they like us and want to take us on dates. I don't want a date, I want a mentor!!”,
- “Having less opportunities to get a job offer”,
- “In the workshops when we were doing practicals for marks , normally when a female does better than a male it is made a big deal. It makes you feel as if females are not as capable as men are. The tone in which technicians talk to females is not the same as for males”.

Question 20

The next area in the open-ended questions concerned the identification of other possible obstacles, barriers, problems in continuing education, and in this case 616 answers were obtained, of which about 5% were negative, while those related to finances accounted for as much as 71% of the answers, apart from that, health and stress were mentioned, personal factors, the necessity to work, to receive help, to stay in residence, problems with traveling home and the like. 159 women (38% of the group of women) indicated financial factors as the most important obstacles to continuing their studies.

Below chosen examples of students' statements regarding the question about obstacles, barriers, problems to continue study were presented:

- “I am currently funded by the NSFAs bursary but if I continue my studies and a bursary can't fund me I would have financial problems regarding my studies,, as textbooks and school supplies cost a lot. I still currently do not have a laptop as I am still waiting on the funding money to come through,, until then I have to use my phone for online lectures due to the Corona virus”,
- “Mental health has always been an issue to deal with myself as there is a lot of pressure from the family, friends and school”,
- “Mainly due to being unable to smell it makes it difficult to know chemicals without seeing the bottle. I struggle to find a bursary and paying using a Student loan puts a pressure on me and my family”,
- “The challenging is finance because I use NSFAS so has a limit. Also in Electrical Engineering there's no need to study for because you will struggle to get a Job”,
- “Unemployment is very high, I study just to keep myself busy than staying at home. Education is no longer a key to success but poverty. As a woman it's difficult to find a job. I only had a 1 years internship in my life and ever since I have been unemployed, during my internship days I was paid a little as a women than man. Traveling allowances was always given to male students because women were not allowed to drive. We drove with male students and they were given a traveling claim”,
- “Health challenges were the barrier I suffered depression during my studies where I tried more in my power to get the highest results not knowing that Engineering was all about passion and capabilities”,
- “Financial problems would be my NSFAs has not paid off and it's giving me real problems and even thinking of dropping out cause my parents can't afford my school fees and accommodation and groceries”,
- “Dealing with the bureaucracy of our institution truly was insufferable throughout my studies. Getting anything done, be it admin, or registration was never straight forward and many members of staff cared very little if not at all for the students and their plight. This, coupled with poor implementation of new qualifications has resulted in a rift between staff, students and the faculty as a whole. Leaving me with very little faith in the institution overall. Regardless, this hasn't severed my interest or progress in the field of engineering, as at least there, I am not reliant upon the institution as my own expended effort is directly proportional to the end result”,
- “My mental health issues and financial issues are taking a big role because my parents still have to support my siblings and myself since I don’t qualify for NSFAs and i also on the other hand suffer from major depression and anxiety”,
- “I have had a really hard time trying to communicate with my fellow classmates because some just make these ugly comments that has led me to have very low self-esteem. I have had depression because I couldn't cope with the negative energy I was receiving and I couldn't try student counselling because i have not been informed about it till very late. So yeah the only challenges I’ve had was having to deal with engineering people who cannot have a decent conversation with a female with throwing an unacceptable comment to/about females. Things like we are stupid , we never do anything right, we get things easily because

we are "females" and some other inappropriate comments. It not funny because sometimes the people teaching us also take part in bringing us down instead of helping us learn",

- "The challenges that I experienced was when I was given a lot of work to do which is something important but it gave me a lot of pressure, anxiety and stress, and when I was staying at home I had to use public transportation to get to school, sometimes no money for lunch, but now things are quite different since I got accommodation and bursary, but the bursary takes long to give us monthly allowance, which sometimes led us to study hungry",
- "I come from a very poor family. I am currently dealing with some financial difficulties, and I'm unable to pay my fees for the first semester. I have designs to obtain a part-time position in order to finance my studies, but it will likely not be enough to cover the whole tuition and accommodation fee in addition to my normal living expenses. Based on my financial situation. I am requesting a student bursary so that I would be able to carry on with my studies while I work to better my circumstances".

Question 22

In the survey, the respondents were allowed to express themselves freely as an open question on issues important to them, but not previously included in the survey questions. 213 people, including 88 women, took advantage of this opportunity. Most of the comments were positive.

Eye-catching and very optimistic comments include:

- "I am really motivated to study at the university (specially VUT), and to be part of engineer of computer systems, I have graduated on diploma and now I am doing my Advance diploma and I really motivate because is something that I found that is very important and very interested",
- "I like that im learning a skill. I'm happy with my choice of university. Engineering as an occupation , does increase income. Why women have taken a sudden interest in engineering, we don't mind physical work, it's exciting, if social media has proven anything it's empowered us to do more, to be more",
- "Ultimately I feel the reason for choosing an engineering path stems entirely from someone's personality and interests for example most people I have observed to not be particularly fond of working with numbers and studying physics. I've observed that most people, females in particular, when choosing the engineering career path prefer to go into more of a designing path and view certain branches of Engineering as a career path which requires getting your hands dirty or doing labor work so mostly I feel there is a misconception on what the field exposes students to",
- "Please look into this matter and implement changes in women in Engineering",
- "I fell in love with the course I'm doing, I'm very happy with my choice and I understand it and what I'll need to do in the workplace",
- "I'll be able to tell if am satisfied with my decision about taking engineering studies after completing my diploma and start working because varsity and workplace set up are completely different".

There were also inspiring but very general statements and comments:

- “I decided to study engineering as I felt that I could make a difference in this space. My decision was influenced by my childhood growing up with the idea that females are breaking boundaries, we are able to take up spaces which were never meant for us”,
- “I was never really passionate about engineering. I took it because it was the only available course at that moment and I didn't want to take a gap year. But as time went by, I fell in love with it”,
- “As an engineering student who had taken up the decision to pursue my dream of being a qualified quality practitioner, I do not regret making this decision because it serves as a stepping stone to better opportunities”,
- “Passion plays a very big role when you choosing a career”,
- “I fell in love with engineering while studying it but the more I did practicals that’s when I really enjoyed it”,
- “Engineering has gave me a lot of knowledge and has opened my mind, because I've learned to think deeper and solve a problem”.

Among the free statements of the respondents there were also negative or pessimistic comments, and they mainly concerned complaints about current affairs at the university (concerning classes, teachers, exams), financial burdens or the possibility of finding a job after graduation. Below we can find several examples of such comments:

- “I find engineering departments can be very cold and have little to no compassion for their students. Students are aware that it's demanding and difficult but to be told that the real world is like that and doesn't care isn't true. Some of us including myself have worked in different fields before studying engineering and work environments can be empathetic and supportive. Especially during a pandemic that has caused so disruption, faculties and staff could also view the students as humans who need more than just lectures”,
- “The problem mostly starts in the work place where women are treated as less capable than men in my experience”,
- “CPUT's civil engineering department is probably close to being the worst because most lecturers don't really care and we still don't have lecturers for other modules and that makes some of us demotivated in continuing our studies”,
- “I loved engineering and had a passion for it but VUT and its system together with the lecturers have stripped that passion out of me. The engineering community in this university is atrocious. The aim is to complete and submit not to learn and evolve”,
- “Other than the negative points outlined above, I do have to mention that some of the lecturers truly were exceptional, and inspired both myself and other students to push past their limits. It is just a pity that lecturers such as this were lost amidst the rest the rest of the aforementioned issues”,
- “The lack of employment in the engineering field makes me feel like I choose the wrong career, I am been un employed for almost two years. and it's very difficult to get a job as most of the jobs ask for years of experience which makes even harder for new graduates to get a decent job. Most of entry level jobs that become available would require a graduate to have own reliable transport which I don't understand how does a company expect an

unemployed graduate fresh from Varsity to have a reliable car if the company itself cannot afford the car, it is very sad and depressing that when you find a job that you qualify for then you come across such obstacles I wish our government and private sector can do better to create jobs to end unemployment. It does not make sense that companies require 5 years' experience for a Junior position",

- "With the pandemic, I get scared that engineers are not in demand anymore as IT students are. Most engineering jobs are retrenching",
- "VUT has too much corruption to even notice gender based discrimination in its property/institution so there's no need".

5. Conclusions and recommendations

The analysis of the whole process of conducting the survey of students from partner universities from South Africa allows to formulate two types of final conclusions and recommendations.

The first one concerns the formal and organizational side of the survey. We are talking here about the long time required to obtain permission to conduct it. It is a very time-consuming activity, in case of some universities it takes several months. This is due, among other things, to many conditions that must be met in order to obtain the consent of a given ethics committee.

Important elements related to the construction of the survey questionnaire include obtaining precise answers from respondents. The experience gained in this area during 1st student survey has allowed us to develop a different approach to creating possible answers. Instead of allowing the respondents to give their own answers (e.g. department or field name), dictionaries of names/variants that can be chosen by the respondents were developed.

While discussing the technical side of the survey, it is also worth mentioning a number of errors appearing in the answers and a lot of "cells" with not available data.

The second group of conclusions can be formulated on the basis of conducted analyses: quantitative and qualitative. They allow to understand, to some extent, the factor which determines that potential students decide to take up engineering studies, determine the effectiveness of particular tools and channels of promotion of these studies used by universities, as well as determine whether and to what extent difficulties/barriers appear during the study itself. On the basis of the conclusions below, the universities may formulate recommendations and take actions aimed at increasing the tendency of potential students to register for engineering studies, as well as modify their promotion and recruitment system.

The most important conclusions drawn from the received answers are:

- Almost all kinds of study are dominated by males (apart from Civil Engineering and to some extent Industrial Engineering),
- Most answers came from Electrical and Mechanical fields of study (23.86%),
- About 80% students (males and females) do not observe any different treatment related to assessment and marks due to their gender,
- For the graduates of public schools the opinion of family and relatives was important was important when they decided about the studying subject/area,
- Teachers' influence is very important for men as well as for these students who were living in a village/rural area before enrolment when they chose Engineering,
- Interest/passion of candidates was important in terms of choosing the type of study only for these students who were living in the village/rural area before undertaken study,
- Future possibilities (earnings, social status) was the most important enrolment factor for female, the graduates of public schools and for students living in the village/rural area before enrolment,
- Own ability/skills, own interest/passion and better job prospects after graduation were the most important enrolment factors for future engineering students,
- The most popular/effective tools used within the promotional and recruitment process were information about bursary availability and visits and workshops in school.

Appendix 1. Questionnaire

PEESA III STUDENT SURVEY (2)

Dear Madame/Sir,

We kindly ask you to complete the following survey related to activities undertaken within the scope of the project Personalised Engineering Education in Southern Africa (PEESA III) – (reference number 585966-EPP-1-2017-1-DE-EPPKA2-CBHE-JP), financed by the European Union programme Erasmus+ Capacity Building in Higher Education. The project is realised by several South African and European universities. The PEESA III project members are seeking to understand the reasons why women and men have chosen to study engineering . The PEESA III Team will ultimately seek to advise policymakers on how best to encourage female (and male) success in Engineering and related disciplines. Please note that this is a voluntary survey and you do not have to complete it. You can also withdraw from the survey at any stage without any consequences, and may choose to respond only to selected questions. The survey is completely anonymous and its results will be used only for purposes of PEESA III. The questionnaire should take no more that 15 min to complete. Members of the project will analyse answers, draw general conclusions and discuss these during their dissemination meetings. Some results after generalization can also account for scientific considerations. We would like to express our understanding and respect for spending your time on this questionnaire.

1. I understand terms and conditions and want to participate:

- ○ Yes (please continue the survey)
- ○ No (please leave the survey)

2. Gender:

- female
- male
- other

3. Age:

- 20 or younger
- 21 to 25
- 26 to 44
- 45 or older

4. Ethnicity:

- African
- Coloured
- Indian
- White
- Other _____ (please define)

5. Total annual household income:

- below R 350 000
- between R 350 001 and R 600 000
- more than R 600 001
- unsure

6. Your parent's education level is:

Level	5.1. Elementary/Primary school	5.2. Secondary school	5.3. Vocational (TVET College)	5.4. Tertiary (public or private university)
Mother				
Father				

7. Which degree are you studying for?

- Undergraduate
- Postgraduate
- Doctoral degree (Ph.D.)
- Other _____ (please specify)

8. Year of study:

- 1st year
- 2nd year
- 3rd year
- Other

9. University name:

- CPUT
- DUT
- TUT
- VUT

10. Faculty name:

- Engineering and the Built Environment
- Engineering and Technology
- Other

11. Study field (qualification name):

- Architecture and Industrial Design
- Building Sciences
- Chemical Engineering
- Chemical, Metallurgical and Materials Engineering
- Civil Engineering
- Civil Engineering and Geomatics
- Civil Engineering and Surveying

- Clothing and Textile Technology
- Construction Management and Quantity Surveying
- Electrical Engineering
- Electrical, Electronic and Computer Engineering
- Electronic and Computer Engineering
- Geomatics
- Industrial Engineering
- Industrial Engineering & Operations Management
- Industrial and Systems Engineering
- Maritime Studies
- Mechanical Engineering
- Mechanical and Automation Engineering
- Metallurgical Engineering
- Chemical Engineering
- Chemical Engineering
- Chemical Engineering

12. Enrollment status:

- Full time study
- Part time study
- International student

13. What type of school have you graduated from?

- Public
- Private
- Other _____ (please specify)

14. Where did you live before attending the university?

- In a town/city (urban area)
- In a village/rural area

15. Please select the appropriate level to which the following factors were important in your decision to study engineering:

Factor	Not applicable (0)	Not at all important (1)	Low importance (2)	Moderately important (3)	Very important (4)
15.1. Family and relatives influence					
15.2. Friends' influence					
15.3. Schoolmates' influence					
15.4. Having an engineer as a family member increase knowledge/interest in engineering					
15.5. Teachers' influence					

15.6. Discussions and workshops with schools and career guidance teachers					
15.7. Your own ability/skills					
15.8. Your interest/passion					
15.9. Better job prospects after graduation					
15.10. Future possibilities (earnings, social status)					

16. Please list below any other factors which were important in your decision to study engineering:

17. Please select the appropriate level to which the following factors were reasons for choosing engineering study at your University:

Factor	Not applicable (0)	Not at all important (1)	Low importance (2)	Moderately important (3)	Very important (4)
17.1. University facilities (e.g. a library, laboratories, sports facilities, dorms)					
17.2. Financial packages and/or scholarships available					
17.3. University reputation					
17.4. Workshops with female during study time – industry or learning environment role models					
17.5. Academic writing workshops for women during study time					
17.6. Other academic workshops during study time (like workshops provided university or gender equality)					
17.7. Reputation of academic staff					

17.8. Pre-courses to improve math and science (e.g. school programmes, short courses or SETA programmes)					
17.9. Engineering open days (with a specific focus on females)					
17.10. Specific Women in Engineering day					

18. Please list below any other factors which were reasons for choosing engineering study at your University:

19. Please select the appropriate level to which the following factors related to marketing and student recruitment specifically were important in your decision for selecting your University:

Factor	Not applicable (0)	Not at all important (1)	Low importance (2)	Moderately important (3)	Very important (4)
19.1. Identifying, visiting, exhibiting at your school (school career days)					
19.2. Use of social media					
19.3. Recruiting videos showing females in engineering roles					
19.4. Specific mention of bursaries (including bursaries for female students)					
19.5. Engineering related subjects, visits and workshops in school to spark the interest in to Engineering					

20. Please list below any other factors which were related to marketing and student recruitment specifically were important in your decision for selecting your University :

21. During your studies, did you feel any different treatment related to your gender concerning:

Subject	1-not at all	2	3	4	5 - to a large degree
21.1. Assessment and marks					
21.2. Peer attitude/fellow student attitude					
21.3. Staff attitude					
21.4. Accommodation access					
21.5. Financial support					
21.6. Advice and mentorship					

22. Please list below any other factors were you felt any different treatment related to your gender:

23. Please explain any challenges in continuing your studies (e.g. private, financial, health, …)?

24. Generally speaking, are you satisfied with your decision about taking up engineering studies?

- Yes
- No
- It's too early to make a statement

25. Other comments:

Appendix 2. An introductory letter of ethical clearance (University of Szczecin)

UNIWERSYTET SZCZECIŃSKI
REKTORAT
Al. Papieża Jana Pawła II 22a
70-453 SZCZECIN
tel. 91 444 11 72

Szczecin, 24th of November 2020

To bodies and persons responsible for ethical clearance at:
Cape Peninsula University of Technology
Durban University of Technology
Tshwane University of Technology
Vaal University of Technology

ETHICAL CLEARANCE LETTER

I declare that the content of the survey aimed at identifying factors that may increase the gender equality among students in engineering education in South Africa, rise the enrolment rate and recognize the most effective tools of engineering study promotion, to be carried out as part of the project *Personalised Engineering Education in Southern Africa (PEESA III – project reference number 585966-EPP-1-2017-1-DE-EPPKA2-CBHE-JP)* financed by the programme Erasmus+ Capacity Building in Higher Education, complies with the rules on research ethics in force at the University of Szczecin, as well as with the recognized ethical practices and fundamental ethical principles. The survey (content in the attachment) will be conducted anonymously and the respondents' response is voluntary. Planned survey is also characterized by ethical clearance with regards to the European Charter for Researchers. Project members – academic staff members of the University of Szczecin – ensure proper conducting, gathering and protection of data, as well as generating, sharing and disseminating results of the survey, in line with recognized ethical principles and practices. They are familiar with the national and international legal requirements regarding data protection and confidentiality protection requirements, and will undertake the necessary steps to fulfil them at all times.

REKTOR
prof. dr hab. Waldemar Tarczyński

Appendix 3. Letter of ethical clearance (University of Szczecin)

UNIWERSYTET SZCZECIŃSKI
REKTORAT
Al. Papieża Jana Pawła II 22a
70-453 SZCZECIN
tel. 91 444 11 72

Szczecin, 24th of November 2020

To bodies and persons responsible for ethical clearance at:
Cape Peninsula University of Technology
Durban University of Technology
Tshwane University of Technology
Vaal University of Technology

ETHICAL CLEARANCE APPLICATION LETTER

Dear Sirs,

University of Szczecin is involved together with your University in the project *Personalised Engineering Education in Southern Africa (PEESA III – project reference number 585966-EPP-1-2017-1-DE-EPPKA2-CBHE-JP)* financed by the European Union programme Erasmus+ Capacity Building in Higher Education. One of the aim of our activity is identification of factors that may increase the gender equality among students in engineering education at South African universities, rise the enrolment rate and recognize the most effective tools of engineering study promotion. To achieve this goals we have to conduct a survey among students of your university (content of the survey you can find in the attachment).

We kindly ask you to provide the ethical clearance of the survey. We would like to point out that this is the same survey (questionnaire) we have received already your approval and we conducted it at your university in 2018/2019. From our side we declare that the content of the survey complies with the national and EU rules and practices on research ethics. The survey will be conducted anonymously and the respondents' answer is not obligatory. We also guarantee gathering and protection of data, as well as dissemination of survey results, consistent with well recognized ethical principles.

Obtained results of the survey will not only allow to realize the main goals of the project, but will also form the basis for joint presentations and publications of your university employees and staff of the University of Szczecin.

REKTOR
prof. dr hab. Waldemar Tarczyński

Appendix 4. Ethical approval from Vaal University of Technology

Chairperson Faculty Research Ethics Committee
Faculty of Engineering & Technology
Vaal University of Technology
7 June 2021

RESEARCHERS: DR T SUTHERLAND
PROJECT TITLE: PEESA III STUDENT SURVEY PROJECT: QUESTIONNAIRE
QUALIFICATION: NON-DEGREE PURPOSE

Decision: Approved

Ethics Reference Number: FREC/ET/07/06/2021/8.1
Student number: 99937

Dear Dr Sutherland:

Thank you for submitting the above-mentioned research proposal for research ethical consideration and approval. This application was considered through a full review process. Your application has been referred back for revisions, clarifications and resubmission. Through the deliberations of the reviewers, the following points were identified that have to be addressed in order to obtain full approval:

1. The committee requested more information and definition on point 7 of the application : how will anonymity and Confidentiality be protected?

In all correspondence concerning this research project please use the Ethics Reference Number provided above.

Any revisions to the research documents, as shared in this letter, must reach the FREC by 30 June 2021

As the primary researcher you undertake:
To follow only those procedures for which the approval has been given.
To inform the committee should there be significant deviations from that which has been approved;
To report any Adverse Events that might occur, within 14 days of the event (following the Guidelines procedure);
- *To submit to the committee annual progress reports, where your reporting date is 1 November; and*
- *To inform the committee on the completion of the project, when the findings have entered the public domain.*

Lastly, we would like to take this opportunity to you well with your research endeavours. Sincerely,

DR T SEODIGENG
CHAIRPERSON: FACULTY RESEARCH ETHICS COMMITTEE
FACULTY OF ENGINEERING & TECHNOLOGY
VAAL UNIVERSITY OF TECHNOLOGY

Appendix 5. Ethical approval from Cape Peninsula University of Technology

Cape Peninsula
University of Technology

FACULTY OF ENGINEERING & THE BUILT ENVIRONMENT

On **16 March 2021**, the Engineering and Built Environment Ethics Committee of the Cape Peninsula University of Technology granted ethics approval to **Staak, Anthony Peter,** Staff No: **30015451** for research activities related to his research proposal at the Cape Peninsula University of Technology.

Title of Proposal	Strategies to promote the enrolment of female students in engineering programmes

Comments:
Data collection is required

PEESA III Student Survey attached.

	23/03/2021
Prof V Fester **Assistant Dean: Research and Innovation Coordinator – Faculty of Engineering and the Built Environment**	**Date**

2021FEBEREC-ST-003