



Attitudes of female pupils and students toward technology higher education programmes

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Abstract: There is a shortage of electronic, mechanical engineers and IT professionals within some segments of the Hungarian labour market. The ratio of women specialized in these fields does not reach ten percentages. There are several reasons for that, including the strong stereotypes about the professions of women and men. The number of female students graduating from technology programmes at universities can be increased by finding a proper invocation of female pupils and by improving the satisfaction of female students. It is important to understand the conditions under which female applicants opt for such programmes. We conducted a comprehensive qualitative and quantitative study in the school year of 2011/12 to investigate what possible barriers stand in the way of getting more female pupils to apply to academic programmes in technology and what means could be utilized to potentially get more girls to

apply. As part of the study, focus groups with female pupils and semi-structured interviews with teachers were conducted at diverse secondary schools. Focus groups and semi-structured interviews with female students were conducted at the faculties of electronic engineering, mechanical engineering and informatics. There were also semi-structured interviews conducted with five professors from each of the three faculties. Results showed that most female students have friends or acquaintances who work in the field of technology. Our findings suggest the possible importance of obtaining personal impressions of an academic programme or profession in the process of making decision on a career. The pupils and students in the sample rated more favourably the options of promoting more girls to apply to technology studies such as taking part in Girls' Day programmes or listening to a lecture by a female student from the faculty of engineering or informatics. At the same time they dismissed non-personal ways, such as poster adverts, and the male-centred presentations of academic programmes on the homepage of the internet. It is also important to encourage an opening towards the issues of combating stereotypes and promoting equal opportunity in education both for the teaching staff and for the students.

Key words: equal opportunities, technology higher education, IT faculty, qualitative study, focus groups.

1 Introduction

In Hungary, since 2007 a number of policy makers and scholars have emphasized the problem of the lack of adequate supply of technology and science professionals. Educational policy-making has reacted to the problem by increasing the number of places in the relevant fields of tertiary education, which were funded by the state. However, this approach has not solved the quality problems; rather it has contributed to a further decline of quality, because students could get into some of these segments of tertiary education without proper selection, with very low entrance points and with limited knowledge (Fábri, 2008a, Kurkó 2008). It is also a frequent problem that the proportion of students who choose these fields of study is too low compared to the total number of students applying for tertiary education studies. Fewer pupils choose these fields as their first choice when marking their preferences for their tertiary education than the number finally accepted (Kiss 2008).

The decline of the standard of science and technology students and the low amount of interest to study in these fields have been linked by some experts to the media not conveying positive images of scientific innovation (Fábri 2008a, Fábri 2008b), to low understanding of the public of the positive benefits of science (Kurkó 2008), as well to the problems with science education in secondary schools (Kurkó 2008, OKNT 2008, Réti 2011). A 2008 national report states that there are great problems with the way

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science subjects are taught at Hungarian schools. The teachers and the textbooks often do not have a modern methodological culture. Emphasis is often placed on lexical knowledge, instead of placing greater emphasis on practice, for example on having tasks that relate closer to practical problems and on the development of competences (OKNT 2008).

It has been defined as a vital strategic aim in Hungary to increase the number of students applying to technology and science fields to intensify their competition in order to ensure that those who get accepted are good enough. One of the possible means for achieving this goal can be to enable more women to choose these fields. This target is rather essential because the private sector shows higher and higher demand for female engineers and IT professionals.

This paper is structured as follows. Section 2 gives a description of the situation of women in the higher education in Hungary. Section 3 shows the research method applied. Section 4 deals with the results of focus groups and interviews at secondary schools. Section 5 depicts the situation of female students at electronic, mechanical engineering and IT faculties. Section 6 includes the steps forward, and finally we give a conclusion.

2 Women in tertiary education

In Hungary (Róbert, 2000; Székelyi et al. 1998), similarly to the developed countries (Freeman, 2004) there are more women in tertiary education than men. Girls tend to choose going to universities immediately after finishing their secondary school as compared to boys. If they are not accepted, then they persist and a greater proportion of them choose to apply again. They are also more persistent within their higher education studies as well: smaller proportion of them drops out of tertiary education, than what is the case with boys (Liskó, 2003). Many of the boys do not make it to tertiary education in Hungary, as they study in vocational secondary schools which do not enable them to choose universities in lack of a higher level final examination and also as many of them turn to getting qualifications which can be acquired faster than a university degree (Fényes, 2006, 2009).

Girls also have better secondary school results, which is a factor that makes their getting into tertiary education easier. The better results of girls in elementary and secondary schools are explained by the literature with their different study methods and strategies, their greater self-discipline as well as a greater inclination to fulfil expectations which can be lead back to the differences in gender socialization (Rostás-Fodorné, 2003; Horváth - Környei, 2003).

According to Fényes (2009), nowadays even girls' mathematics grades are better than those of boys. There is no difference in the results of the PISA-surveys regarding many aspects of science knowledge between the girls and the boys in Hungary. However,

there is a slight difference for mathematics, with boys having a slight advantage (PISA, 2009).

	2008		
	women	men	all
Education	71,9	28,1	7,0
Arts	57,6	42,4	2,7
Humanities	66,6	33,4	10,4
Social sciences	64,4	35,6	9,4
Business and management	58,8	41,2	19,7
Law	62,5	37,5	4,2
Sciences	49,6	50,4	4,8
Informatics	13,1	86,9	4,3
Engineering	18,9	81,1	17,3
Agronomy and animal health	47,3	52,7	2,5
Health and social sector	68,2	31,8	10,1
Services	60,2	39,8	7,8
Total	52,6	47,4	100,0

Table 1
Percentage of students participating in the bachelor and master level higher education by gender and by subject in Hungary in 2008 (%)
KSH, SzMM, 2009, 62. p.

There is a horizontal segregation within tertiary education in Hungary: some fields are dominated by female students, others by male students. The gender segregation is deepest in informatics and engineering where the rates of men is 6,6 and 4,3 times higher than that of women. Within mathematics, science and technology academic programmes the rate of men is more than 3,5 times as high as that of women (excluding the fields of life sciences and environmental protection). Female students are more successful in obtaining a degree even in these fields: a lower proportion of them drop out of universities and a higher proportion of them obtain a degree than the proportion within male students (NEFMI, 2006).

Thus, in spite of the higher number of women in tertiary education, they are in a significant minority in engineering and IT academic programmes. The small proportion of female students in these fields has also been defined as a problem in several societies. The causes of the problem were linked to gender stereotypes among teachers, students and members of society and to shattered self-esteem of girls (OECD PISA, 2006;

Spencer et al, 1999). Combating gender stereotypes and promoting equal opportunity in education have been set as one of the aims of the European Union (European Parliament 2006). To get more girls to study in technology related fields Germany and in other countries started various initiatives such as Girls' Day, where girls could visit companies with technical departments, laboratories, where they could get personal experience and talk to the employees of the organization. Some universities have started new interdisciplinary academic programmes with the aim of reaching more female students. According to German experiences in these interdisciplinary academic programmes, such as media-informatics there is a greater proportion of female students than in more traditional technology programme fields such as mechanical engineering (Csekei, 2008).

3 Method of the research

We conducted a comprehensive qualitative and quantitative study in the school year of 2011/12 to find a proper way of the invocation of female pupils and to find how we can improve the satisfaction of female students. We were concerned with the experience of female pupils and students at the schools and the university. Professors gave gender-specific answers regarding the preparedness, performance, motivation and the labour market perspectives of students.

We applied focus groups, which is a type of group interviews (Vicsek 2010). As in our case, focus groups can be a good method for interviews, because the research is explorative in nature and we want to get a rich, deep and nuanced description of the phenomena under investigation. One important constraint of focus group research is the limits of generalization (Vicsek 2010). This problem has to be taken into account especially here as we have conducted only a very small number of focus groups. Thus, we can state that the results are true for this group of girls and can only make assumptions that what we had found here might apply to other female secondary students as well in Hungary – but we do not know it with high confidence.

As part of the research, focus groups with female pupils and semi-structured interviews with teachers were conducted at three secondary schools in October and November of 2011. The girls in the sample all wanted to study in tertiary education and basically all were in the last year of their secondary school studies and had to decide which university to apply to within months from our research. One group was composed of 11 girls from a medium strength high school in Budapest and all the participants had good grades in math. The other group was composed of 9 female pupils of a secondary school in Budapest where it was also possible to specialize in technology. In the third group there were 12 girls who specialized in math and studied at a strong secondary school in the countryside.

All group sessions took place in one of the classrooms of the schools, and lasted approximately one hour. The semi-structured discussion was based on a guide containing questions first on where they intend to study and how they decide, then

focusing on technology academic programmes and gender issues. There were also questions on what tools they thought would help in getting them or girls in general to choose technology academic programmes. There was no video recording as some of the questions involved sensitive issues with respect to giving opinion on teachers and we felt that the students would talk more freely if there is no visual recording, where the possibility of identification would have been even more obvious. We have also organized semi-structured interviews with teachers at the same schools, who were either teaching science subjects or were homeroom teachers.

Focus groups and semi-structured interviews were also conducted with female students from the faculties of electronic engineering, mechanical engineering and informatics. Each of the three group sessions was consisted of 6 or 7 students and took place at the university, and lasted about one hour. To facilitate an open discussion of participants, no video record was taken. The participants of the semi-structured interviews were in their first year, while in the focus groups the students were from upper years. The focus groups and interviews were moderated by one of the authors, Erzsébet Takács.

There were also semi-structured interviews conducted with five professors from each of the three faculties. We have chosen those professors who have experience of several years in the education of technical subjects and have lectures or seminars with about few hundred students each semester. At least one woman and the vice-dean or the coordinator from every faculty was among the interviewees. One of the authors, Beata Nagy conducted all the interviews. All focus group sessions and interviews were voice recorded and then transcribed.

4 Viewpoints of pupils

4.1 Knowledge about technical academic programmes

Moderator: What do you think is the difference between an electronic engineer and a mechanical engineer?

Bianka: An electronic engineer does not need draw.

Moderator: Are they interesting or boring professions?

All (together): Boring.

Moderator: Why?

Évi: You cannot hear about them.

The pupils in the focus groups knew extremely little about technology academic programmes and about what technicians actually do. However, tasks related to such jobs were labelled as “boring”. In many cases the students had a misconception regarding the tasks of IT professionals, such as conceiving of them as only doing

programming. The girls' own stereotypical views of the investigated professions created a barrier to some of the girls to choose IT academic studies. It was a barrier even for those who were quite good at informatics at secondary school. Mainly only those students had greater knowledge of the tasks connected to these professions, who had family members who were engineers or IT professionals. However, these students also expressed stereotypical views to a lesser extent.

The content and quality of science subjects at the secondary schools also determined the expectations of technical programmes. The negative experiences with and the bad (or not so good) grades of the science subjects at the schools created a barrier, at least mentally in the way of choosing technology academic programs or science programs.

In all groups it was the dominant opinion that boys were more interested in technology and the related careers and that it was mainly men who did this kind of jobs. This view can potentially operate as a self-fulfilling prophecy: girls who might be otherwise interested in technology studies might feel that they are not like typical girls and this might pose a problem for their gender identity, which in turn might reinforce their other kinds of interests. Although many of the girls argued that the fact that these professions are held to be "masculine" did not influence their choices for study, many teachers expressed the strong belief that this *was* an important factor in both the eyes of the girls and their parents.

4.2 Self-confidence in technical fields

The lack of interest in technology academic programmes was argued to be caused by the inherently different spheres of interest of boys and girls, but the different result of gender socialization was not mentioned (although it was mentioned that there are exceptions). For some of the girls who would have been interested in studying technology, low self-esteem set up a barrier. They were afraid of not being good enough and of dropping out of the university. Stereotypes set up a barrier for them to apply to technology studies as it seemed to reinforce their low self-esteem. In some cases they met with negative attitudes even within their own families:

Betti: For me the major thing that sets me back is that I feel that men treat women negatively in this respect, they are of the opinion that I would not be able to learn as fast as them how machines work, as I have less experience... My brother, he is always occupying himself with these things (machines), and if I do not know something, then he instantly says, that I am stupid, and that this is because I am a girl... They discourage us.

Some girls: Yes.

Betti: Yes, you feel that you are stupid and you should not follow that road just because you are a girl.

Moderator: Who discourages you?

Alexa: The men (laughter).

Natália: Those, who know these things better, and then if you try to do something for the first time, such as writing a programme or something like that -

Zsóki: Then they do not even give you a chance...

Some pupils expected discrimination in the labour market as well, because often it is expected that men have greater experience in technology related fields. Some of the girls themselves interiorized the belief that men have greater experience in that field and it was a factor towards choosing a different profession. Teachers have emphasized that female pupils are aware of the biases against women in technical professions, which make a much higher level of their performance necessary if they want to be accepted.

4.3 Behaviour in science classes

Many of the girls claimed that the boys got more attention from the teachers, they were the ones who were most often called to answer teachers' questions, they were more loud and confident, and asked more questions during class. Some of the attention from the teachers could possibly be led back to the fact that the girls obeyed the school rules to a greater extent, whereas some of the boys had to be „disciplined”. However, this greater attention from the teachers can also convey a hidden message that the success of boys is more important than that of the girls. In those cases when they asked help from teachers, most girls claimed that teachers were usually very helpful with them and stated that they had no experiences with teachers treating negatively based on gender stereotypes. However, one of the participants mentioned that all the girls were automatically put into the lower level math group. The girls choose very rarely the higher number of the classes of physics. One of the participants mentioned that they had a teacher who had a negative attitude towards the girl students:

Évi: What I saw in physics class was, that I think the teacher has the attitude that this is something the boys love and know well.

This kind of attitude from some of the teachers can work as a self-fulfilling prophecy: the girls can feel that they are perceived to be less good, and can be less confident, while boys on the same level of knowledge might consider themselves more talented.

The teachers of sciences themselves stated that the girls are diligent, while the boys are more clever, but lazy. Learning strategies by gender were considered significantly different and were evaluated differently: preciseness on the part of girls was rated less favourably than the reflectiveness on the part of boys. The gender stereotypical attitudes of the (female) teachers toward pupils exist in spite of that they know about their disadvantageous impacts on the performance of girls and women.

4.4 Role models

Parents seemed to play an influential role in the study choices of some of the students. There were cases where parents pushed their children into different directions according to sex:

Évi: My parents influenced me in this respect. My father is very maths oriented, and because of this my brother was told that he should be an engineer, and he tried real hard until he realized that he didn't want to do it... In my case, I was told that I was like my Mom, and my mother told me, I did not necessarily have to know it (math).

The lack of female role models and examples can also contribute to girls not preferring technology related studies or professions. The girls are in a difficult situation as in many cases from the books, advertisements, television programmes, movie films they meet with stereotypical portrayal of women and their professions. This has the result that in the majority of cases the girls do not meet with female figures who work in these fields and who could serve as role models. The majority of the girls in our sample knew no female engineers or IT professionals.

Teachers regarded traditional gender stereotypes and expectations of roles as important factors behind that girls wanting to settle down in the future feel difficulties to conciliate the work on technical fields and the responsibilities at home. As the models of female engineers and IT professionals are missing in their lives, female pupils may feel that they should choose “girlish”, “easier” professions due to social expectations. Because of the fear that technical professions do not fit into the image and roles of a women, they are not actually inclined to choose these fields. However, the teachers in the interviews emphasized, which fits well into the explanation above that in the case of girls who have applied for technical higher education programmes they were always in a *special* situation where the model of parents in the field of engineering or science served as a base for choosing a profession of engineers and IT. A teacher interviewed also mentioned that one of her pupils decided to choose a technical profession instead of a trendy, well-paying occupation when she took part on an open day.

5 Viewpoints of students

5.1 Motivation

In accordance with the findings in the literature, majority of the female students in the focus groups have a father, a grandfather working in the field of technology, or a brother, a sister taking part in the technical higher education. Also the impact of friends and of teachers of the secondary school was significant. Every student had in their environment some models of the faculty chosen. Many of the students were engaged in tinkering since childhood and were aware of the characteristics of the jobs of engineers or IT professionals. As a motivation were also mentioned the chance to get accepted in the profession, the possibility of a career and getting a well-paying job of high prestige.

Angi: I had such an experience, since I worked as an engine-fitter. There were my bosses who were quite interesting, and were great male persons... they did simply not accept that I really knew anything. So this was my motivation to get able to do those things which they can do also. So to get accepted in this profession, because my boss

always stood next to me and saw what I did, although I always do everything flawlessly, since I do the same activity at home as well, when I am just at home... It is my motivation to graduate from a university and to get considered as a human being in this profession.

Szonja: I totally agree.

5.2 Role of parents and teachers

Although many students had a relative familiar with technical fields, this situation was not exclusively equivalent with a support:

Panni: I was told (by my parents) that I can do anything you want to do, but they were rather against it, that I should not do it, because you are a girl, what you want to do there, because you do not have any chance there. I say that it does not matter, we will see who laughs at the end. And it seems that it is me who will laugh because I see in the eyes of my parents, especially after the new laws of education, that I have really had a good decision ... It was all right, the application (of my brother) to the faculty of mechanical engineering, but what I want to do there, they did not know.

Similarly to the parents, teachers also had an ambiguous role during the choice of career of female students. Some of them provided specific help in attaining their target, but there were cases where the incredulity of teachers lead to an attempt to deter the pupils from their objective to get for technical higher education programmes.

5.3 Experience in the university

The level of difficulty and the structure of university studies might have been significantly different depending on the students' previous expectations. General complaint was, however, about the cool university atmosphere, the closeness of students, the unpoliteness of boys and the lack of companionships. Almost half of the students planned to study further on to get an MSc degree. However, they think that this aim can be attained by working and attending a correspondence course at the same time within few years after their graduation.

Léna: To my opinion as well, anything can be acquired, if somebody decides on that ... I was constantly asked that what an engineer does. And I could not reply for a long time and now wherever I look, I could not see anything in which I could not discover that one and all is our work.

The professors at the university all conceived that female students are more diligent, devoted, purposeful, and more conscious when they choose the technical career. The male students were considered more creative and more informed in the field of their speciality, but the social abilities (motivation, being organized, discipline, consciousness, kindness) of female students were exclusively regarded much more developed, which has a very beneficial impact on the organizational culture.

5.4 Stereotypical thinking

Every female student in the focus groups told about that their choice to become an engineer or IT professional arouses, in their environment often and among the strangers regularly, amazement:

Szonja: ... you are a female IT professional, hem ... that is like a guinea pig, neither maritime, nor pig. ...

Many of the students in the sample was faced with the criticis that they would become unfeminine and would wear checked shirts and other boyish clothing. For these women such stereotypical approach did not cause any dilemma during their career choice, because they either loved that field since their childhood or this problem did not occur to them in the years of secondary schools.

5.5 Advantages or disadvantages because of the minority status

Many of the students benefited from their minority status that is male mates promptly and willingly gave help if they had a putative or real problem related to the university. All the students mentioned the help on the part of professors. There were supportive behaviour, concrete help in the special field and permissive, or rather scornful attitude. In some cases discrimination might have seemed positive but it was rather negative, hurtful:

Bianka: I have received an easier assignement, I could choose which I want, and he said: this will be suitable for you, this is the easiest one, this will be done for you by head by everybody on the corridor, even the receptionist..

Disadvantages caused by the minority status were told without any related question by the moderator:

Móni: I have received that ... a girl's place is in the kitchen.

Mária: They might have said that like a joke ...

Klára: At the faculty of electronic engineering I have not received it, but ... because of my boyish bringing-up and my engagement in such boyish activity, I was told to get thee gone to the kitchen ...

The adaptation to the culture dominated by the male majority does not seem difficult for the students interviewed. However, it is really problematic that even these female students, aware of and resenting the gender stereotypes, use similar stereotypic expressions against women, when they describe other female mates. The restraints to prove themselves in the everyday life may lead to various mechanisms to protect themselves and to counter that they would be "others" (than the male students). On the other hand, the hick and male chauvinist comments on the part of male students seem to be closely related to the decisions of female students to quit the university.

On the part of the professors the students received various negative, but also some positive comments concerning their gender. The jokes may seem unharmed, but they certainly contribute to the survival of gender stereotypes.

6 Measures to inspire girls to choose technical higher education programmes

The pupils and students in the focus groups as well as the teachers in the interviews underlined that it would be particularly important if female secondary students could acquire greater knowledge of the opportunities in technology tertiary education and in technology professions, as they hardly have any knowledge. The girls were enthusiastic about possibilities that would somehow allow them to get direct personal experience or get into personal contact with representatives of the profession or technology students. Such options included taking part in Girls' Day programmes (where they can get to see what members of a profession do by visiting a company and where they can even try out a profession for a day), or hearing lectures from successful female engineers or IT professionals, or hearing the experiences of alumni students of their secondary school who studied in tertiary technology education, or taking part at the open days programs at universities. Non-personal ways of gaining information, such as poster adverts of academic programmes being put up in secondary schools, were rated less positively. Visual media was considered by the students significant „to kill stereotypes”: to present female students in situations not stereotypical, to increase the self-confidence of potential girl applicants, and to give a real picture of the content of studies and professions. The pupils are interested in the practical side of studies and the students' life. and they would The influence of personal experiences was emphasized recurrently by the research subjects:

Lilla: It would be good to meet with such a woman: then you could see that there is a woman in the profession if they came to our school to tell us that this is really not bad for girls either.... An open day is I think an important possibility,... so that girls can go to a workplace and look around. If there could be workers there designated, each of them to students and they show the girls around, they try to work together. I think it is really important for the girls to see what these people actually do, how this and that works...

Those girls who had low self-esteem would have found it a good solution, if they had a mentor from the university to help them. In that case some of them would have been more likely to choose to study the investigated fields. According to the opinion of our research subjects, girls in general and they themselves as well would be more interested in technological academic programmes, if they were paired with other non-technology fields.

Conclusions

The opinions of female pupils, teachers and professors in the research are strongly influenced by the related public opinion. They generally accept the present gender gap and do not strive for the progress towards equality, in spite of that many pupils and students suffer from discrimination. They are not aware of the importance of equal opportunities. Gender inequality is a general social issue and pupils' and students' gender relations at schools and at the university is only one of its manifestations.

To widen the potential scope of talented applicants and to meet the demands of the private sector for a higher number of female engineers and IT professionals, it is vital to attract more women to the field of technology. The faculties should deliberately work out plans to implement those steps which are considered important by pupils and students interviewed. There should be an effort to join with and institutionalize the support of professors sensible to the problem of inequality and to create a mentoring system to encourage female students. A support should be given to establish a professional organization and to start special programmes for female students (within e.g. preparatory course). The faculties should invite female technicians as role models, and multinational companies that have committed themselves to equal opportunities. It is imperative to open towards the issues of combating gender stereotypes and promoting equal opportunity in education both for the teaching staff and for the students.

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