

Gender as a factor determining the choice of technical studies

A. Porebska, S.A. Mitkowski, A.M. Dąbrowski & P. Zegarmistrz

AGH University of Science and Technology
Krakow, Poland

ABSTRACT: In this paper, the problem of women's interest in engineering studies is presented and analysed. The first part shows how gender determines the decision about the type of university education, and how this has been changing in Poland during the past four years. The next part of the paper describes a competition for young would-be students who apply to the AGH University of Science and Technology in Kraków, Poland. The results of the competition show that in the technical sciences, women are able to achieve results similar to men.

INTRODUCTION

The year 2011 has been declared the *Year of Maria Skłodowska Curie* in Poland and France. One hundred years ago, the Nobel Prize in Chemistry was awarded to this famous Polish and French scientist. Maria Skłodowska Curie was the first woman to win the Nobel Prize. She was also the only woman awarded the Nobel prize twice: in Physics (together with her husband Pierre Curie and Henri Becquerel) and in Chemistry, and the only person awarded the prize in multiple sciences.

Maria Skłodowska finished her high school education in 1883 in Warsaw, the capital city of the then Polish territories under Russian governance [1]. Since women could not study at universities in Poland at that time, she decided to continue her education at the Sorbonne in Paris in 1891. She received a bachelor degree in Physics (in 1893) and Mathematics (in 1894). Universities in France were open to women, but not to French women, since there were no high schools for girls that could prepare them for the final examinations necessary to apply to universities.

For many years subjects such as physics, biology, and Latin were not taught to girls in high schools. The law allowing high school education for women was established in France in 1880, but until 1937 the school programmes for boys and girls were different. The law allowed university education for women at Jagiellonian University in Krakow in 1897 (in Austria's part of the then partitioned Poland), four years after Maria Skłodowska Curie, and received her first Bachelor degree.

What has changed after 100 years in women's education? Everything. The programmes at schools, at each level are the same for girls and boys. Women have equal access to every type of university. In Poland, 60% of all students are women. However, women comprise just 34% of technical university students.

The next section describes how the number of female students has changed at Polish technical universities during the past four years. The predisposition for engineering studies, using the example of participants in the competition organised by the AGH University of Science and Technology in Krakow, Poland, is then discussed.

WOMEN'S PARTICIPATION IN STUDIES AT TECHNICAL UNIVERSITIES IN POLAND

Women's participation in engineering studies has been examined since 2007 by the *Perspektywy* Educational Foundation. The Foundation, together with the Conference of Rectors of Polish Technical Universities (CRPTU), were initiators of the education campaign *Girls as Engineers!*, which aimed to stimulate women's interest in technical studies. Having compared the number of female students during the past four years, the Foundation noticed that the number of women at universities that participated in the campaign increased more than at those which did not join it [2].

Information about female students is included in Figure 1, for the following public technical universities in Poland:

- AGH University of Science and Technology in Krakow
- Bialystok University of Technology
- Cracow University of Technology
- Czestochowa University of Technology
- Gdansk University of Technology
- Kielce University of Technology
- Koszalin University of Technology
- Lublin University of Technology
- Opole University of Technology
- Poznan University of Technology
- Rzeszow University of Technology
- Silesian University of Technology
- Szczecin University of Technology
- Technical University of Lodz
- Technical University of Radom
- University of Technology and Life Sciences in Bydgoszcz
- Warsaw University of Technology
- Wroclaw University of Technology
- Military University of Technology.

All these Universities have different numbers of students in engineering and science faculties. Those with a bigger number of engineering faculty students have a smaller share of female students. Figure 1 shows the percentage of women as students at technical universities, and how it has been changing during the past two years. Universities are arranged by decreasing numbers of female students in the 2009/2010 academic year.

Generally, an increase in the number of female students as a percentage of all students in 2010/2011 can be observed. The increase is about 2%, and is greater only for the Technical University of Radom and smaller for Warsaw University of Technology, where a reduction was observed. As a result, the order of universities remains almost unchanged. The average percentage of women among all students is 34%.

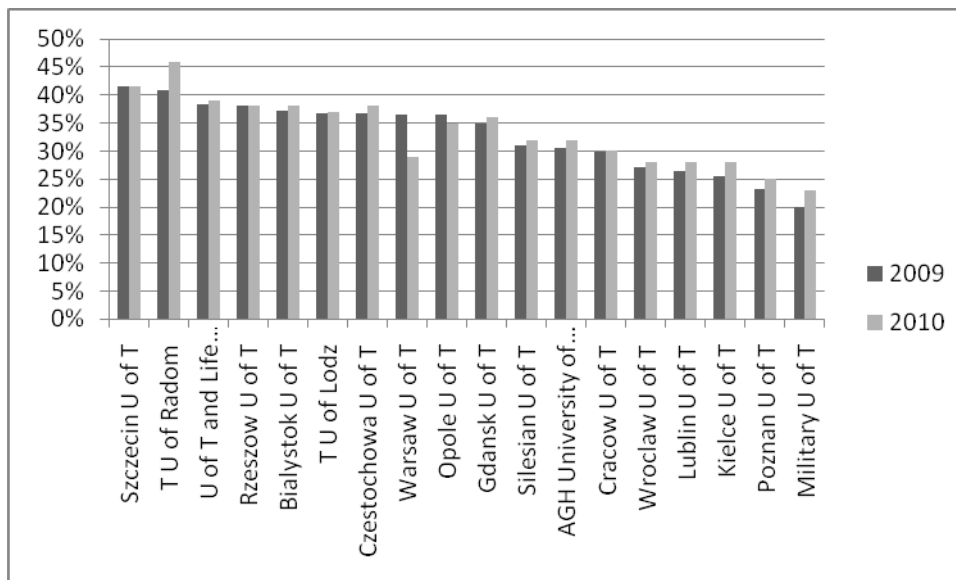


Figure 1: Percentage of female as students at Polish technical universities in 2009/2010 and 2010/2011 (Source: *Perspektywy Educational Foundation 2010-2011*).

The increased share of female students at technical universities is closely connected with the increasing number of female students in the first year. How it has been changing can be observed in Figure 2. This shows the percentage of female students in the first year of studies at technical universities from 2007/2008 to the 2010/2011 academic year [2][3]. Two universities showed significantly greater changes than other universities in the past year, and it is connected with the establishment of new faculties.

Generally, there is a tendency for an increased interest in engineering education among women. The average percentage of women in the first, and subsequent years of studies, is near 34%. This is important because of demographic data,

which points to decreasing numbers of young people between 20 and 24 years. Therefore, a greater percentage of high school female graduates are choosing an engineering education. Nonetheless, women remain in a minority among students of technical universities and a majority at other types of university.

Universities have different structures, and enrol different numbers of students in technical and non-technical faculties (such as science or management). Even though the number of female students at universities is large, the engineering faculties are less attractive to them. Figure 6 shows the proportions of female students in technical and non-technical faculties at specific universities during the 2009/2010 and 2010/2011 academic years. In each case the number of women in technical faculties is significantly different. For five out of 11 universities, the percentage of women last year is less than in the previous year.

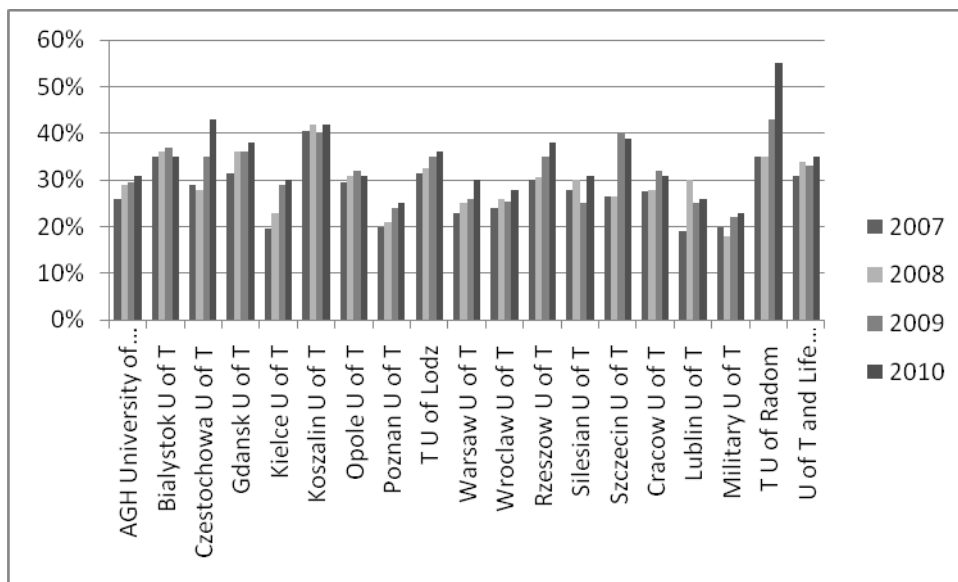


Figure 2: Percentage of women at the first year of studies at technical universities in different years (Source: *Perspektywy* Educational Foundation 2010–2011).

Moreover, according to the *Perspektywy* Educational Foundation [2], typical technical faculties have only a few percent women students; for example, at the Faculty of Electrical Engineering and Computer Science, Rzeszów University of Technology, women comprise 2.4% of students; at the Faculty of Electrical Engineering of Silesian University of Technology women are 2.5% of the students; at the Mechanical Faculty of the Technical University of Radom only 3%.

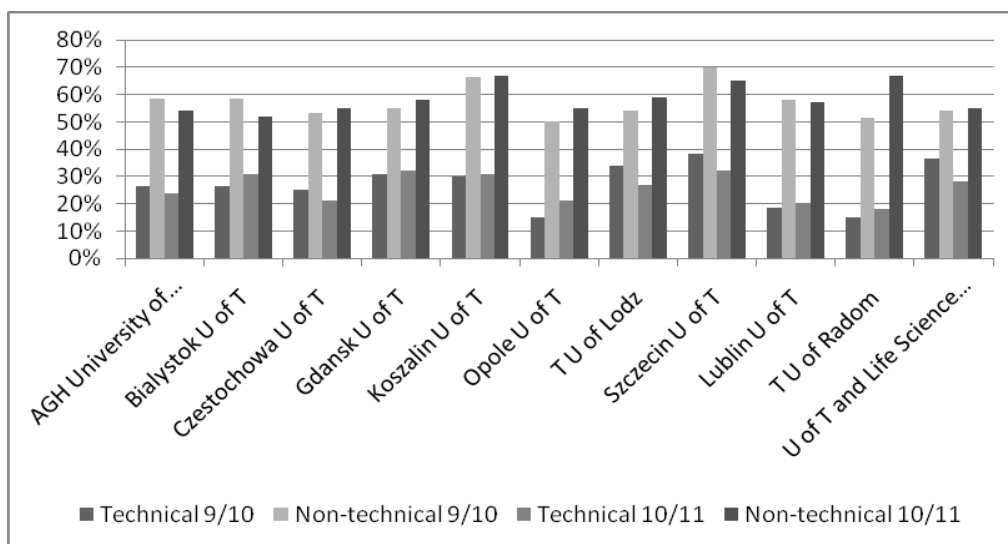


Figure 3: Percentage of women as students of technical and non-technical faculties in 2010/2011 compared with 2009/2010 (Source: *Perspektywy* Educational Foundation 2010-2011).

However, the general trend in departments with the lowest percentage of women is for that percentage to be still growing. An excellent example is the Faculty of Mechanical Engineering and Robotics at the AGH University of Science and Technology in Kraków, where, between the academic years 2009/2010 and 2010/2011, the participation of women starting studies increased from 5% to 7% of the total.

Are girls less predisposed to engineering education? Why is gender a factor in determining the choice of technical studies? Some answers can be found in *Women and Information and Communication Technology* prepared for the European Schoolnet (EUN) in 2009 [4]. The authors based their results on investigations of five European countries (including Poland) and concluded:

- *Girls are roughly equal to boys in aptitude for ICT at the secondary level.*
- *Most girls enjoy studying ICT, however this enjoyment does not often translate into careers.*
- *Female role models generally exert a strong influence on girls making decisions about further study/careers.*
- *These role models are not tech-savvy - however, most mothers surveyed are positive about ICT. Where mothers are most positive, daughters share these positive attitudes.*
- *Both students and role models generally believe that technology is better suited to men [4].*

It seems that such statements could be extended to other fields of engineering education.

WOMEN'S PARTICIPATION IN COMPETITION OF THE AGH DIAMOND INDEX

Since the academic year 2007/2008, the AGH University of Science and Technology in Krakow, Poland, has organised the *AGH Diamond Index* (Diamond Study Book). That is a competition for young people who want to study at this university [5]. Every year students from Polish high schools demonstrate their knowledge in four fields: mathematics, physics, chemistry and geography. After reaching 70% of possible points, participants are qualified at the upper level.

There are three levels of the competition and winners (those who obtain 70% of points at the highest level) in each field, can study at the AGH University regardless of any other qualification process. In level 1 of the competition, students solve problems individually at home. The task is for participants to solve the maximum number of problems and return the solutions in writing to the organisers. During the next two levels, the participants undertake a test within the given subject area under supervision.

The number of female and male participants in the *AGH Diamond Index* is presented in Figure 4, after the second level and Figure 5, after the third (final) level. Data refer to the two academic years 2009/2010 and 2010/2011.

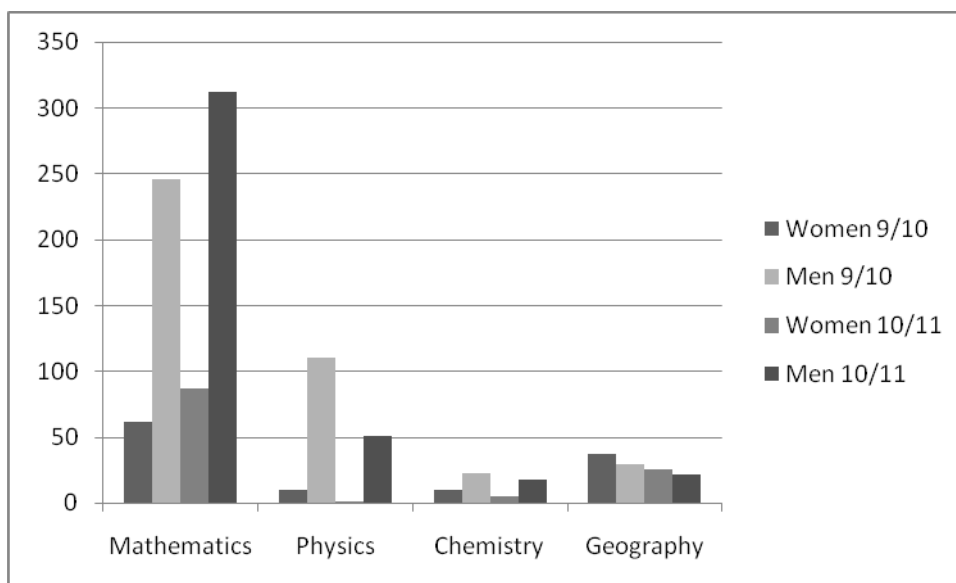


Figure 4: The number of female and male participants in the *AGH Diamond index* after the second level in the academic years 2009/2010 and 2010/2011.

In the 2009/2010 academic year, 2,152 participants took part in the competition. The number of participants who passed to the second level was 1,871, and there were 1,216 participants in mathematics; 328 in physics; 1,114 in chemistry and 213 in geography. In the 2010/2011 academic year, 1,606 participants reached the second level of the competition. There were 810 participants in mathematics; 419 in physics; 87 in chemistry and 290 in geography.

As can be seen in Figure 4, mathematics and chemistry are respectively the most and the least popular subject in the competition. The number of female and male participants in mathematics with the highest score after the second level increased in 2010/2011 over 2009/2010. For other disciplines, the numbers were smaller. Girls are in the majority for geography only. In physics, the disproportion between girls and boys is the biggest. While in 2009/2010 ten female participants passed to the next level in this field, in the next academic year only one women managed to do it.

As can be seen in Figure 5, the number of both female and male winners in mathematics and physics increased in 2010/2011 compared to the previous year. Similarly to 2009/2010, there were no women among the winners in physics. Only four women received the highest score in chemistry, and in the previous level there had been just five girls. Thus, their success is significant. In geography, there were the same number of female and male winners. The best results in 2010/2010 were in mathematics, which had many more winners than for other subjects.

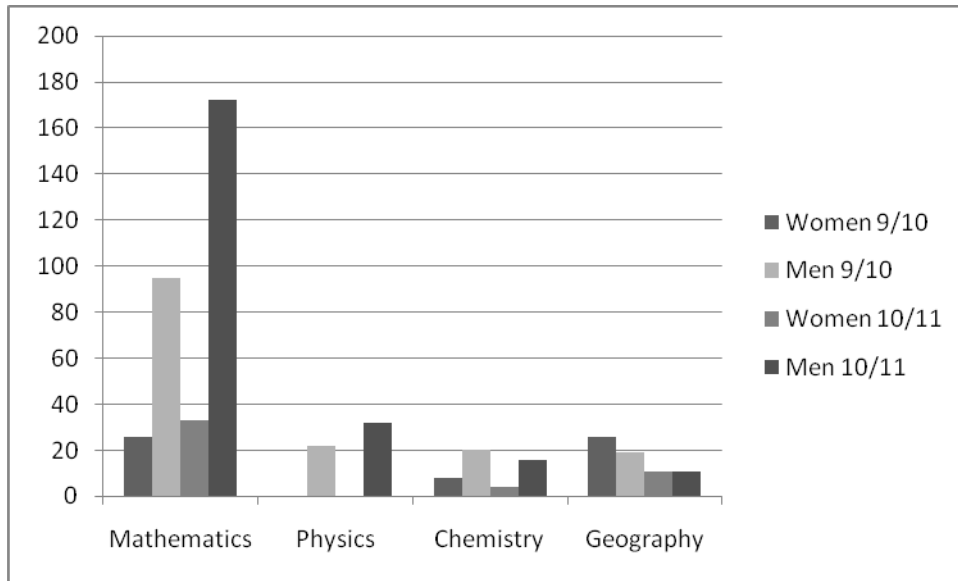


Figure 5: The number of female and male winners in the *AGH Diamond Index*, after the third level in the academic years 2009/2010 and 2010/2011.

In Figure 6, the percentage of female participants, after the second and final level, is shown. The average proportion between male and female participants of this competition is similar to, and reflects, the general tendency of women's interest in engineering studies.

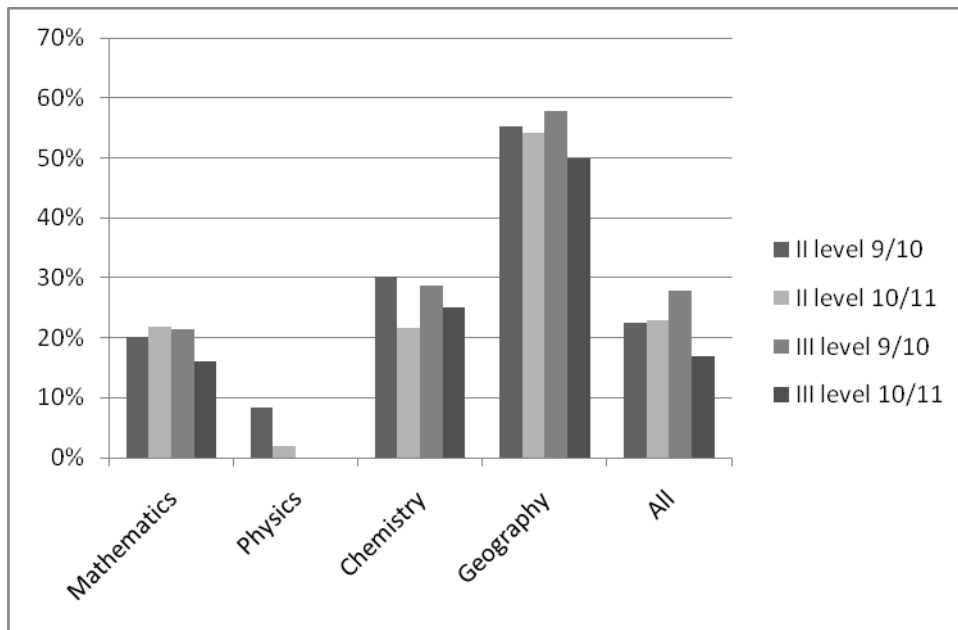


Figure 6: Percentage of women in the *AGH Diamond Index* after second level and after last level in 2009/2010 and 2010/2011 academic years.

The percentage of women among the participants who received 70% or more of the total points was even bigger on the third level of the competition than on the second level in 2009/2011. This proportion significantly decreased in physics only. In 2010/2011 this is practically the same at the second level, but clearly decreases at the third level. The only exception is chemistry. In mathematics and geography, girls are as good as boys, and their representation stays almost constant at different levels of the competition. In chemistry, women's results are even better. On the other hand, physics seems to be very difficult for all participants, and particularly for women. The average percentage of women at the third level for all fields except physics is 30%.

Because physics and chemistry are perceived as necessary in technical universities, the graduates of high schools are more likely to choose non-engineering studies. Making the teaching of both of these fields more friendly would attract more young people, especially girls, interested in technical subjects and encourage them to continue their education in engineering.

CONCLUSIONS

Technical universities are not as popular as other types of university, particularly among girls. Engineering and technology education is considered to be difficult by both male and female students. Many women perceive an engineering career as better suited to men. A smaller percentage of girls, compared to boys, are interested in subjects necessary for a technical education, such as those in which Maria Skłodowska Curie received Nobel Prizes. Nevertheless, results for girls in the competition *AGH Diamond Index*, are as good as the boys' results and show that women are not less successful in technical sciences.

Women's participation in technical universities in Poland is systematically growing (from 30.5% in 2008/2009 to 34% in 2010/2011 of total student numbers). The educational campaigns aimed at stimulating women's interest in technical studies, such as the one organised in Poland by the *Perspektywy* Educational Foundation, help to convince women that gender should not be a factor determining the choice of their studies. There is definitely no better opportunity than the *Year of Maria Skłodowska Curie* for successful role models such as that ingenious woman scientist.

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