

“Good afternoon, gentlemen, is there a woman present?”

Gender Issues in Engineering Education

Christine Wächter

IFF/IFZ Graz

Address: Schlögelgasse 2, 8010 Graz, Austria

Phone: +43 316 813909-14

E-mail: waechter@ifz.tugraz.at

Abstract

Over the last 30 years, a variety of initiatives have been set up to involve more women in the study of engineering. Earlier attempts focused primarily on young women and making them more informed. Subsequently, stronger emphasis has been put on changing and improving degree courses and the cultures of engineering institutions. It is in this context that the project “WomEng – Creating Cultures of Success for Women Engineers”^{} is situated. In seven European countries, hindering and supportive factors for successful engineering careers of women have been investigated. One of the main questions was: “Once women have enrolled in engineering degree courses what factors affect their decisions to either persist or drop out?”*

It has been observed that drop out, rather than being a result of a lack of intellectual ability is dictated fundamentally by the discouraging climates found in the various departments, courses, and schools of engineering. For these women, contributing factors such as lack of practical experience, an alienating atmosphere, and weak to non-existent, non-specific faculty support play the decisive role in their decisions to leave.

It is vital for women to feel part of a larger engineering community. A sense of belonging is strongly linked to a student’s self-confidence, especially for female students in a minority and in male dominated degree courses.

Introduction

It has been observed that drop out of women engineering students, rather than being a result of a lack of intellectual ability is dictated fundamentally by the discouraging climates found in the various departments, courses, and schools of engineering. For these women, contributing factors such as lack of practical experience, an alienating atmosphere, and weak to non-existent, non-specific faculty support play the decisive role in their decisions to leave, all of which is highlighted by European and North American research such as Adelman 1998, Crawford/MacLeod 1990, Engler 1999, Goodman et al. 2002, Heublein 2000, Lewin 1995, Lewin et al. 1995, Minks 2000, Robst/Keil/Russo 1998, Rayman/Brett 1995, Sandler/Hall 1984, or Seymour/Hewitt 1997.

In the last 30 years, all over the world a variety of initiatives have been set up to involve more women in the study of engineering. Earlier attempts focused primarily on young women and making them more

^{*} The WomEng Project was carried out between 2002 and 2005 in the Fifth Framework Programme of the European Commission under “Improving the Human Potential and the Socio-economic Knowledge Base (IHP)“. Project Partners were CDEFI Paris, France (co-ordination); INSA Lyon, France; Technical University Kosice, Slovakia; University Wuppertal, Germany; University of Stirling, UK; EDEM Greece, Athens; WITEC Finland, Tampere. The Synthesis Report and further information can be found on the website www.womeng.net. This paper is based on a previously published version „Success and Non-Persistence in Engineering Education“ in the Conference Proceedings of the Final WomEng Conference (Thaler/Wächter 2005).

informed (Diegelmann 1995, Gaudard 1975, Heinzerling 1990, Kucklich 1996, Wächter 1999). Subsequently, stronger emphasis has been put on changing and improving degree courses and the cultures of engineering institutions (Bennett 1996, Copeland 1995, Godfrey 1995, Hering/Nöller 1996, Kahlert/Mischau 2000, Lewis/Copeland 1999, Wächter 2004). It is in this context that the WomEng project (www.womeng.net) is situated. The main question of work package 3 for the Higher Education sector was: "Once women have enrolled in engineering degree courses what factors affect their decisions to either persist or drop out." (Thaler 2005)

To investigate those issues, quantitative and qualitative methods have been applied. The results presented in the following are based on 1.336 questionnaire results of 699 engineering students (335 females, 364 males) and 637 non-engineering students (355 females, 282 males) in seven European countries (Austria, Finland, France, Germany, Greece, Slovakia, United Kingdom). Qualitative Sources comprise 21 focus groups with male and female engineering students, 60 interviews with students who study engineering (in Austria, Finland, France, Germany, Slovakia, UK), who quit, changed subject or could have but did not take up engineering, like the French example, (in Austria, Finland, France, Germany, Slovakia) as well as 48 interviews with representatives of the University Steering Committee who are in charge of curriculum development (in Austria, France, Germany, Slovakia, UK), male and female faculty (in Austria, France, Germany, Slovakia, UK), and Equal Opportunity Officers (in Austria, France, Germany, Slovakia, UK).

Key Results

Drop out

Generally, within the seven countries covered in this study, there is no specific data available. Drop out data is not gathered, not monitored, not evaluated. Some interview partners state that they think data is collected but they do not know where and what the exact figures are. Guessings vary between a range as far as between 10 to 60 percent.

According to our research, one third of the engineering students have thought about dropping out at least once. Apart from Finland, female engineering students think more often about it than their male colleagues. 70.1% of the students know of at least one colleague who dropped out of an engineering degree course.

The most difficult phase of a study is the entrance. Among other factors, students have to organise themselves, learn how to learn and handle the new freedom. Most of the drop outs happen in the first two years. The subjects in this time, though basic and important, are very "dry", as one interviewed expert put it.

Reasons for Dropping out

More than 10% of all engineering students of both genders questioned thought of dropping out because of the heavy workload, the different course expectations, or exam failures, and because of considering to change to another course.

The heavy workload dominates in Austria, whereas it is the course change in Finland. In France and in Great Britain it has more to do with the different expectations about the degree course, and in Germany and Slovakia most drop out thoughts are connected to poor exam performance.

More than three quarters of the students of both genders think that poor exam performances are the main reason for dropping out of an engineering degree course. More than two thirds also say that different expectations about the course and the heavy workload are further reasons for drop out. A little less than two thirds of the students think that a dislike of the subject could be a reason and more than one half believe that students who dropped out from engineering had changed into another course.

More females say that the dislike of the subject is very often a reason to drop out of an engineering degree course. On the other hand fewer females than males think that the heavy workload is a reason. The change to another course is slightly more often mentioned by females. The main difference to the female perspective is that males agree more with the heavy workload but not so much with the different expectations as main reasons for dropping out.

Austria has a high percentage of agreement with the statement “I did not feel comfortable”, followed by the German sample. In France this statement has no agreement at all. The feeling of isolation is also a bigger drop out reason in Austria, again followed by Germany, than in other countries. On the other hand the “low number of female students and teachers” is a relatively bigger reason in Great Britain to think about drop out than in the other countries.

Self Description and Drop out Thoughts

More than two thirds of all students see themselves as co-operative, logical, caring, and clever. Three quarters of the engineering students agree with co-operative and logical. Three quarters of the non-engineering students agree with caring and co-operative. All female students describe themselves to be more co-operative and caring. Males see themselves more as logical and rational. Nevertheless more than two thirds of the male students, as well, say that they are caring. Generally the self-images of the students fit to the image that others have of them. Male students are considered to be more competent in engineering relevant tasks, while females are regarded as harder working and more socially competent.

A look at the correlations between self description and thinking about dropping out shows some interesting country and gender differences. No drop out thoughts occur among

- Austrian female engineering students who describe themselves as rational and analytical and believe in their leadership qualities;
- Austrian male engineering students who see themselves as only a little or not co-operative;
- Finish female engineering students who describe themselves as team players;
- Finish male engineering students who see themselves as creative;
- French female engineering students who describe themselves as machine oriented;
- French male engineering students who see themselves as clever and logical and have a high degree of self-confidence;
- Greek female engineering students who describe themselves as determined, rational and competitive;
- Greek male engineering students who see themselves as intuitive and risk taking;
- Slovakian female engineering students who describe themselves as very co-operative;

- British female engineering students who describe themselves as very ambitious, very logical, very analytical, and very determined;
- British male engineering students who see themselves as very rational, very co-operative and very hardworking.

In Germany, there are no significant correlations between self descriptions, gender, and drop out thoughts.

Knock out Exams

More than a quarter of the students report knock out exams. About 60% of the students think that knock out exams lead to drop out. Almost 60% say passing knock out exams increases their self-confidence. But only 15.6% females and 26.3% males feel comfortable with those exams.

Gender Differences

Generally, interview partners say that fewer women drop out than men. That could be true considering their assessments of the motivation of female students to study. It could also be a biased conception. Since no data exists this is difficult to evaluate.

Interviewed experts and students, in general, say that there are no gender specific differences for dropping out. However, one gender difference mentioned in the expert interviews by both faculty and students is that female engineering students always have to justify their degree choice as it is perceived as not normal for a woman to study engineering. This can subsequently lead to a decrease in self-confidence. Students report that they have to justify their decision, that they have to perform better, that they constantly have to prove technical competencies. Often they are also addressed as “the secretary”.

And they are confronted with subtle but persistent discrimination in the form of jokes, remarks, different exam standards. Some students also report discrimination through wrongly understood politeness, for example some professors give women easier exam questions and better grades. But this is not what female students want and it does not help them at all.

Sexist jokes and remarks were mentioned by Austrian and Slovakian students.

Women engineering students require their needs be given equal consideration to those of the men. They are very sensitive towards women promotions because they think that could be seen as a privilege. Females need to be treated unbiasedly and to not always have their engineering competencies unduly questioned. Female students often are treated as if they can have no technical competencies. Problems of women are treated as individual problems, they are not seen as gender problems. Gender fair language is not used and is made fun of. Women have to get used to common male dominated language. But if someone is talking to them as an individual they want to hear terms that refer to them as females.

Coping Strategies

The most often mentioned coping strategy is talking problems over with friends or family members, or with colleagues. Only a few students consult counselling services offered by the university or student organization/union and seek professional advice.

Non-persistent students often reported that they did not talk about their problems with others but were brooding and tried to settle their inner conflicts by themselves. Doubts remain unspoken, partly because of fear of giving the impression of, or actually being a failure.

To turn to advisors or talk to professors seems to be more common in France. Communication with professors appears to be particularly difficult in Slovakia. Several students talk about not being treated like adults and not liking the demeaning behaviour of their university teachers.

The support from the department, including the secretaries, is very important for the students. Measures should aim at increasing communication, and stimulating and supporting bonding between staff and students.

Austrian experts mention several times that dropping out should not be seen as something negative, as a failure, but as a re-orientation that helps students finding a better solution for their careers.

Supportive People

While more than half of the engineering students agree that their parents were encouraging for their pursuit of an engineering career, only about one third of the non-engineering students see their parents as encouraging for the choice of their degree course.

The most important supporting persons for engineering students are friends and family, colleagues, room mates in dormitories, and members of the department. Study groups and tutorials are very important as well.

The support of family and peer group is vital for the pursuit of an engineering career. Female engineering students think that both parents are influencing them nearly the same way. Male engineering students think that the influence of their father is bigger. Role models are equally important for both sexes. Teachers have a stronger influence on women than on men.

Supportive Factors

More than two thirds of the students agree that interest in the subject matter in engineering, salary potential and employment opportunities were the most encouraging factors for their pursuit of an engineering career. Salary potential and employment opportunities are more important for male students than for females.

Self-confidence

More than two thirds of all students think that their ability to think analytically and critically and their communication skills increased during their studies. Two thirds of the engineering students say that they also improved their engineering and team working abilities, while more than one half of the non-engineering students say that their team working skills are better now.

Atmosphere

The atmosphere of the engineering department has a relatively high importance to all students (40.3%), but the importance is for females higher than for males (46.3% vs. 34.9%). The atmosphere of engineering courses is a more encouraging factor for females (41.9%) than for males (37.1%).

A little less than one half agrees that they have a healthy combination of private and studying life and the atmosphere at their department is supportive for their individual development and their personal concerns are valued. About one half of the engineering students describe the atmosphere in their degree course as a healthy atmosphere of telling stories and jokes.

More than half of the students want more co-operation in their department atmosphere. 40.1% of the males and 46.2% of the females want more personal concern too. More than half of the males but only one third of the female engineering students want more women students. More than one third of the engineering students (more females than males) want more women staff.

An interesting result is that the number of women in the major and the number of the women faculty are more discouraging for males (42.9% and 46.6%) than for females (29.0% and 34.7%). A little more females think that competition in engineering classes is discouraging (39.5%) than males (33.5%).

Infrastructure

Most students feel comfortable with using computer facilities, the library, and laboratory equipment. Females feel a little more comfortable with the workplace than males and equally comfortable with the workload. However, there is a big gender difference in using workshop equipment (41.4% females, 52.6% males) and asking questions in class (34.6% females, 45.4% males).

Interdisciplinarity

More than one third of the engineering students want to have more non-engineering subjects. There is only a slight gender difference. 34.6% of the male and 37.9% of the female engineering students want more interdisciplinarity in their degree courses. What is interesting is that more than one quarter of the non-engineering students say that they would have chosen an engineering degree course if more subjects from human and social sciences were included.

Austrian students (58.2%) want non-engineering subjects more than the other European engineering students (average number for seven countries = 36.3%). More Austrian females (64.7%) like to have non-engineering subjects than the Austrian males (53.3%), but most males also want to have more of them too. And the gender difference is not as big as in other countries (for instance Finland, where 35.0% females but only 16.7% male students want more non-engineering subjects). One explanation could be that the need for more interdisciplinarity is so big in Austria that the country difference is much higher than the gender difference. French students also say that more subjects from human and social sciences would have influenced their decision to study engineering (38.9%), with a huge difference between males (28.2%) and females (47.5%). Consequently, more human and social sciences in engineering studies will attract more women.

Recommendations

Students who experience a positive atmosphere in their department and classrooms are more likely to stay in engineering (Dahmen 2005, Sagebiel 2005). Social enrichment activities like guest lectures, field trips, social events can contribute to that. In addition to these social opportunities further support measures like mentoring, tutoring, skills workshops, career explorations are particularly crucial during the early years at university. Academic advisors, fewer required “grunt” courses in the first two years and more room to

pursue interest outside of engineering are other recommended measures. Networking and study groups can help to counteract the isolation that women in engineering may experience due to their minority status.

Internal Study

Cultures and history of universities differ not only between countries but also within countries. Therefore it is highly recommended to look at institutions specifically to develop particular measures. See, for example the successful program to retain female students in computer science at Carnegie Mellon (Blum 2001a, 2001b).

Statistical Data

So far, data about dropping out is not gathered, not monitored, not evaluated. To have a firm basis for university planning, it is vital to have access to statistical gender aggregated data.

Exit Interviews / Questionnaires

To learn more about the motivation and reasons of students who quit a degree course or change to another subject, exit interviews or questionnaires should be institutionalized.

Curriculum Reform

Approximately 50% of all students, male or female, drop out in the first two years. Subjects in the first two years are basic and dry. The problem is not a female one. A reformed curriculum, including some project oriented seminars where students get an impression what it would be like to work as an engineer, could influence the drop out rates. There is, however, a conflict since some universities like the drop outs because they do not want such a high number of students and in many minds there is still the idea prevalent that only those who survive the dry basic subjects have the right to persist.

More Interdisciplinarity

Curricula do not fit the requests of work life reality and therefore engineers can lack certain social competencies also required in the profession. The myth that engineering is so complicated leads to the wrong idea that it must be taught purely and without other disciplines – so that graduates become “real engineers”. But interdisciplinary degree courses have supportive aspects for students and reflect real work life situations. Existing curricula must be evaluated.

Shorter Study Duration

Austrian experts consider the long study duration a major cause for the high drop out rates. To reduce the long duration of studies is perceived as an important issue. Thus, the introduction of the Baccalaureate is by some experts seen as a measure to reduce the drop out rate. A short study offers the students a closer aim and helps them to get better orientation and overview.

“Common Year”

Reducing the duration of study and the introduction of a “Common Year” for all first year students of all degree course may decrease the drop out rates. It works successfully at the University of Mining in Leo-

ben, Austria. The “Common Year” is a guided first year where all students learn the basics together, learn how to organize themselves, learn how to prepare themselves for exams and after one year they can decide which degree course they choose. This approach could better inform the students and their decisions.

“Catch up” Courses

“Catch up” courses for students with different or insufficient levels of knowledge from high school should be offered for male and female students. These additional knowledge requirements should be made available to all high school graduates. But they must be a voluntary offer for students who think they lack something.

More Group and Project Work

Group and project work is appreciated by both male and female students. However, it is much more work for lecturers and students.

Improve Didactic Skills of Faculty

Professors and assistants need pedagogical competencies. Professors and assistants should learn about adult education and gender before they teach students.

Gender Sensitivity and Gender Mainstreaming Training for Students and Staff

Gender equality should be an interdisciplinary topic for every degree course. It should give at least one lesson in the beginner tutorials, where the issue can be discussed. Gender trainings should also be obligatory for every professor and assistant at the university. Gender fair language – in words, pictures, illustrations, and examples used – should be a standard (in every paper, on each web site, and especially in the courses) for an institution which always claims to want more females.

Contact Persons

Gender sensitized contact persons should be available at a low threshold level, so that students are encouraged to talk to somebody they can trust. This aims at increasing the number of students who seek advice and accept counselling as an enriching and supporting service.

Social Counselling Service

The University of Stralsund, Germany, for example, offers a social counselling service, especially students who are afraid of exams find help there. Many female students are fraught by this kind of anxiety.

Install “Communication Zones”

“Communication Zones” help to increase interaction with faculty and encourage more personal talks. Support from the department, including its secretaries, is very important for the students. Therefore, measures should aim at increasing communication, and stimulating and supporting bonding between staff and students. A Technical University is a place where people should get in contact and communicate with others, there should be room for that purpose.

Entry Events to lower the “Cultural Shock” in the First Semester and More Tutorials

In these courses students get introduced to the university, to the buildings, infrastructure, how to learn, how to organize the study, what they can expect from their study. This strategy does not help to avoid drop out but it helps students to find out at an early stage if this degree course is suitable for them and if it will meet their expectations. Students will realize faster if they have chosen the wrong degree course. Tutorials for beginners are helpful but they also need to be enriched with gender issues.

Mentoring for Female Students as well as for Female Faculty

Mentoring is very important for female students. They can get advice, learn to avoid the usual troubles, learn from faults of others.

More Accompanying Measures

Accompanying measures, like guest lectures, field trips, career explorations, skills workshops, are helpful for female students during semester time, to better keep in touch better with their demands and needs and to avoid dropping out or changing of degree courses. Such measures are extremely important especially during the first months.

Role Models and more Female Staff in Engineering Subjects

It is vitally important to make women engineers visible. Hiring more female staff, especially in engineering subjects, is strongly recommended. Young women should see that being a women goes well with being an engineer. Furthermore they need more information about what contains an engineering degree, which jobs they can get afterwards and how the career prospects look like. Using gender-sensitive language avoids the situation of giving some female students the feeling that they are not welcome. Positive role models play an important role in challenging prejudices like “Women cannot be engineers.”

Present a Different, more Appropriate Image of Engineering

Technology counts as destroyer of the environment. An engineer is a rational, analytical, problem-oriented person. Engineers are not supposed to be creative. Stereotypical assumptions perceive engineers as competent, qualified, having a lot of experience, being field-oriented, and earning a lot of money. There are a lot of prejudices against female engineers, they are not expected to be good engineers. Role models are missing, a female engineer is always an attraction. Female engineers are watched more critically therefore one sees more mistakes. There is a prejudice that engineers are interested only in technology. The image of technology is hard. Women are responsible for the soft things. To counteract these stereotypes and to present appropriate images and information, women and men actually working as engineers should meet young students and explain to them what they do. It is very important to have women and men doing that. A television serial which would show women scientists or engineers could also give insights in what engineers do and help changing women's image in the general public.

Better Information

To decrease the drop out rate more information about the degree course and the professions, more engagement and open house days are necessary. Technical Universities and high schools should co-operate more closely and better inform their students what additional knowledge could be useful for their further

education. More easily accessible, readable, and complete information about the degree courses as well as about other aspects of studying engineering (such as study groups, counselling services, networks, internships, studying abroad, etc.) addressed to all high schools. This would make students' choices easier and they would know better what to expect from university studies (content, extent, form, and requirements).

Conclusion

A detailed country-specific analysis of European data is very important. European engineering education has many potentials (and needs) for improvement. Stumbling blocks and factors of success differ in the various European countries, but they also differ for female and male engineering students.

It is vital for women to feel part of a larger engineering community. A sense of belonging is strongly linked to a student's self-confidence, especially for female students in a minority and in male dominated degree courses. It can be promoted and increased when they experience that their peers, professors, family, and friends believe in their engineering abilities and genuinely want them to be part of the engineering community.

References

- Adelman, Clifford (1998), *Women and Men of the Engineering Path: A Model for Analyses of Undergraduate Careers*, U.S. Department of Education and The National Institute for Science Education, Washington, DC.
- Bennett, Liz (1996), "Für ein verändertes Curriculum in der Ingenieurtechnik", in: BMBWF (Ed.), *Frauen gestalten den Strukturwandel. Engagement von Frauen im technischen Bereich*, Leipzig, 169-178.
- Blum, Lenore (2001a), "Women in Computer Science: The Carnegie Mellon Experience", http://www-2.cs.cmu.edu/~lblum/PAPERS/women_in_computer_science.pdf [03.06.2003]
- Blum, Lenore (2001b), "Transforming the Culture of Computing at Carnegie Mellon", <http://www-2.cs.cmu.edu/~lblum/PAPERS/TransformingTheCulture.pdf> [03.06.2003]
- Copeland, Jane (1995), "Not stirring up trouble: Women engineering students talk", in: *Second Australasian Women in Engineering Forum*, Report, Melbourne, 13-18.
- Crawford, Mary; MacLeod, Margo (1990), "Gender in the College Classroom: An Assessment of the 'Chilly Climate' for Women", in: *Sex Roles*, 23 (3/4), 101-122.
- Dahmen, Jennifer (2005), "Who or what creates a successful study environment? – How female engineering students in Europe assess their study situation", in: Thaler, Anita and Christine Wächter (Eds.): *Conference Proceedings of the International Conference „Creating Cultures of Success for Women Engineers“*; 6.-8. 10. 2005, Leibnitz/Graz, IFZ Eigenverlag, Graz, 63-71.
- Diegelmann, Karin (Ed.) (1995), *Mädchen in Naturwissenschaft und Technik. Dokumentation eines Schulprojekts*, Darmstadt
- Engler, Steffani (1999), "Hochschullehrer und die Herstellung von Geschlechtergrenzen: Der Empfang von Studentinnen und Studenten in Elektrotechnik und Erziehungswissenschaft", in: Neusel, Ayla and Angelika Wetterer (Eds.) *Vielfältige Verschiedenheiten. Geschlechterverhältnisse in Studium, Hochschule und Beruf*, Frankfurt am Main, 107-134.
- Gaudart, Dorothea (1975): *Zugang von Mädchen und Frauen zu technischen Berufen*, Wien
- Godfrey, Liz (1995), "Transforming cultures. School, university and workplace", in: University of Technology Sydney (Ed.), *Australasian Women in Engineering Forum*, Report, Sydney, 29-35.
- Goodman, Irene et al. (2002), *Final Report of the Women's Experiences in College Engineering (WECE) Project*, Cambridge, MA, http://www.grginc.com/WECE_FINAL_REPORT.pdf [20.11.2002]

- Heinzerling, Maren (1990), *1. Münchner-Mädchen-Technik-Tag*. Dokumentation als Leitfaden zur Vorbereitung von Mädchen-Technik-Tagen, München
- Hering, Barbara and Monika Nöller (1996), "Der Bielefelder Modellversuch 'Frauen im Ingenieurstudium an Fachhochschulen' – Geschlechtsspezifische Aspekte in Lehre und Studium", in: *22. Kongress Frauen in Naturwissenschaft und Technik*, 16.-19. Mai 1996 in Braunschweig – Dokumentation, Darmstadt, 118-126.
- Heublein, Ulrich (2000), *Lebensorientierung und Studienmotivation von Studienanfängern*, HIS-Kurzinformation, Hannover.
- Kahlert, Heike and Anina Mischau (2000), *Neue Bildungswege für Frauen. Frauenhochschulen und Frauenstudiengänge im Überblick*, Frankfurt am Main.
- Kucklich, Clarissa (Ed.) (1996), *Erst ausprobieren – dann studieren. Bundesweite Sommeruniversität für Frauen in Naturwissenschaft und Technik*, Frankfurt am Main
- Lewin, Karl (1995), *Studienabbrecher 1994: Zukunftsperspektiven*, Hannover.
- Lewin, Karl, Heublein, Ulrich, Sommer, Dieter and Heidi Cordier (1995), *Studienabbruch: Gründe und anschließende Tätigkeiten. Ergebnisse einer bundesweiten Befragung im Studienjahr 1992/94*, Hannover.
- Lewis, Sue and Jane Copeland (1999), "We're tired of talking about women: working with men to address the culture of male dominated work and study places", in: *Winds of Change. Women & the Culture of Universities*, Conference Proceedings, Vol. 2, University of Technology, Sydney, 755-761.
- Minks, Karl-Heinz (2000), *Studienmotivation und Studienbarrieren*, HIS-Kurzinformation, Hannover.
- Rayman, Paula and Belle Brett (1995), "Women Science Majors: What Makes a Difference in Persistence after Graduation?", in: *Journal of Higher Education*, 66 (4), 388-414.
- Robst, John; Keil, Jack Keil and Dean Russo (1998), "The Effect of Gender Composition of Faculty on Student Retention", in: *Economics of Education Review*, 17 (4), 429-439.
- Sagebiel, Felizitas (2005), "Gendered Organisational Cultures in Engineering. Theoretical Reflections on WomEng Results and Future Research Perspectives", in: Thaler, Anita and Christine Wächter (Eds.): *Conference Proceedings of the International Conference „Creating Cultures of Success for Women Engineers“*, 6.-8. 10. 2005, Leibnitz/Graz, IFZ Eigenverlag, Graz, 143-156.
- Sandler, Bernice R. and Roberta M. Hall (1984), *Out of the Classroom: A Chilly Climate for Women?*, Washington, DC: Project on the Status and Education of Women, Association of American Colleges.
- Seymour, Elaine and Nancy M. Hewitt (1997), *Talking About Leaving: Why Undergraduates Leave the Sciences*, Boulder, Co.
- Thaler, Anita (2005), "Influence of Gender and Country-specific Differences on Success in Engineering Education", in: *Proceedings of the Fourth European Conference on Gender Equality in Higher Education*, 31. 8.-3. 9. 2005, Oxford.
- Thaler, Anita and Christine Wächter (Eds.) (2005): *Conference Proceedings of the International Conference „Creating Cultures of Success for Women Engineers“*, 6.-8. 10. 2005, Leibnitz/Graz, IFZ Eigenverlag, Graz 2005.
- Wächter, Christine (1999), "FIT – Female Careers in Technology. A Women-into-Engineering-Program at the Technical University in Graz, Austria", in: *Winds of Change: Women & the Culture of Universities*, Conference Proceedings, Vol. 2, University of Technology, Sydney, 788-793.
- Wächter, Christine (2004), "Gender-inclusive interdisciplinary engineering education – Reaching for the stars?", in: Werner Lenz and Annette Sprung (Eds.), *Kritische Bildung. Zugänge und Vorgänge*, Münster, 273-291.