Gendering technical professions and secondary school science education in Hungary

Valeria Szekeres, PhD.

Óbuda University, 1084 Budapest, Tavaszmező u. 17, szekeres.valeria@kgk.uni-obuda.hu

Abstract: Formal schooling is a major agent in reinforcing cultural expectations for males and females. Socialization in schools occurs through various channels such as classroom interactions and subject choices. Girls may feel obliged to fit into a pre-determined stereotypical model of femininity. The paper deals with gendering technology and secondary school science education. The research was based on focus groups with female students and interviews with teachers about familiarity and feelings concerning tech fields and the factors behind.

Keywords: gender beliefs, STEM, secondary school, higher education

1. Introduction

A fundamental way to express gender is through technology. Technical skills or lack of them basically shape masculinities and femininities. In Western societies men are regarded as possessing a kind of natural affinity with machines and technology to such a great extent that technology is coded male. On the other hand women are supposed to dislike it, which is originated in their totally different engagement in the past. Men are viewed as being enthusiastically involved in making and tinkering with machines. Women also use machines, but are considered to simply be just beneficiaries of inventions, passive in relation with machines. Women are characterized by using machine without any deep understanding or affection (Bray, 2007). Meanwhile in modern societies gender is having the power to enact what is recognized as technology: washing machine is not a technology when used for washing clothes (by a woman), but becomes technology when it is repaired (by a man). As a consequence gender is also closely related to the determination whether skills can be categorized as negligible or significant.

Gendered attitudes and beliefs are featured in throughout of social institutions. From the viewpoint of striving for a deeper democracy that can be achieved

through the establishment of a greater gender equality, an important goal of analyses is to understand how technology is implicated in the (re)production of gender inequality. Even though women constitute the majority of the students of higher education in the developed world, the relatively low number of women in fields related to science, IT or engineering is widespread. According to traditional expectations for boys and girls, students are treated differently by teachers. Knowledge is also gendered and certain fields are seen as masculine, whereas others as feminine.

Secondary schools play an important role in this respect because they may further foster and support societal stereotypes for gender behaviour at the same time when students face with difficulties of career choice. Teachers, however, may contribute to dismantling fears and encouraging ambitions towards fields not expected by gender. The views and expectations of technical programmes may significantly be influenced by the content and quality of science subjects at the secondary schools. Negative experiences in the class and/or bad marks obtained in subjects of science may create a mental or a real barrier deterring girls from technical/science academic programmes.

In this article we analyse the gender conditions that may exercise a significant impact on the career choice of secondary school female students concerning tech fields in Hungary. Section 2 summarizes some of the main findings of the researches on gender issues in science education. Section 3 gives the methods of research. The results of research can be found in section 4. In the following section there are some suggestions by students to make technical programmes more attractive. Finally we give concluding remarks.

2. Review of literature

Cheryan et al. (2016) draws attention on that STEM (science, technology, engineering and mathematics) is not uniformly hostile place for women. They proposed a model with three overarching factors to explain the larger representation of women in certain fields, like biology and mathematics than in others, e.g. IT and engineering. First, due to their hostile masculine culture ("chilly climate"), certain fields can work against women. Masculine culture implies stereotypes of people in the fields, negative stereotypes of women's abilities, and lack of female role models. The second factor, although having a less potent explanation, refers to the early scarce experience with computer science and physics, which may imply a limited number of course offerings and insufficient freedom to choose courses. Computer science is an example of fields where the culture has been "made masculine". Seeing other girls and women in courses helps avoid stereotype threat and weaken association between STEM and males. The third factor is the gender gap in self-efficacy, or the disparities between women's and men's

confidence in their abilities. Self-efficacy is the belief about one's capacity to be successful at a certain task. Mann and DiPrete (2013) indicates that gender gap in subfields other than life sciences is wider than it was ten years ago.
Riegle-Crumb and Humphries (2012) explored, with the help of the theories of intersectionality whether gender stereotypes about math ability shaped high school teachers' assessments of their students resulting in the presence of bias. The bias measured implied explicit as well implicit bias referring also to unintentional behaviour or an orientation that the person wants to conceal. Such implicit stereotypes might be more common than explicit ones among contemporary cohorts and in certain cultural circumstances. Riegle-Crumb and Humphries (2012) found that teachers held the belief that math was easier for white males than white females across all course levels. They warn that occurrence of bias in high schools likely function to maintain and reproduce inequality "throughout the math pipeline". They also referred to researches in various fields, one of the most important is that of Correll (2001) giving evidence of the persistence of stereotypical beliefs that, relative to males, females have inferior ability in the field of math which is a key gatekeeper to elite occupations in science or technology. Using longitudinal data of junior and senior high school students, Correll showed that girls attributed less math ability to themselves than did boys with the same math test scores and grades. Correll (2001), among others, also points to that internalization of such stereotypes by young females inhibits their performance on math test and weakens their feelings of self-worth and competency. Legewie and DiPrete (2014) argue that strong math and science curricula have a great effect on the STEM orientation of girls. Supportive school environment plays an important role in the strengthening/weakening of gender stereotypes, and is particularly beneficial for disadvantaged groups, like girls in the case of STEM interests. They are less concerned, compared to boys about violating gender stereotypes. Researchers and policy makers are encouraged to take seriously the potential impact of high school interventions on girls' STEM orientations. It also found that less gender segregation in extracurricular activities reduces the gender gap in science orientation.

Chapman (2013) noted that gender socialization in schools and a gender biased hidden curriculum work against gender equity, and girls are short-changed in the classroom. Teachers socialize them towards having feminine characteristics like neatness and quietness, while boys are encouraged to be creative and active. Gender bias is embedded in textbooks, lessons and the interactions of teachers with students: contributions of women are often omitted and their experiences are tokenized, while gender roles are stereotyped. Men are described as being brave, bright, and powerful, and women as being passive and invisible. Educational sexism imparted explicitly or implicitly to students is a huge challenge to be dealt with in order that girls could unfold their gifts. Buchmann et al. (2008) mentioned gendered norms within families as another source of constraints which may cause basically different educational pathways for girls and boys.

3. Research methods

The qualitative research[41] was carried out in a teamwork with Erzsébet Takács (Eötvös Loránd University) and Lilla Vicsek (Corvinus University). We organized focus groups with secondary school students and semi-structured interviews with their teachers in the schoolyear 2011/12. The students involved in the groups were in the last year of their school and planned to study in tertiary education. In the first group there were 11 girls who studied in a medium strength Budapest secondary school and had good grades in math. The second group was composed of 9 girls from a Budapest secondary school with a possibility to specialize in technology. There also was a group of 12 students from a countryside strong secondary school who specialized in math.

The group discussions were carried out in one of the classrooms of the schools, and took about an hour. The semi-structured conversations first included questions on where the participants intend to study and how they decide, and then focus was on technical academic programmes and gender issues. After, there were questions on what tools the participants thought would stimulate them or girls in general to choose technical academic programmes. At the same schools we have also made semi-structured interviews with teachers, who were either teaching science subjects or were homeroom teachers. The questions included similar topics as those for students and regarded the factors behind the choice of career or gender differences in performance in science classes.

4. Results of research with female students

The focus groups with female students provided a look into the life of three secondary schools. In order to get an insight from the other side, there also were semi-structured interviews with their teachers being involved in either the problem of teaching science or further education and career choice. Although the vast majority of teachers in secondary school education are women, we succeeded in getting men at each school among the interviewees.

41 The research project was a part of the gender sub-project of TÁMOP 4.2.2/B-10/1-2010-0020. The Hungarian acronym TÁMOP refers to the Social mobility programme of the European Union.

4.1. Familiarity with technical academic programmes

Each focus group discussion gave an impression that the students knew very little about higher education and much of their information stemmed from the Internet. However, according to them, universities only have limited amount of information interpreted easily by secondary school students on their web-sites. A further source of information was the talk of their friends studying at universities. Besides the little knowledge about higher academic programmes, the students knew very little about what types of professions existed and what the concrete content of professions was (excepting few well-known occupations).

The participants of the focus groups knew extremely little about technical academic programmes and about what such graduates actually did. Students had scant knowledge of the market demands and salaries such professionals had, or they were not fascinated by the good salaries of such experts.

Moderator: What does a mechanical engineer do?

Mazsi[42]: I have no idea.. Maybe, he[43] thinks out how things are put together, or tests them once they have been put together, I don't know.

Panna: He makes plans.

Someone: Plans?

Anna: I don't know.

Mazsi: He plans the heating of the buildings, the piping....

Eszti: But that's the architect's job, isn't it? ...

4.2. Feelings about technical academic programmes

Notwithstanding the lack of knowledge about technical fields and simply because the students did not hear them, tasks related to technical occupations in question did seem interesting for the students. The negative attitude evolved in such circumstances might be connected to the media's role conveying rarely information about jobs in such fields.

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42 The names of the participants involved in the focus groups and interviews were changed to protect anonimity.

43 Although in Hungarian the singular third person has no gender, unlike „he" does in English, when participants talked about a singular third person, it was translated as „he".

Moderator: Are they interesting or boring professions (electronic engineer and a mechanical engineer)?

All (together): Boring.

Moderator: Why?

Évi: You cannot hear about them.

However, in the focus group of the Budapest's stronger school, students had quite a few IT experts and engineers among their parents and brothers, there were less stereotypical statements, or they were confuted on the basis of the examples of the relatives.

Janka: My brother is a programming mathematician. But he is a cube. He is very, very good at maths. And he has interesting tasks, for example … he makes a GPS system.

Ibolya: My father's job (electrical engineer) is interesting in my opinion,… he plans a lot of things, fountains, small cars, and so.

Janka: And he has an own workroom … full of with various inventions, and I said at home that he is an inventor … So it must be interesting, if somebody is an insider and familiar with that …

In many cases the students in the groups had a mistaken belief about the jobs of IT experts. They thought they only included programming (while usually one third of the tasks of an IT professional consist of programming (Collet, 2006)). Stereotypical views of professions deter some of the girls from IT studies. Even those who were quite good at informatics at secondary school were inclined to decide on different careers. Generally only those students were familiar with the tasks of an IT expert, who had relatives dealing with IT. But these students also expressed, although to a lesser extent stereotypical views.

Moderator: What image do you have of what an IT professional does?

Anna: He sits at a machine.

Someone: He does programming.

Someone else: He puts in the program and there are numbers running across the screen ... (laughter) and he snaps...

The lack of knowledge about jobs in technical and IT fields among the students interviewed seems quite severe. It is also problematic that even the curiosity seems absent in these girls, which can be rooted in the not so interesting presentation of science by the media. Instead of its function to inform people about technology, personal relationships fulfil this role.

4.3. Gendering technology: free choice or gender-tracking?

Discussion about the choice of career in technical fields was an important part of focus groups. It was dominated by thinking in gender stereotypes. As masculinity is closely related to technical professions and societal roles are highly gendered, students in the focus groups had strongly biased views concerning decisions on further studies.

Free choice argument

Firstly free choice argument explains that the decisions on the career path by the students are freely chosen by them based on their preferences. Female students were not captivated by the plan to get involved in technical academic programmes. Many girls at the stronger school in Budapest and at that in the countryside argued that they did not choose technology academic programmes mostly because they were simply not interested in it and not for any other reason.

Moderator: And how do you find electrical or mechanical engineering?

Szilvi: For example it does not interest me at all. Exactly because I hate physics, and I do not search in such direction that I do not like, because why and it does not interest me and I do not orientate …

Low self-esteem

Secondly, it seems that the students have the interest yet. Some of the girls would prefer studying in technical fields, but their low self-esteem worked as a barrier towards achieving their goals. They were considerably frightened by not performing well enough at the university and being laid off.

Erzsébet: I am interested in math, physics, but I am a little bit afraid as I am not good enough at them, but I would be interested in studying them (at the university).

Female students showed low self-confidence in technical fields which fits well with results of previous international research, indicating that girls often underestimate their own skills in various fields including even their performance at technical studies (OECD PISA, 2006.).

Societal gender tracking

It seems that lacking self-esteem is the outcome of societal gender tracking. If one has only very limited information about academic programmes and professions, a considerably influential factor towards decision can be the beliefs about persons who were fascinated by certain studies and jobs. Female students in all the groups had a dominant opinion that boys were more fascinated by technology and related careers, and such jobs mainly were done by men.

Gabi: It is rather the boys, who are interested in how things work, the machines...(laughter)

Évi: The boys' thinking is different… Girls engage themselves with other things, we are interested in people, in ourselves – because of this we mature earlier, as we know more about ourselves. And the boys are involved in maths, physics …

Csilla: … technical things interest boys and they need ideas …

Gender stereotypes seemed to weaken further the low self-esteem of students particularly at the not so strong Budapest school, where an interviewee emphasized that their acquaintances having technology related studies coped with many problems.

Tünde: I have quite a few male acquaintances, who study in such field and now they feel that they are more stupid, and the others know better, and are more prepared in class …

Family background

Places where they met with negative attitudes as to their ambition for technical fields included their own families. In the focus groups some of the students described their parents as exercising an important impact on the selections of the field of study. Sometimes parents had different decisions according to the gender of their children.

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).

Betti: 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...

Experience of general negative attitude by men

Fear of an experience of failure in the higher education in the field of technology and science seems deeply rooted in the difficulties girls face in the everyday life because of gender stereotypes. Concordant opinion of the girls was that their interest in technical things is very rapidly taken away due to negative behaviour by men. For the girls at the not so strong Budapest school this problem was very vivid, and became spontaneously present in the talks.

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... 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...

Fear of negative attitudes by prospective employers

Students seem afraid of having troubles at their workplaces in the future. Even though the interviewees emphasized the possible unique value-added a woman can provide in technical fields owing to her different thinking, it was a dominant opinion that men had a greater experience. In the focus groups there were students afraid of gender discrimination in the labour market in the future because of men's greater experience in technology. The view that men have better skills in this field was even internalized by some of the girls, which became an important factor of preferring a different profession.

Vivi: I just happened to hear about mechanical engineers that women applicants are not employed anywhere, and similar stories ...

Moderator: Why?

Vivi: Because men have greater experience or something like that ...

Panni: Or they just think that they have greater ... (laughter)

Rozi: Most often they think they do ...

In the focus groups girls and boys were viewed by the students as having essentially different scopes of concentration, although exceptional cases were mentioned. The considerably different process of socialization by gender was not mentioned. Low self-esteem of the students in technical fields was reinforced by some of their concrete negative experience, but also their dominant opinion that boys were more fascinated by technology in which jobs mainly were done by men. This view might have a dangerous consequence, because girls who are interested in technical studies may feel that they are not like typical girls. Due to a gender identity conflict, they may feel forced to evolve other kinds of interests. As the participants of all focus groups mainly thought that men were more involved in technical career, this view can lead to a self-fulfilling prophecy: girls who might be otherwise interested in technical studies may turn towards other kinds of interests.

4.4. Gendering science education at school

Science and technical fields are not popular in the society which can be explained by many factors. Science education is not able to keep alive the interest from childhood towards the nature. Teachers lack competencies to choose innovative teaching methods and rather require memorizing from the students instead of using problem-solving approaches. Also, team work and experiments are absent in the classes. Personal initiatives to innovate education methods remain very insignificant and the process of education, lacking the cooperation with natural museums or R&D companies is limited within the frameworks of schools (Kurkó, 2008).

The views and expectations of technical programmes may significantly be influenced by the content and quality of science subjects at the secondary schools. Negative experiences in the class and/or bad marks obtained in subjects of science may create a mental or a real barrier deterring girls from technical/science academic programmes.

Way and content of teachings

Female students interviewed mostly complained about the way physics and chemistry was taught, but mathematics was rarely criticized, rather some of the girls liked the math classes. Girls very rarely preferred classes of physics in a higher number per week. Several students complained about incompetent teachers, which led many girls to dislike these subjects.

Vivi: In my opinion the whole system should be changed, because we have physics classes for two years, and the curriculum is weighed down in a concentrated form and not gradually. During the first year I understood almost everything and was good at it, but in the second year the complicated issues became dominant and I began to dislike and did not study it, just wanted to survive.

Insufficient grades

Girls may conclude from the messages coming from their societal environment that they are not so capable of performing well in technical fields as their male mates. As a consequence, girls' decision on career choice may much more significantly be based on how they perform and the grades they get in science classes.

Many of the students in the focus groups could not get five, the best mark in physics, and concluded that they would not be able to get into and perform well at technical academic programmes. This experience was an important factor explaining their decision of another programme instead of technology to study. Negative attitudes with science subjects became an obstacle for girls towards choosing academic programmes in technology or science.

Moderator: And for some of you is studying to be a mechanical or electrical engineer a real possibility?

Timi: It could be a possibility for me, but I will not apply to such places, because I know how important physics is for that, and if because of that I would be thrown out after the third day, then that would not be so good.

Behaviour of boys

Numerous female students stated that boys in classes behaved differently and received more attention from teachers. Boys were more loud and self-confident, and put more questions during classes. This kind of difference in the behaviour of girls and boys at secondary schools has also been shown in other countries (Catsambis, 1994).

Menyus: (The boys) have better logical thinking, are faster with the class work, ... because they are more loud. They could be better, but do not pay attention. ... In my opinion they are lazy to study.

Móni: They are more loud ... and more confident, if they make a mistake, then well, it just runs off, does not bother them.

Moderator: And the girls?

Móni: They remain in silence (laughter).

Moderator: And whether why is it?

Móni: I rather prefer not to say, because it might be wrong. Finally we solve the exercise, and I think it is important to know whether it is good or not. I finally know, whether I understood.

Attitude of teachers

There were questions on the difference in attitudes towards boys and girls in the classes of real subjects.

Moderator: And there are opinions that boys are more encouraged ...

Menyus: I do not think so.

Tündi: In my opinion the girls ...

Natália: No, I think much more helpful, if you have any problem... If you seem attentive and want to do it, then (you will get a help).

Gender discrimination in the school was firmly rejected in two focus groups, and teachers' attitude towards students was owned to the level of diligence and cooperation. When girls asked for help, teachers usually were very ready to lend a hand and did not show a sign of negative gender stereotypes. However, in the stronger Budapest school girls found discrimination, but there was only one answer for the question of moderator.

Évi: … do not take it wrongly, but we originally were put in classes of lower level (in physics)… 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.

Other students seemed reluctant to make any gender-specific critical comment. The citation shows well how the conviction of a teacher operates as self-fulfilling prophecy: because of the teacher's attitude girls may feel less confident, thus boys may think of themselves as more competent even with the same level of knowledge. Attitudes of some of the teachers can be very harmful from a gender perspective, because girls can have a feeling that they are supposed to be less good at some subjects than boys, thus becomes less self-assured.

Moderator: And do you see any difference with respect to teachers? How is their attitude towards boys ….?

Móni: They ask them all the time (laughter.)

The lower level of attention paid towards the girls might have the hidden message that the boys' success is more important than that of girls. This may provide a basis for such attitude in the later phase of life that the professional advancement of women becomes subordinate. Our results as to the adverse experiences of the research subjects in science classes are largely similar with those of the national report discussed earlier, which had found that science education does not meet the needs of the students in secondary schools. Lack of the satisfaction of students at schools may also be entailed by the absence of gender-sensitive approach in education.

4.5. Role models for students

As seen from the above, students in the focus groups very rarely had female relatives or acquaintances in the field of technology, which could cause that they did not prefer technical studies or professions. Advertisements, books, TV programmes, and movies constantly show women in stereotypical representation. Majority of girls did not meet any woman who worked in technical fields and could have served as model in their choice of study. Some of the students knew only male engineer or IT expert.

Moderator: What do you think an IT expert do?

Tünde: My brother do similar things … he gets some objects or something like that, and has to do it in picture, in 3D …

Csilla: My father graduated as an engineer, and now he is an IT expert …

Models of female engineers and IT professionals were absent in the lives of female students, thus they might have felt that they should have choose girlish thing for living. Due to the fear that technical professions do not fit into the image of

and social expectations about a woman, in fact they might not have been driven towards such fields.

4.6. Teachers' views and intervention

In secondary schools students' preferences for subjects and choice of career are greatly determined by teachers' way of teaching and attitudes. Teachers' views in the interviews reflected an extremely traditional approach to gender roles.

Science teachers stated that girls were hardworking, while boys clever, but lazy. Teachers detected significant differences in learning strategies by gender and evaluated them in a different way. Preciseness of girls was considered less positively than reflectiveness of boys.

Moderator: And the girls, why do they think that they do not choose (math in higher number)?

Teacher: In general girls are more diligent, and boys are more thoughtful… I can reach more with the average of boys than with the average of girls. Girls do everything precisely … but not every girl is thinking, but rather learns how to do. … The average of boys is very lazy in the class of math in higher number

Other opinions went further on with the explanation of differences. Gender differences were reasoned by biological characteristics and logical thinking was owned to boys. Besides, however, their habit to trimmer was also emphasized among the explaining factors.

Moderator: What do you see is there any difference in studying science subjects between girls and boys?

Teacher: Surely in my opinion. Technical subjects are boyish. More boyish subjects, more boyish professions, than the human. … (Boys)' thinking is more logical possibly, even if they might be lazier to study, but with brain, with brain they can get here …

Moderator: Do you see any difference in the study of math and physics?

Teacher: Girls study with diligence, there are very few clever girls, such very clever girl, who would have great idea … obviously they (boys and girls) have brain working differently, and boys rather have a feeling toward technology, they rather than girls trimmer in my opinion.

Even though many girls argued that the supposed "masculinity" of professions did not exercise any (negative) influence on their choice for study, their teachers were convinced that in fact it was an important issue in the case of both the girls and their parents. During the interviews teachers considered traditional gender stereo-

types and gender roles as important reasons for that girls found difficult to reconcile work in technical fields and responsibilities at home.

Moderator: What do you think is there any difference in the (career) decision of boys and girls?

Teacher: Yes, they are impacted upon by their future role, the family, fortunately still every boy thinks that he will sustain the family some when, thus more important decision is to earn money…

Moderator: And the girls?

Teacher: For girls it is more simple, to become kindergarten teacher, hairdresser, or beautician, so there is a girlish profession, which they deal with anyway, and are happy to study… I think it is a little bit easier for girls. And there is no any breadwinner role. She works at most from 10 am till 5 pm.

Another teacher of math had a similar approach, but gave a more gender specific description in the answer.

Moderator: Why do not girls choose a career in technology? Why do they go elsewhere?

Teacher:… Maybe they know that this is a form of life, they know somehow unconsciously that this does not fit into their femininity, or female role.

Moderator: And what do you see when the parents give advices is a factor of decision if the profession is considered boyish or girlish?

Teacher: Surely… I think it is also a tradition, an unsaid viewpoint that girls have to care about the family, his husband, to bear all the consequences of leading a household …

Secondary school teachers underlined that female students knew about the biases against women in technical professions and consequently about a much higher level of women's performance necessary to be accepted like men.

Teacher: If we think about (we know) a woman needs to perform much better in technical field in order that her achievement get acknowledged. Is not such the society?... For a woman to live in a profession dominated by men she must have a very high level of knowledge.

Moderator: Does that have an impact on girls?

Teacher: Of course. … After a while the girl thinks that whatever she does her brain is not like that of that boy. … So she looks upon the boy in this aspect.

That same teacher had gender stereotypical attitudes toward female students, even if she was aware of the unwanted impacts of them. Her students said that they were automatically put in the weaker group of math. The teacher's confidence about the better performance of boys in math works as self-fulfilling prophecy:

girls are considered less creative, thus they get less exciting tasks in the classes, and consequently there is no chance for independent work and great ideas.

Teachers in the interviews emphasized that girls who applied for technical higher education programmes always were in an exceptional situation: their (one of) parents worked in the field of engineering or science and served as model(s) during making decision about higher education.

Moderator: And what about those three girls?

Teacher: Their parents are engineers, or math teacher, that is they have scientist background. They have at home the burden, the orientation in their genes, so they were in a special situation.

On the question of the moderator teachers had various suggestions as to how to increase the number of girls applying to technical fields. Increasing the self-confidence of girls was the own suggestion of a teacher, but the idea to invite successful engineers to talk about their own career to girls was proposed by the moderator, and positively accepted by teachers.

Moderator: And how would it be possible to make this (technical career) attractive (for girls)?

Teacher: ... to live and to get on is more difficult as a woman everywhere ... So the self-confidence of girls should continuously be strengthened, because boys have much higher self-confidence. By the time girls get here, inferiority has already been evolved within them. ... (they may think) I cannot do that anyway, I am a girl.

Moderator: And what if successful engineers gave lectures to girls? Would it impact on them?

Teacher: Of course it would impact on them. Before we had similar event, the day of student biologist ... so many scientists come and we can realize that the interest is a little bit increased (towards that field).

Summarising the discussions of interviews, one may have the feeling that the cause of that most girls are not targeting technical fields despite having talent and knowledge in maths (and physics), rather lies in the opinion and pressure from their social environment than in their own interest and diligence.

5. Girls' opinions to make technical programmes more attractive

An important part of our research concerned the question what means could be utilized to potentially get more girls to apply to technology academic programmes.

The last part of focus groups with female students dealt with the issue. The significance of the topic is indicated well by that even students in the group studying math in a higher number neglected technical field as an objective of further study to a great extent.

Students showed enthusiasm about the possibilities to acquire personal experience in engineering or meet with engineers or technical students. They would have preferred taking part in the programmes of open days at universities, listening to lectures by successful women engineers or IT experts, taking part in the programmes of Girls' day, or hearing about experiences of alumni students who studied in higher technical education. Interviewees did not appreciate impersonal ways of getting information, such as poster advertising of academic programmes in secondary schools.

Elimination of lack of knowledge

The first cluster of suggestions referred to the elimination of ignorance caused by the lack of information. Students in the interviews underlined the particular importance of greater knowledge of the opportunities in technical higher education and technical professions for female students. They mentioned various forms of giving information, particularly open day in higher education and concerning this the emphasis was placed on that it should take a day.

Mazsi: For a girl, as we think through things and we are more level-headed, there is a need for not an hour or 1,5 hour long information, but for a day long one.

As participation in an open day might be problematic for students in the countryside, they preferred a lecture in the organization of school. A successful female engineer or IT expert was thought to be ideal for such an event.

Lilla: There is really a woman or more women in a profession, and then they come and tell that it is really not that bad for girls either.

In two groups of students Girls' day spontaneously came as an idea.

Lilla: 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 let's say to three 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 work...

Students considered important to know about material requirements and performance expected in order to reduce the extent of anxiety. In this aspect introductory class was mentioned as useful.

Panna: Examination should not be shown as failure, because the first thing to hear about technology fields that how many people fell out … success experience means a lot for a person.

Mentor program

Girls, who were unsure about their choice of technical or other fields, would have found a good solution to meet a mentor from a university to get advices on various professions. In such favourable situation they would have been more likely to decide on livings in engineering or IT. The idea of a mentor program was received by enthusiasm.

Anikó: It would be a great security if we had a thought that all the time there is somebody, a safe point, a person, who helps and gives advices …

Fellowship

Due to the different social background, students' groups had different opinion on the possibility of getting a stipendium. Those living with divorced parents considered financial incentives and state allowance as very influencing factor. Sensitivity could be detected towards students with severe financial needs.

Móni: … they in the eighth district (within difficult financial circumstances) may have other opinion (that they need a fellowship), because they might not have family background like ours, let us say, because they would need fellowship very much.

Girls' school

There was a strong opinion, without saying examples that teaching methods in technical fields should be modified in order that technical professions fit in the interests of and get attractive for girls.

Moderator: And in your opinion is there anything that would help encourage girls in real subject?

Ibolya: There could be a girls' secondary school with superb teaching methods, where girls can get a very good level of education of math, physics, and they get into university and show (what they know) to the boys.

Interdisciplinary education

This concept received uniformly positive welcome in all the three groups. Moreover, pairing of technical majors with others appeared spontaneously in the talks. The most popular pairs were economic informatics and media technology, the latter was thought to be more creative than the other technical majors.

Bettina: The media is the closest to us, because of every day is not it, and also surrounds us.

Opinions of our research subjects indicated that girls would be more interested in technical academic programmes, if they were combined with other non-technical fields. Research in other country discussed above also showed how starting interdisciplinary academic programmes can be useful to get more girls to apply.

Conclusions

The views of female students and their teachers of secondary schools in our research are strongly influenced by gendered beliefs, i.e. cultural beliefs about gender that define the distinguishing characteristics of men and women and how they are expected to behave. These gender beliefs work in our topic of research as cultural rules or instructions for coordinating the interest and career choice of students towards traditional fields. Teachers' behaviour in science classes and thinking about the performance of their students are prejudiced according to the relevant content of gender. Girls are praised for diligence and boys' thinking is acclaimed as creative. Such attitude of teachers has long-lasting consequences not only for the career choice and thus the lives of students, but, from a broader perspective also for the (unchanged) gender structure of the various segments of labour market. It may support gender segregation of jobs and contribute to that there will not be an increase in the number of men in women-dominated fields and in the number of women in men-dominated fields. Cultural beliefs about gender have self-fulfilling effects on perceptions and behaviours that give them a remarkable ability to persist. Attitudes by teachers may strengthen the gender-biased self-estimates of ability of students. Girls more easily may decline to choose technical fields, while boys may persist at them in the face of difficulties.

It would be significant to understand the consequences of gender beliefs in order to decrease gender inequality. As to our research topic, widening the potential scope of talented applicants and meeting the demands of the private sector for a higher number of female engineers and IT professionals can be attained by attracting more girls into technology. Workforce in the fields of science, technology, engineering or math is crucial to the future's innovative capacity and global competitiveness. Women are vastly underrepresented in such jobs despite their large presence in the labour market. As a way to attain changes in the gender ratio of people involved in STEM fields, female students indicated their enthusiasm towards interdisciplinary education, such a media technology. To change the gender stereotypical thinking, persistent accumulation of everyday challenges to this system of beliefs would be needed that can greatly be supported by steps such as provisions of gender-sensitization courses for secondary school teachers.

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