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Study Choices Leading Women to Engineering and Technological Careers: Case of Lithuania

Virginija Sidlauskiene
Siauliai University
P. Visinskio str. 25, LT-7635 Siauliai, Lithuania
E-mail: msc@cr.su.lt

Abstract

The paper summarises the Lithuanian specific case studies, providing gender specific data on traditional and innovative pilot degree courses in E&T and identifying innovative study programs in engineering, then there is a comparison of traditional and interdisciplinary study courses. For that purpose an in-depth qualitative and quantitative analysis of some engineering study programmes grounded on transnational iterative methodology has been done. From this first analysis, a set of Lithuanian case studies has been selected for further analysis of students' perception of E&T studies. The paper summarises the results found after an in-depth examination of these selected case studies for a posterior evaluation of the success of pilot projects in E&T in attracting more female engineering students. The research draws up whether women are more likely than men to study engineering because of its perceived societal and cultural impact, and whether women are more attracted to engineering programs in universities that include an interdisciplinary approach, student-centred learning and the teaching and empowering studies environment.

Keywords: study course, traditional, interdisciplinary, gender, E&T.

Introduction

Research problem and relevance. In Europe, women comprise 29% of science and technology researchers. They also comprise 29% of those employed as scientists and engineers across the EU, but the growth rate of their participation between 1998 and 2004 was lower than that of men (European Commission, 2006). Preliminary EU She figures from 2009 show that the share of women graduating at a PhD level in sciences grew by an average of 7.3% per year between 2002 and 2006, compared with a 3.8% increase for men. Research policy focuses on the challenge that few young people in general, and women in particular, choose to pursue an education and career in engineering and technology (E&T) (EU, 2004; Jacobs & Simpkins, 2006; NSB, 2006). The overall aim of the EU is to contribute to improvement in recruitment, retention and gender equity patterns in E&T educations and careers. The Barcelona EU summit agreed to increase the EU expenditure on R&D to three percent of GDP by 2010. To reach this goal, it is estimated in the report "Europe needs more scientists" (EU, 2004) that around 700000 new scientists and engineers will be needed. The report further remarks that increasing the number of women entering science and engineering careers would go a long way towards helping to solve the problem. The publication "She Figures 2009" (EC, 2009) suggests that the EU's research capacity will be difficult to sustain and impossible to increase according to the ambitious plans that have been set, if intellectual resources are not drawn from those with appropriate abilities and attainment on a more equitable basis than they are at present. There are large and interesting differences between countries with respect to the proportion of students enrolled in E&T studies, which subjects show the weakest recruitment, how large the recruitment problem is perceived to be, etc. Especially in technology, engineering, physics, mathematics and to some extent also chemistry, the recruitment figures are low. Furthermore, the gender differences vary from one country to another, but, in most countries, the boys outnumber the girls in physics, engineering, technology and mathematics studies, while the gender balance is shifted towards the girls in subjects like biology, medicine, veterinary medicine and environmental science. Some highly developed countries, such as the Scandinavian, are among the "world champions" in gender equity (UNDP, 2007), but have a gender-segregated labour force and a distinctly "gendered" pattern in young people's career choices (NMCE, 2006), with few girls in physical, mathematical and engineering educations and occupations. The FP7 – *Capacities* Work Programme for Science in Society (EU, 2007, p. 78) states that "the pursuit of scientific knowledge and its technical application towards society requires the talent, perspectives and insight that an increasing diversity in the research workforce will ensure. Therefore, a balanced representation of women and men at all levels in research projects is encouraged". The issue of recruiting more women to education and careers in E&T is one of quantity as well as quality: of quantity, because women represent the greatest recruitment potential; and of quality, because a higher parti-

cipation from women in E&T may expand the scope and ways of thinking, prioritizing and working within this area, and contribute to gender equity. Schiebinger (2008) provides examples of how taking gender into account has yielded new research results and sparked creativity, opening new avenues for future research. In order to create a sustainable and knowledge-based economy in an equitable society, expertise in science and technology is needed, and the participation of both women and men is desirable. There has been growing concern at the EU level about the under-representation of women in scientific careers, representing a considerable deficit of women's skills and knowledge (HGWS, 2002). This has prompted significant and concerted action at a trans-national level. The European Commission adopted a communication in February 1999 setting out an action plan to promote gender equity in science (EC, 1999). Participative equity is also emphasised as an important feature of the European Higher Education Area (EHEA) of the Bologna Process.

Empirical evidence shows that social and cultural factors appear to have more influence on youth (male and female) motivations and preferences than their underlying abilities have. The theoretical framework analyses the way in which individuals build their identity in a social context and also considers the way in which social values and beliefs affect in scientific and technological fields. Some studies highlight that women students are more interested in social or societal – oriented problem-solving, while men are more interested in the accrual of knowledge for its own sake or for economical growth. Hence, the focus is on a specific issue in the field – the students' intentions to study engineering and whether interdisciplinary curricula has an influence on men and women's attraction towards science, whether the perception[1] of societal impacts of the scientific and technical curricula has an influence on men and women's attraction towards science, what factors affect the women choices of engineering and technologies studies, whether integrating *interdisciplinary approach* into academic programs can become an efficient means of providing multidisciplinary education, whether it better suits labour market demands of multidisciplinary skills, to use multi-functional and intercultural teams to cope with complex problems?

The object of research[2] is factors affecting women's study choices on engineering and technological career.

The aim is to check whether these gender-based preferences exist and have consequences on the choice of multidisciplinary E&T study field made by males and females students. More specifically, the research addresses the following *objectives:*

1. To review the main research findings on what the perceptions, priorities, considerations, values and experiences on which young women and men base their educational choice E&T study field are.
2. To gather gender specific data on traditional and innovative successful pilot degree courses in E&T in Lithuania.
3. To analyse traditional and pilot innovative E&T degree courses in regards to attracting and retaining female students.

The increasing presence of women at university requires us to reconsider a commonplace that presents women as less competitive and more ready to do support work, in some cases explained by reference to biology. This view is based on patriarchal patterns, reproduced by women as well. In the construction of their identity during childhood, girls and boys decide what they 'want to be'. When their characters mature during adolescence they need to experiment with roles and behaviours by mentioning their interests in technical, vocational, scientific and humanistic studies. When career choices are made at school, students are often unaware of the total range of options that are open to them.

Young women and men perceptions, priorities and choices related to E&T study choice

There exist "models" and frameworks for studying educational choice (Adamuti-Trache et al., 2008, Eccles 2007); however, there is no single comprehensive theoretical framework with the capacity to give a complete understanding of girls' and boys' educational choice and the reason why they choose to study (or not to study) E&T. The perspectives described in the following sections have all been invoked in attempts to describe educational choices, identity symbols and late-modern youth culture; interests, self-confidence, and abilities. Schreiner & Sjoberg (2007), arguing from a sociological perspective on youths in late-modern societies, point to the pre-eminence that contemporary society gives to an individual and claim that modern youths evaluate education against how it may contribute to their self-development.

[1] Perception is the process by which people translate sensory impressions into a coherent and unified view of the world around them. Though necessarily based on incomplete and unverified (or unreliable) information, perception is 'the reality' and guides human behavior in general (http://www.businessdictionary.com/definition/perception.html) or the ability to understand inner qualities or relationships, or the knowledge gained from the process of coming to know or understand (http://www.britannica.com).

[2] The research leading to these results has received funding from the European Community's Seventh Framework Programme FP7/2007-2013 under grant agreement No. 230376.

Young people in late-modern societies feel culturally liberated and they are free to choose their own values and social identity (Beck, Beck-Gernsheim, 2002; Ziehe, Stubenrauch, 1993).Youth studies describing different late modern youth sub-cultures refer to specific girls' and boys' cultures (Lyng, 2004; Schreiner, 2006). Warrington and Younger (2000) point out that mathematics and science subjects are socially constructed as masculine – it is therefore conceivable that E&T studies are conceived as boys' cultures and tend to alienate girls. The idea of E&T studies that young people get through peers, family, mass media, leisure-time activities, and the advertising material from educational institutions, is held up against their priorities and aspirations, and if it does not appear to meet their image of who they want to be, they will choose not to pursue education and career in E&T. How do these aspects of late modern youth culture – a culture which may be less pronounced in some societies than in others – come into play in youth's perceptions of educational choices in a range of countries? A number of studies conclude that when young people explain their reasons for their educational choice, they emphasise *personal interest* (Angell, Henriksen, Isnes, 2003; Lindahl, 2003; Ramberg, 2006). A number of interest studies in science education shows that girls' and boys' interests are *different* (Cerini, Murray, Reiss, 2003; Kjærnsli, Lie, 2000; Osborne, Collins, 2000, 2001; Scantlebury, Baker, 2007; Schreiner, 2006). On a general level, girls are more interested in issues to do with human health and well-being, whereas boys are more interested in things to do with e.g. engineering, technology and physics. One's perception of own abilities and qualifications is reported as important for educational choice. While girls in general outperform boys in many school subjects, boys do better than girls in a number of E&T subjects, and girls express less self-confidence in such subjects (Kjærnsli, Lie, Olsen, Roe, 2007). Bandura, Barbaranelli, Caprara, and Pastorelli (2001) pointed to young people's self-efficacy beliefs as shapers of educational aspirations and career trajectories. Interests and self-efficacy are also important components of educational choice models such as that of Eccles (2007).

Buksnyte and Pukelyte (2008) in their study have shown that the greatest part of teenagers is in higher identity states. The relationship between teenager identity states and learning motivation type in girls group was found: girls who belong to lower identity states have more expressed external learning motivation, and girls who belong to higher identity states have external and internal learning motivation at the same level. It is interesting that there were no relationship between teenager identity states and learning motivation in boys' group, but there were found tendencies that boys are affected by internal and external learning motivation at the same level regardless of which identity states (higher or lower) they belong.

Research carried out by Urboniene proved socio-cultural factors that stimulate the development of professional motivation of young female students in the chosen field of technological and physical studies to be the following ones: effectively organized studies followed by principles of gender mainstreaming in providing with information and knowledge, stimulation and evaluation, also participation in the student exchange programs, positive changes in the male lecturers' attitudes towards young women studying technological and physical sciences, examples of good female practice in the studies while studying, and optimised system of professional orientation in the secondary schools. Among personal factors professional suitability is crucial; its positive evaluation depends mainly on others' attitudes that usually correspond with the professional stereotypes. In terms of *professional motivation* Urboniene determined that female students expressed lower professional interest in the technological and physical sciences as well as lack of personal experience and accidental choice of the profession in comparison with male students.

It has also been stated that academic environment and especially the male lecturers' attitude towards young women induce them to evaluate their professional choice as well as professional suitability negatively. It is important to highlight that obstacles for the development of the professional motivation are created due to stereotypical views dominating the society and influencing the attitudes of both male and female students. Thus, an assumption could be made that there is a lack of psychological and educational contribution from the families and educational institutions striving to encourage and empower young women for the chosen studies in the field of technology and physics sciences.

Novelskaite (2007) discovered the link between 18-22 year old students' decisions and motivation to choose specialties: female students who had followed physics and mechanics study programs at Lithuanian universities were more often inclined to continue their studies in the same field at master's degree level than male students were, whereas only about 1/3 of females and almost half of male students in informatics programs had similar plans. The findings of the 2007 survey carried out among 16-17 year old school pupils and their teachers showed almost as often as boys, girls have plans to study chemistry at the university, but they mention mathematics somewhat less frequently than boys. Girls tend to choose informatics or engineering studies from 3 to 6 times less frequently than boys. Most teachers are inclined to

think that boys are not only more talented than girls in engineering and technological sciences, but also are more suitable for a career in this field.

The findings of the 2008 survey carried out among 20-22 year old female students has shown that female students following engineering or technological sciences encounter negative stereotypes and a lack of adequate role models, which is one of the reasons of the declining interest among females in S&T, where they constitute a minority. The decision in choosing a field of science is greatly influenced by the professions of the family members. In the case of exact and technological sciences, fathers appear to be playing a significant role in their children's, especially daughters', career, while the choice of medicine is often conditioned by the role model of mother. A central role in women's choice to follow an engineering or technological science career path is played by teachers.

Although a strong effort has been made over the past decades to avoid sexism in education and science, a solid image of science as a 'masculine job' is still pervasive (Calloni, 2009). It seems that the hidden curriculum creates a scientific bias between women and men and perpetuates the transmission of stereotypes, often involuntarily, to students. This kind of process has a negative impact on the lives of both women and men and on society as a whole.

Curriculum, contents and contexts, teaching and learning strategies

As indicated above, the interests of girls differ from those of boys. How are these interest patterns matched by the actual content of science, technology and math (STM) curricula and by the choice of examples, emphases and points of departure – or, in short, the context in which the curricular topics are presented? There are indications that female E&T students prefer to pursue more applied directions, for instance, linked to environmental issues (Schreiner & Sjoberg, 2003; Wistedt, 2001). Also, women, to a greater extent than men, emphasise context and connectedness in the presentation of teaching / learning material (Angell, Guttersrud, Henriksen, & Isnes, 2004; Osborne & Collins, 2001; Stadler, Duit & Benke, 2000; Wistedt, 2001). We have to study how these preferences match the everyday reality that women meet as E&T students.

Wistedt has (2001) claimed that there is a need for radical experiment with the *contents* of STM educational programs. In 2006, the science curriculum for 14–16 year olds in England underwent radical reform (Qualifications & Curriculum Authority, 2005). The revised courses have a stronger focus on teaching about the nature of science and the broader social impacts of science on society – issues likely to be attractive to many women. The presence of science courses with an applied / vocational dimension has also been enhanced. This wider range of available science courses means that students are making choices about the particular context of science courses followed at age 14–16. Valuable insights may be gained when combined with an overview of girls' and boys' experiences and preferences within school science and how to design E&T curriculum contents and contexts so as to match students' interests and learning styles, thereby contributing to better long-term recruitment and retention of E&T students on all levels of higher education.

Not only the science content and contexts, but also the teaching and learning approaches have an effect on young people's engagement with STM or E&T. During the last decades, much has been written about socio-cultural learning theory and the importance of language and social interaction for learning (Mortimer & Scott, 2003). Furthermore, a range of teaching / learning approaches for different school and university levels has been suggested and trialled (Kornov, Johannsen, & Moesby, 2007; Novak, Gavrin, Christian, & Patterson, 1999; Linn, Clark, & Slotta, 2003; Mork & Jorde, 2004). However, despite these efforts, there is evidence that school science is in most cases still dominated by traditional content knowledge and "transmissive" teaching (Angell et al., 2004; Carlone, 2003; Osborne & Collins, 2001). Stokking (2000) found that physics students in the Netherlands wanted a stronger orientation of physics towards everyday life, and teaching methods that supported active participation. Labudde et al. (2000) suggested that exactly these factors would be effective for improving girls' experience of (and therefore choice of) physics. Wistedt (2001) found that Swedish university technology programmes that succeeded in recruiting and keeping female students were characterised by cooperation-based and problem-oriented methods and by rich opportunities for interaction among students and between students and staff.

The decreasing interest of young people in science can have different roots, ranging from early socialization in the family to education and socio-cultural-economic transformations, as considered above. This lack of interest might be partly explained as a consequence of science teaching. Science is often taught in secondary school classes with old standards, when science was considered as 'reliable knowledge' able to develop exact analytical and technical skills in the process of modernisation. The (natural) science subjects were also meant as a space for the selection of a small minority of students who would enrol at university and later become part of the elite. Curricu-

la contents still reflect elitist assumptions influencing the public education framework where contemporary debates are neglected or non-existent. In relation to all these aspects, at the same time the EU needs to ensure fair access for interested students to all scientific disciplines, supporting talented and motivated students to undertake and pursue a scientific career.

A review of Curriculum Research in Engineering in HELENA[3] partner countries deals with research that explores research discussion of the framing of curriculum development in gendered or non-gendered terms and how curriculum can be taught in technological-economic,technological-social,technological-humanitarian, innovative terms in HELENA project countries. Country reports from six different cultures have produced a large amount of interesting data. From the Engineering Curriculum Research in the EU before this project there were mentioned main findings during last 15 years. Universities are exploring ways to revise the *engineering curriculum* in order to meet the changing needs of industry and society. Any restructuring of an engineering curriculum must take into account the correlation between society, engineering competencies and the changing paradigm of engineering education. The 'employability' of graduates depends on a combination of great technical knowledge, practical experience, and soft skills. Decreasing student enrolment figures in engineering in many countries call for appropriate measures to be implemented including the development of attractive programmes of study and challenging learning environments.

Over the last decade here have been many initiatives in the European Union and other countries to encourage girls to become engineers. Reviewed literature has shown that females have more negative attitudes toward *engineering* and technology than males do. Despite greater equality in access to higher education and employment women's participation in engineering careers does not reflect this. Higher education engineering curriculum is male-based. In construction of engineering curriculum three aspects have been neglected: 1) students' background in the light of formal and informal experience and interests; 2) student-student interactions; 3) teacher-student interaction. Innovation of the curriculum with regards to gender mainstreaming means broadly oriented integrated and content-rich teaching material, diversity in teaching and learning methods. As an academic discipline, engineering is continuously undergoing a process of rapid expansion and diversification that is now significantly characterized by interdisciplinary approaches. There is a rise of interest in increasing interdisciplinary studies. As a profession, engineering has to deal with scientific and technological matters, but economic, political, ethical, societal and environmental aspects are increasingly taken into account as well. Society places many demands on an engineer; to be technicians with a human side, be adept in interdisciplinary skills that include technical and non-technical competencies that enable them to critically analyze, solve problems, communicate effectively, and be able to learn continuously as the workplace changes. Introducing social science and other disciplines into engineering could, ideally, help bridge the rift that exists between producers and consumers of technology. Social sciences, humanities, cultural and management studies are as important as the traditional applied sciences for the portfolio of engineering competencies, because students need to understand the financial, business, environmental, economic and social constraints in which engineers operate. Most of the studies and projects showed that interdisciplinary curriculum is one of the central elements for tackling gender and engineering stereotypes. Reviewing literature of engineering education and curriculum, learning and teaching methods we have found that many studies have been presented in the last decade. Past studies have shown that a change in learning environments and the methods by which learning takes place might increase the number of females choosing engineering carriers. Supported by the experience of the Scandinavian, the United Kingdom and other EU countries more and higher technical education institutes are introducing new forms of education, such as problem-based and project-based education, which increase the appeal of technical education and have a positive effect on the intake, retention and output of students. Surveys and reports undertaken to document and evaluate active teaching and learning methods indicate that project and problem-based learning can satisfy the demands for required knowledge, skills and attitudes of engineering graduates. But active and experiential learning is not limited to project orientation and problem-based learning. It should also use ICT environments, various extra curriculum activities and more traditional forms such as labs, exercises, and design activities.

However, changing teaching methods and didactical design of engineering courses are steps in the right direction but not sufficient for making education gender inclusive. Changes must also be made in content, followed by redesign of existing courses and design of new ones. Broadening and repositioning of the curriculum is the challenge to technical education for the next few years. From the perspective of larger

[3] The study was conducted in the frame of the project "HELENA – Higher Education Leading to ENgineering And scientific careers". The project (SIS8-CT-2009-230376) is co-funded by the European Commission through its FP7 under area 'Capacities'.

participation of women, the exploration of the boundaries of technology is especially interesting. Integrating more real-world concerns can also potentially reverse the declining interest in engineering.

Reviewing the curriculum research and engineering education modernisation findings in E&T area, HELENA project partners from 6 countries – Austria, France, Spain, Serbia, the UK, and Lithuania – defined the first two of them: 1. *Description of pre-existing conditions* (Bologna reform impacts: standardised degree levels across Europe, greater transferability and standardisation; course content proscription by the professional bodies that accredit courses); 2. *Interdisciplinary approach to E&T courses.* The interdisciplinary, multidisciplinary, or holistic approaches to engineering courses are a positive step and curricular transformations and research move towards innovations. Engineering education is adopting multi-disciplinary approaches and more innovative teaching and learning methods are applied, but these are mostly developed without gender mainstreaming in mind. The term "interdisciplinary education" today is used to describe studies that combine several established fields of science. It focuses on problems thought to be complex for adequate understanding within a single discipline. The interdisciplinary approach in general is already considered to be common in scientific and industrial communities. If we are going to campaign for more girls and women to study science and technology, we need to be able not only to explain why it is important for them to do so, but also to demonstrate that action is needed to make it happen and to suggest how that action might be constructing the architecture of study / degree course programs. Two main hypotheses have been constructed (Godfroy, Pinault, Thaler, Wachter, 2010) in the research:

1. Engineering study programmes with more than 25% of non-engineering[4] subjects are more attractive[5] to women than 'traditional' engineering study programmes.
2. Women who study in interdisciplinary engineering study programmes have a higher success rate than women in 'traditional'[6] engineering study programmes.

Research methodology

Answering these hypotheses with solid empirical fieldwork (quantitative analysis followed by qualitative analysis) brings the chance for our research to have a high validity. The research combines different levels of mixed data collection: information on national settings, academic frameworks, structure of engineering degree courses, Bologna process implementation, statistics, etc. Empirical fieldwork involved: 1) decision for one or two disciplines / subjects (e.g. mechanical engineering, IT), collection of quantitative data on engineering degree courses, at bachelor or master level presented on website; 2) listing all study programmes (bachelor, master) of this discipline in country and institutions; 3) setting up of a representative[7] sample of study programmes in country. The sample focused on comparison between 'traditional' degree courses and 'innovative' degree courses. 'Innovative' was defined as interdisciplinary degree courses where 25% or more of the total number of ECTS are in non-engineering disciplines. In the same discipline (electrical engineering, ICT, chemical engineering, mechanical engineering, civil engineering, etc.), 'innovative' and 'traditional' degree courses were compared, all parameters were equal except the proportion of non-engineering ECTS. In each country two disciplines were identified and the identification of disciplines (study courses) was made according to the classifications existing in the country. For qualitative data, in each country at least 2 case studies per discipline were chosen: a traditional one and an innovative one. The total number of case studies was at least four in each country; 4) when necessary, e-mail interviews (or phone or face-to-face interviews) with responsible persons of the respective study programmes were used to gain data which was not available on the study programme webpage; 5) deduction of interdisciplinary study programmes based on first data and curricula analysis against two criteria: a) study programmes with averagely high share of women students and / or graduates; b) study programmes with more than 25% of interdisciplinary subjects; 6) documentation of case studies and all the collected quantitative data were entered into a database[8]. The database ensures a common way of presen-

[4] Non-engineering subjects – all subjects except engineering, technology, physics and mathematics subjects (i.e. management, business, economics, languages, cultural studies, sociology, politics, psychology, philosophy, ethics, arts, STS (science, technology and society), communications, law, history, design, gender studies, inter-cultural competencies, diversity management, "soft skills", etc.)

[5] More attractive in comparison to similar degree course with less than 25% of non-engineering subjects.

[6] The term 'traditional' is used for mono-disciplinary degree courses and therefore for study programmes with less than 25% of non-engineering subjects. The limit of 25% was a decision by the project team based on results of other studies (Wachter, 2005).

[7] Lithuanian data was collected for 68% (requirement was at least 30% of the existing degree courses of each country).

[8] Established and maintained HELENA project database on portal http://www.fp7-helena.org/ can be accessed by logging into the private part of the portal. The database aims to store the data collected by HELENA researchers and to facilitate analysis of higher education engineering programs and curricula. It will serve as a repository for three different types of data: collected data about universities and collected gender specific data on traditional and innovative pilot degree courses in E&T in Europe.

ting the data and facilitates comparison procedures through a data retrieval interface. It is also a way to have no risk of cross-posting, work on different versions, or loss of data; 7) second, more profound case study in-depth analyses (qualitative part of empirical fieldwork); 8) description of case studies regarding their degree of innovation (interdisciplinary) and success in attracting more female students and how interdisciplinary and traditional study programmes differ, what the main similarities are; 9) primary analysis of data and writing national reports. General transnational comparative analysis is grounded on multi-level iterative analysis at each step – material produced for previous steps is re-used in the following steps: analysis at country level from national reports, then analysis at work package level and finally – cross comparative analysis.

Research results on interdisciplinarity as a possibility to enhance gender diversity in engineering education

The higher education system comprises university and non-university study programs provided by state and non-state higher education institutions – universities and colleges. Higher education is based on the European Credit System (obligatory in Lithuania to 2010). Bachelor degree can be followed by a one or two year vocational qualification diploma, such as a teaching qualification or a master's degree, which in turn can be followed by a doctorate. The titles of qualifications awarded depend on the field of study to which the relevant program is attributed. The 63 study fields are grouped into 6 study areas (Humanities, Arts, Social Sciences, Biomedical Sciences, Physical Sciences, and Technological Sciences). There is a classification of the fields and areas of consecutive university studies provided at higher education institutions of Lithuania and the list of qualifications awarded on completion of the studies thereof, and the classification of research fields, areas and branches. List of study areas and fields in which studies are offered in higher education institutions in study area of *Technological Sciences* is divided into groups of study fields – Engineering and Technologies – and, finally, these are divided into study fields. Technological Sciences study area is divided into 126 Engineering and 41 Technologies branches of the study field.

Among 144336 students at universities of Lithuania at the beginning of academic year 2007/2008, women were the majority (60%) on the Bachelor and professional study level (59%), integrated (69%) and special professional study level (79%) as well as in master's degree (64) study programs (58). Women's participation in higher education was the broadest (67%) in distance studies (58% and 50% in full-time and part-time study programs respectively). Only in part-time (evening) bachelor and professional study programs women (47%) were outnumbered by men. With the ratio of women to men in Lithuania being 53% to 47%, the data above indicate that men are less inclined to seek higher education. In Lithuanian higher education specialty-based segregation between women and men can be observed on all levels of studies:

1. At the BSC degree level in 2007/2008 women constituted absolute minority (approx 1 in 10) in the fields of security and transport services, engineering and computer science studies. They also constituted minority (approx 1 in 5) in personal services, architecture and construction study programs. Among those enrolled in physical sciences, agriculture, forestry and fisheries programs women made up about a half of the student body, and among those following mathematics and statistics and environment programs they slightly outnumbered male students. In other study fields – production and processing, natural sciences, social sciences, humanities, arts, and health care – women were a substantial majority.
2. At the master's degree level gender balance in 2007/2008 was slightly better than at the BSC level in such study fields as security, transport services, engineering, computer science, personal services, architecture and construction. In other study fields mentioned above, women constituted a majority.

Recently women and men statistics show the following tendencies: 59% of all HE students are women, 66% of all graduates are women, 22.3% of engineering students are women, 30.8% of engineering graduates are women (data of 2008). About 58.3% of women and 41.7% of men studied at BSC level in academic year 2009/2010.

Lithuanian Government is committed to state and private universities and colleges to provide quotas for the numbers of students in study fields in respect of the demands of labour market. Recently the E&T study field gets more student quotas, i.e. more 'student's baskets' (vouchers for bachelor studies) and enrolment in the field of E&T is slightly increasing during the last few years and women student enrolment is increasing as well. State funding for bachelor studies is provided in the form of student vouchers to the best school leavers. Students who receive financial support from the state can freely choose an educational institution – whether it is a public or a

private one. State funds allocated for vouchers are divided into six fields of studies to meet the demand for different kinds of specialists.

An analysis of all Lithuanian study courses in engineering shows that the most attractive fields in engineering for the Lithuanian young women are Production and Processing (65.7%) together with Environmental Science (57.2%), followed by Agriculture, Forestry and Fisheries (43.6%), and Physical Sciences (43.3%) according to data of 2008-2009. Women are consistently under-represented in Transport Engineering (13.6%), Computer Science (16.2%), and Electronic Engineering (16.1%).

As a result of the preliminary data analysis it was decided to select one discipline with averagely high share of women students or graduates and another one with low share, not having the highest or lowest rates. As a consequence, the following two disciplines were selected: BSC degree in Mechanical Engineering and BSC degree in Environmental Engineering / Environmental and Professional Engineering. The Mechanical Engineering discipline represents a traditional case study. Mechanical Engineering study courses have a long history since the industry development period and have been male-dominated for many years. The study course Machinery Manufacturing Technology started in 1959 at Kaunas Polytechnic Institute and its branches in Siauliai and Panevezys, then was renamed Mechanical Engineer in 1991 and was absolutely male-dominated. Environmental Engineering is the second more modern and challenging currently important discipline to be studied in the case of Lithuania because it presents a big number of interdisciplinary and non-engineering subjects and has a better proportion of female students. It could be considered being not purely engineering. It is a relevant example for comparison purposes in the context of climate change in the world and project aim to determine the extent to which the study programmes facilitate a better student balance from women and men balance perspective. Both disciplines by the adoption of the new rules of Bologna Treaty in the engineering study programmes are regulated by the General Technology (engineering) Science (BSC) study area regulation passed in 2005. Due to the mentioned Regulation E&T study program is structured as follows:

Part of general education (human education and communication elements) is not less than 6% of non-university study program and the volume in the university study program is not less than 7% of the main volume, not less than half of the volume of this part shall consist of basic global issues, covering the physical sciences and technology philosophical and historical foundations, the rest of the volume shall consist of humanitarian, social, or artistic studies. Subjects proposed in this part of the studies may be: philosophy, history, sociology, politics, literature, art, foreign language (only for the improvements in use of engineering language). They could include the philosophical and historical foundations of science in technology and people, technology history, science research, professional ethics. Engineers should be fully aware of their social responsibility and get to know the factors relevant to decision-making process, the higher school should provide for the humanities and social science course work as an integral part of the engineering study.

Engineering framework (in the core of the study program) consists of a framework of general engineering subjects, the main directions of study subjects and social science subjects at universities are:

1. General theoretical framework of engineering: mathematics, physics and chemistry. Knowledge of mathematics is to be provided in other parts of the program as well. The framework of general engineering and special engineering studies has subjects to teach students to apply mathematics knowledge and skills in solving engineering problems. Other common subjects related to engineering in mathematics and physical sciences and engineering practice are the mechanical, electrical, electronics, materials, information technology, engineering graphics, environmental and human safety studies. All of these subjects to one or other extent (depending on the direction of study) must be studied in all of the training programs regulated by this Regulation.

2. Social science subjects are included in the basic university studies: economics, management, basics of law, accounting, industrial management, finance, personnel management, engineering economy, etc.

3. Part of special engineering / technological education (special study direction matters of professional practice and the final project) ensures the completion of basic training. In university study programs, many of these subjects must be components of the engineering model, the design objectives and criteria, analysis, synthesis, construction, testing, evaluation and decision taking into account economic factors, safety, reliability, aesthetics, ethics and social impact of students' creativity, education, modern design theories and methodologies and the development and application.

As a result of the study, a sample of 15 universities was drawn (22 universities and 23 colleges were registered in AIKOS[9] database in 2010). 58% of them are public and 42% are privately owned (or branches

[9] AIKOS is a register of studies and teaching programs which is administered by the Ministry of Education and Science; an open vocational information, counseling, and guidance system providing a wide range of users with information based on public, departmental, and other databases and registers, available online at http://www.aikos.smm.lt/aikos/programs.htm.

of foreign higher education institutions). The profile of the selected universities is considerably different and a relevant example for analysis. The curriculum analysis shows that of all study programmes analyzed nine have at least 25% of non-engineering subjects and 6 have less than 25% of non-engineering subjects and are thus categorized as 'traditional'. The tables 1 and 2 give an overview of analyzed study programmes in Lithuania, listing the name of the study programme, the degree of interdisciplinarity, and the proportion of female students. The list is sorted by the degree of interdisciplinarity in descending order.

Table 1

Range of innovative (interdisciplinary) study programs (more than 25% of non-engineering subjects in the curriculum)

	Study course/ Study program	Interdisciplinarity, %	1st year female students in 2009/2010, %	Female students in 2009/2010, %	Graduate female students in 2008/2009, %
1.	Engineering of Storage and Processing of Agricultural Products, Lithuanian University of Agriculture	41.3	0	0	21
2.	Environmental Protection Engineering, Vilnius Gediminas Technical University	40.0	52	53	79
3.	Agricultural Engineering and Management, Lithuanian University of Agriculture	39.9	19	17	24
4.	Engineering of Agricultural Production, Lithuanian University of Agriculture	38.2	0	0	33
5.	Environmental and Professional Safety, Siauliai University	34	79	65	58
6.	Water Supply and Management, Vilnius Gediminas Technical University	26.4	46	46	63
7.	Hydraulic Engineering, Lithuanian University of Agriculture	25.1	13	13	20
8.	Environmental Engineering, Kaunas University of Technology	25	66	66	72
9.	Mechanical Engineering, Vilnius Gediminas Technical University	25	4	4	6

Table 2

Range of traditional study programs (less than 25% of non-engineering subjects in the curriculum)

	Study course/ Study program	Interdisciplinarity, %	1st year female students in 2009/2010, %	Female students in 2009/2010, %	Graduate female students in 2008/2009, %
1.	Hydrotechnics, Lithuanian University of Agriculture	23.7	0	0	37
2.	Agriculture Mechanical Engineering, Lithuanian University of Agriculture	22.6	2	2	0
3.	Mechanical Engineering, Siauliai University	22	0	0	11
4.	Mechanical Engineering, Klaipeda University	21	0	0	7
5.	Mechanical Engineering, Kaunas University of Technology	20	4	4	13
6.	Environmental Engineering, Klaipeda University	16	52	53	58

The first data analysis showed that the tendency is that interdisciplinary degree courses have, on average, more female students than male, although this statement is not true in all the analyzed cases. By discipline, *Mechanical Engineering* has lower interdisciplinarity and thus lower rates of females enrolled (with the exception of Mechanical Engineering course at Vilnius Gediminas Technical University having 25%

of non-engineering subjects and attracting more women to studies). One of the factors to attract more women to the mentioned university is the geographical place (Vilnius is the capital). However, *Environmental Engineering* and *Environmental and Professional Safety* courses presented a high degree of interdisciplinarity and in general, better proportion of female students at all universities. The results show that in Lithuania *Environmental Engineering* programmes with more non-engineering subjects have more female students; i.e. hypothesis 1 is supported by Lithuanian results. The following interdisciplinary subjects have been identified in the innovative programmes: *Basics of Communication, Culture of Professional Language, Fundamentals of Law, Engineering Economics, Processes in Environment, Applied Ecology and Microbiology, Introduction to Waste Management, Fundamentals of Management, Basics of Environmental Economics and Law, Principles of Sustainable Development, Human Safety, Foreign Languages of study subject, Professional Communication, Ecology, Occupational Protection and Health, Environmental Chemistry, Micro- and Macroeconomics, EU and National Environmental Protection Law, Safety of Technologies, EU Labor Law or Occupational Health, Environmental IT, Extreme Situation Modeling and Safety Management, Economics and Sociology of Environment, Recreation*, etc.

In the next step we state the percentage and absolute numbers for student population in each study programme in order to answer the hypothesis of the research. For that purpose, the numbers of the first year students, total enrolled students, and graduates were disaggregated by gender in each study programme and these numbers were added to the sample. With regards to the second hypothesis, it can be highlighted that in general, the success rates for females are higher in most of the selected study programmes. It is worth mentioning that the percentage of women graduated in the recent years in both selected fields of engineering was higher than the proportion of new female students. Taking into account this empirical fieldwork, four engineering study programmes were pre-selected to be potential case studies for further analysis among the sample. Two case studies refer to 'innovative' study programmes with more than 25% of interdisciplinary subjects. The rest of the study programmes are 'traditional', with less than 25% of interdisciplinary subjects. An innovative and a traditional case study have been selected per study course and arranged in the following order (Table 3) for the next step of the research.

Table 3

Sample of the selected case studies

Case study	Interdisciplinarity, %	1st year female students, %	1st year female students	Female students, %	Female students	Female graduates, %	Female graduates
Traditional 1 Mechanical Engineering, Kaunas University of Technology	20	4.6	3	4.3	3	13.9	11
Traditional 2 Mechanical Engineering, Siauliai University	22%	0	0	1.2	1	10	4
Innovative 1 Environmental Engineering, Kaunas University of Technology	25	66.7	18	63	58	73	27
Innovative 2 Environmental and Professional Safety, Siauliai University	34	74.1	20	69.1	67	53.3	16

The quantitative analysis of study programs according to two criteria shows that higher degree of interdisciplinarity of study courses correlates to higher share of women students in E&T study courses. Average female enrolment in this Environmental Engineering discipline is 23.67%, although this percentage varies if we take into account the female first year average enrolment, which is almost two percent higher (25.56%). The average number of female graduates is considerably higher (32.77%), which shows higher success rates among females. In general, universities with higher rate of interdisciplinarity show higher success rates of 1st year female students, all female students, and female graduates.

Research shows that students' choice to study depends on geography, history and modernisation of institution, prestigiousness of study course, excellence in teaching, and endeavour to achieve employability in future perspective. In the case of Lithuania two different universities comprised the sample. The oldest technological university (which started as the Higher Courses in 1920) established in Lithuania

was Kaunas Polytechnic Institute (in 1950). The Institute became the main institution of E&T studies. In 1991, after restoration of independence, the Institute was reformed into Kaunas University of Technology aiming to modernize engineering education by renewing study programs and cutting study courses not relevant to national industry needs and to elaborate the pilot (aviator), transport engineering, fire sciences, road building engineering (all of them were served in USSR) studies. The second in the representative sample was chosen **Siauliai University** – a classical type higher education institution located in the north-western region of Lithuania, founded in 1997 by merging Siauliai Pedagogical Institute and Siauliai Polytechnic Faculty of Kaunas University of Technology. In academic year 2009 Kaunas Technological University reported official numbers of students to be 15652 (teaching staff being 1119) and Siauliai University had about 11000 students and 500 teachers.

The in-depth analysis of selected study programmes and particularly interdisciplinary subjects proceeded with some background information about the general engineering curricula in Lithuania. Bearing in mind the dramatically decreased interest in enrolling in engineering programs of study by women, the need for improving the attractiveness of these kinds of studies by providing innovative programs and challenging learning environments has been expressed. In particular it is expected that innovative curricula helps to interest female students and raise their share among the engineering students and graduates, which, in some engineering branches, is below 10%. Even if it is obvious that the curricula themselves are not the main reason for this unsatisfactory situation, we know from some experiences that innovative curricula can contribute significantly to better the situation.

Responding to demands of employers and trying to achieve employability do not necessarily cover all the interests of the students and future graduates, in particular when only short-term interests are satisfied in employer-oriented qualification profiles. Graduates need to be prepared for lifelong learning and for competing successfully on an ever changing labour market. In addition, students as learners with different abilities and learning styles want to find a certain diversity of offers and challenging learning situations addressing the increasing heterogeneity of the student body. They do not appreciate being threatened by inappropriate assessment and selectivity patterns. They also expect programs with a certain degree of flexibility in terms of individual options, recognition of prior learning, and the opportunity to profit from full-time or part-time or distance learning.

Conclusions

One of the aims pursued was to introduce into Lithuanian academic community (as well as into entire Lithuanian and European society) the topic of social gender specifics as it is conveyed in Lithuanian scientific community in general. More concretely, the focus is on some particular fields of women choices in engineering and technological sciences, where problem of women's underrepresentation is most evident today and in future will restrict the successful development of competitiveness of the country. The first quantitative analysis shows that the more non-engineering subjects the IT study programmes offer, the higher the female share among the students is. There is a tendency that women in interdisciplinary IT study programmes have higher success rates than women in traditional IT study programmes. However, more statistical data have to be obtained for a representative result.

The selected case studies are a relevant example for comparison purposes and to generalize the extent to understand if *innovative* or *traditional* study programmes help to achieve better student balance from a gender perspective. Interdisciplinary studies also give skills that help future engineers to cope in a changing environment. *Innovative curricula* show responsiveness to new demands and possibilities. Case studies show that universities enhance interdisciplinarity and transdisciplinarity by reconfiguring their teaching and research agendas to seize the opportunities offered by new developments in existing fields and by new emerging lines of scientific inquiry. This requires less focusing on scientific 'narrow' disciplines (physics, mathematics, chemistry, etc.) and more on research domains**,** associating them more closely with related or complementary fields (including humanities, social sciences, entrepreneurial and management skills), or offering courses that combine disciplinary depth with interdisciplinary perspectives, and fostering interaction between students, researchers and research teams through greater mobility between disciplines, sectors and research settings. Current curricula rarely address such mentioned challenges therefore making engineering education cross-disciplinary / interdisciplinary / multidisciplinary is a serious but worthy challenge.

Empirical evidence shows that social, cultural and academic factors appear to have more influence on female and male motivations and preferences than their underlying abilities have. The theoretical framework analyses the way in which individuals build their identity in a social context and also considers the way in which social values and beliefs affect in engineering and technological fields.

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Šidlauskienė V.

Mokslo suvokimo įtaka inžinerijos ir technologijos mokslų studijų pasirinkimui. Lietuvos atvejis

Santrauka

Straipsnyje pristatoma viena Europos Sąjungos ir neabejotinai Lietuvos moterų, studijuojančių ir dirbančių mokslinį darbą inžinerinių ir technologinių (IT) mokslų srityje, trūkumo problema. Nepaisant ankstesnių iniciatyvų aukštajame moksle, moterys sudaro mažumą IT mokslų ir studijų srityje. Šioje srityje lyčių disbalansas akivaizdus, todėl siekiama atkreipti mokslo bendruomenės ir visuomenės dėmesį į reikšmingiausius lyčių problematikos Lietuvos moksle aspektus, esamus ir galimus tokios situacijos padarinius tiek konkretiems individams, tiek Lietuvos mokslo ir net visos šalies raidai. Sistemiškai apžvelgus moterų įsitraukimo į minėtas mokslo sritis kaip į socialinį reiškinį, kurio pirminės priežastys, tikėtina, jog slypi ankstyvosios ir kiek vėlesnės − antrinės − socializacijos procesuose (šeimoje, mokykloje, visuomenėje, aukštajame moksle). Vėlesni šio reiškinio raidos ir plėtros mastai taip pat priklauso nuo visuomenėje vykstančių socialinių, kultūrinių, ekonominių ir politinių procesų, kurie daro įtaką stojančiųjų moterų į aukštąsias mokyklas pasirinkimui.

Mokslinė tyrimo problema formuluojama keliant šiuos probleminius klausimus: ar mokslo suvokimas ir visuomenėje vykstantys procesai lemia merginų IT studijų srities pasirinkimą? Ar padidinus IT studijų programų interdisciplininiškumą ir kartu technines bei technologines kompetencijas papildžius socialiniais ir perkeliamais gebėjimais, studijos tampa merginoms patrauklesnės? Tyrimas atliktas vykdant BP7 projektą *HELENA: Aukštasis mokslas, orientuojantis moteris studijuoti inžinerijos ir technologinius mokslus* su mokslininkų iš Austrijos, Prancūzijos, Jungtinės Karalystės, Serbijos, Ispanijos ir Lietuvos komanda. Tyrimo metodologija grindžiama kiekybinių ir kokybinių tyrimo duomenų trianguliacija, pradedant kiekybinių ir kokybinių duomenų rinkimą, pasikartojančią (iteratyvinę) pakopinę analizę institucijos, nacionaliniame ir tarpnacionaliniame lygmenyse. Vėliau numatyta ES šalių rezultatų tarptautinė lyginamoji analizė. Šiame straipsnyje pristatomas Lietuvos atvejis. Pradiniame tyrimo etape nustatyti studijų programų *tradiciškumo* ir *inovatyvumo* (*interdisciplininiškumo)* parametrai. Pirmojoje hipotezėje teigiama, jog studijų programos, kurių tarpdalykiškumas viršija 25 proc., yra patrauklesnės studijuoti moterims. Nustatytas priklausomas kintamasis – studenčių dalis visų studijuojančiųjų imtyje, nepriklausomas kintamasis – studijų programos tardalykiškumo laipsnis. *Neinžineriniai* studijų

dalykai operacionalizuoti kaip visi studijų dalykai, išskyrus fizikos, matematikos, inžinerijos ir technologijų dalykus. *Labiau patrauklūs* studijų dalykai operacionalizuojami, lyginant panašios studijų programos, kuriose neinžineriniai dalykai sudaro mažiau nei 25 proc., studijuojančių moterų dalimi. Antrojoje hipotezėje numatyta, kad moterų, studijuojančių tarpdisciplininėse studijų programose, studijos yra sėkmingesnės nei studijuojančiųjų tradicinius studijų kursus. Nustatytas priklausomas kintamasis – studenčių, sėkmingai baigusių studijas dalis visų studijuojančiųjų imtyje. Nustatytas nepriklausomas kintamasis – studijų programos tardalykiškumo laipsnis, o priklausomas kintamasis – įstojusių moterų dalis 2009 / 2010 m., pirmajame kurse studijuojančiųjų dalis 2009 / 2010 m ir baigusiųjų (absolvenčių) dalis 2008 / 2009 m.

Remiantis Godfroy, Pinault, Thaler, Wächter (2010) tyrimo metodologija, išanalizavus 126 inžinerinių ir 41 technologinių mokslų studijų sritis, iškeltai hipotezei patvirtinti atrinktos 23 studijų programos, kuriose įstojusių, studijuojančių ir studijų baigusių merginų skaičius yra arba mažas, arba akivaizdžiai didelis. Programos ranguotos pagal abu kriterijus. Devynios studijų programos tenkino tarpdisciplinišKumo kriterijų (= arba daugiau nei 25 proc. neinžinerinių dalykų), tačiau tik keturiose jų moterų studijavo daugiau: *Aplinkosaugos inžinerija* (40 proc. tarpdisciplinišKumas) VGTU; *Aplinkos ir profesinė sauga* (34 proc.) ŠU; *Vandens apsaugos inžinerija ir valdymas* (26,4 proc.) VGTU; *Aplinkosaugos inžinerija* (25 proc.) KTU. Penkios studijų programos (*Hidrotehnika*, LŽŪU; *Žemės ūkio mechanikos inžinerija*, LŽŪU; *Mechanikos inžinerija*, KTU, KU, ŠU, kurių tarpdisciplinišKumo laipsnis žemesnis nei 25 proc., studijuoti patraukia labai mažai moterų. Aptikta viena išimtis – *Aplinkosaugos inžineriją*, kurios tarpdalykiškumo laipsnis siekia tik 16 proc. KU, studijuoja daugiau nei 50 proc. moterų. Regioninio universiteto, artimesnio gyvenamai vietai, prioriteto motyvas gali lemti moterų studijų programos pasirinkimą. Apibendrinant galima teigti, kad Lietuvos tyrimo atveju pirmoji hipotezė, teigianti, kad studijų programos, kurių tarpdalykiškumas viršija 25 proc., yra patrauklesnės studijuoti moterims, patvirtinta. Tokios studijų programos yra inovatyvios, savo turinyje komponuoja socialinių, humanitarinių, kultūros, teisės mokslų dalykus, tokius kaip *Komunikacijos pagrindai*, *Profesinės kalbos kultūra*, *Teisės pagrindai*, *Aplinkosaugos ekonomika ir teisė*, *Inžinerijos ekonomika*, *Vadybos pagrindai*, *Darni plėtra*, *Ekologija*, *Profesinė sauga ir sveikata*, *Aplinkosaugos chemija*, *Aplinkosaugos sociologija*, *Mikro- ir makroekonomika*, *Ekstremalių situacijų modeliavimas ir saugus valdymas* ir pan. Tradicinėse studijų programose tarpdalykinių studijų dalykų, atspindinčių mokslo sričių ar krypčių sankirtas, nėra daug ir jose dominuoja vienos mokslo srities *gryni*, teoriniai studijų dalykai: *Matematika*, *Fizika*, *Chemija*, *Informatika* ir kt. Interdisciplininės studijų programos absolventams suteikia ne tik fundamentinių bendrosios inžinerijos ir cheminės technologijos žinių, aplinkos procesų ir aplinkos apsaugos technologijų, darniosios plėtros, aplinkos ekonomikos ir teisės principų supratimo, bet ugdo žodinio ir rašytinio bendravimo, komandinio, projektinio darbo, veiklos, laiko planavimo įgūdžius; lavina kūrybingumą, novatoriškumą, lankstumą, nuolatinio profesinio tobulėjimo siekį, t. y. bendrąsias kompetencijas, reikalingas šiuolaikinei darbo rinkai.

Antroji hipotezė pasitvirtino Lietuvos atvejo tyrimu: moterų, studijuojančių tarpdisciplininėse studijų programose, studijos yra sėkmingesnės nei studijuojančiųjų tradicinius studijų kursus. Vykdant pasikartojančią (iteratyvinę) pakopinę analizę nacionaliniu lygmeniu ir susiaurinant tiriamų programų kiekį, suformuota dviejų aukštųjų mokyklų (KTU ir ŠU), kurių kiekvienoje išskirta po interdisciplininę (inovatyvią) ir tradicinę studijų programas. Lyginamajai analizei užtikrinti abiejuose universitetuose parinktos analogiškos studijų programos, suteikiančios aplinkos inžinerijos bakalauro ir mechanikos inžinerijos bakalauro kvalifikacinį laipsnį. Būsimoje tyrimų stadijoje numatyta tirti tarpdisciplininių ir tradicinių studijų programų viešinimo medžiagą ir marketingą, studijų programų tikslinės grupės numatymą, karjeros, kokybiškos praktikos, skatinimo, mobilumo užsienyje galimybių pristatymą, šiuolaikinės studijų didaktikos ir kokybiško mokymo ir mokymosi sąlygų akcentavimą. Lygiagrečiai bus atliekama išskirtų interdisciplininių (inovatyvių) ir tradicinių studijų programų studentų (moterų ir vyrų) apklausa, taikant F2F interviu metodą, kuriuo siekiama nustatyti, kas efektyviau skatintų moterų inžinerijos ir technologijos mokslų studijų pasirenkamumą.

Pagrindiniai žodžiai: studijų dalykas, tradicinis, tarpdisciplininis, lytis, IT.

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