

Women in Male-Dominated Technology Study Programmes – Findings of a Survey Conducted at the Kiel University of Applied Sciences

*Britta Thege*¹

1 Introduction

Despite all the efforts of policy makers, educators and researchers to go against gender stereotyped study choices and to overcome structural barriers, especially in the STEM (science, technology, engineering and mathematics) subjects/SET (science, engineering and technology) field over the last 25 years, study choices in German universities remain fairly gender specific. Although the top leading study, business management, is the number one choice of both genders, the following subject choices in the ranking are prominent: The five dominating subjects chosen by women are German philology, medicine, law, pedagogy and English language and literature studies; by men, mechanical engineering, computer sciences, electrical engineering, law and business information systems. The difference in higher education results, further on, in occupational segregation, horizontal as well as vertical.

At the Kiel University of Applied Sciences conspicuous gendered study choices are noticeable in three of the six faculties: At 75%, female students are clearly overrepresented in the Faculty of Social Work and Health and, with 10%, clearly underrepresented in the Faculty of Computer Science and Electrical Engineering, as well as in the Faculty of Mechanical Engineering with 12%. The current gender composition of the social and engineering study programmes is highly imbalanced; men are persistently in the minority in the study of Social Work and women in the study field of Engineering.

In contrast to so-called hard-core engineering course programmes, three cross-disciplinary programmes at the Kiel University of Applied Sciences, which combine business and engineering know-how, seem to attract more women,

1 Dr. Britta Thege | britta.thege@fh-kiel.de | Kiel University of Applied Sciences | Institute for Interdisciplinary Gender Research and Diversity (IGD) | Kiel, Germany

namely, Business Information Systems (BIS), Technology Management/Marketing (TMM), and International Sales and Purchase Engineering (ISE). While the proportion of women in the hard-core engineering fields lies between 5 and 10%, the proportion in BIS, TMM and ISE is almost 20%. In total, 787 students were registered at the Kiel University of Applied Sciences in the winter semester of 2011/2012 in these subjects; 143 (18.2%) women and 644 (81.8%) men. Job opportunities for graduates are perceived as being very good in these fields:

- The consecutive study programme Business Information Systems (BIS) (Bachelor/Masters) offered by the Faculty of Business Management qualifies students for management positions in information and communication systems in the economy and in public administration.
- The interdisciplinary study programme, Technology Management/Marketing (TMM), is the result of cooperation between the Faculty of Computer Science and Electrical Engineering and the Faculty of Business Management, qualifying students for posts in management and marketing interfaces mainly in the power technology business and the field of information and communication technology.
- The study programme, International Sales and Purchase Engineering (ISE), offered by the Faculty of Mechanical Engineering, combines basic education in engineering with business management know-how and foreign language competence in order to qualify students for posts in sales management, purchasing and the conception of high-quality technical products as well as services and system solutions.

However, not all students complete their studies successfully. The discontinuation rate in BIS (B) was 15% (SS 2009) in TMM, 6% and in ISE 3% (WS 09/10). In this context, the Institute of Interdisciplinary Gender Research and Diversity at the Kiel University of Applied Sciences, in cooperation with the Faculty of Business Management, was interested in exploring the study satisfaction of students as well as the stress factors that could possibly interfere with study success or even lead to students dropping out of the three highlighted study programmes.² The major interest of the survey, however, was to investigate gen-

2 This article is based on a research project undertaken by the Institute for Interdisciplinary Gender Research and Diversity (IGD) in cooperation with the Faculty of Business Management. I would like to thank Prof. Dr. Roswitha Pioch, Prof. Dr. Doris Weßels and Annelie

der differences. The risk of termination of studies is influenced by a multitude of individual and external factors. In our context we were particularly interested in external factors, such as satisfaction with study conditions and study successes, because besides wrong notions of one's own capabilities and wanting study success, institutional shortcomings have a major impact on increasing the risk of termination of studies (cf. Heublein/Spangenberg/Sommer 2003: 59). Our research question was whether women in three cross-disciplinary course programmes combining engineering and business management were less satisfied with their studies, exposed to greater study problems and more likely to drop out of studies compared to their male counterparts.

2 Data collection and sample description

The research was conducted in December 2011 through a quantitative survey using a questionnaire that contained closed questions as well as some open-ended questions. With the consent of the lecturer, questionnaires were distributed to students and collected by staff of the Institute of Interdisciplinary Gender Research and Diversity prior to their courses. Completed questionnaires were coded and analysed by means of the statistics software SPSS Version 20.0 for Windows.

In total, 270 students participated in the survey, 54 women and 212 men (4 missing values), which corresponded to 34% of all registered students in Business Information Systems (BIS, Bachelor/Masters), Technology Management/Marketing (TMM), and International Sales and Purchase Engineering (ISE). The sample was fairly representative of the basic population registered in the three course programmes under investigation; both in terms of students' proportions in the subjects and the proportions of the two genders in the subjects (cf. Table 1 and Table 2):

Tallig for their indispensable contributions to the project and Sabrina Flindt in particular for the data processing.

Table 1: *Students' proportions in the course programmes and in the sample, WS 2011/12*

Course	Basic population %	Sample %
BIS (B)	22.6	15.6
BIS (M)	5.7	5.1
TMM	27.3	28.9
ISE	44.4	50.4
Total	100.0	100.0

Table 2: *Female and male proportions in the course programmes and in the sample, WS 2011/12*

Course	Women registered KUoAS		Men registered KUoAS		Total reg. students	Women in sample		Men in sample		Total sample*
BIS (B)	14	8%	164	92%	178	4	9%	39	91%	43
BIS (M)	9	20%	36	80%	45	3	23%	10	77%	13
TMM	46	21%	169	79%	215	19	25%	57	75%	76
ISE	74	21%	275	79%	349	28	21%	106	79%	134
Total	143	18%	644	82%	787	54	20%	212	80%	266

* Four missing values.

3 Findings

3.1 School education and vocational education background

School and vocational qualifications have a significant impact on study choices and there is evidence given for a correlation between advanced-level courses at school and study choices (cf. BMBF 2008: 3-4). Research shows that, firstly, students of universities of applied sciences who specialised in the natural sciences segment at school are likely to take up a study in engineering, although

far fewer girls than boys choose mathematics, physics or chemistry as a special course (except biology). Secondly, significantly more students registered at universities of applied sciences have considerably more vocational experience or were professionals before the beginning of their studies than university students (ibid).

Our interest in the respondents’ educational background was therefore based on the assumption that subject choices at school, as well as professional experiences gained prior to study admission, influence study choices and that women and men studying BIS, TMM or ISE have dissimilar educational backgrounds; consequently, women lack technical qualifications compared to their male counterparts and, thus, are put at disadvantage at the beginning of their studies. As a result, their ‘subject-specific interest’ as a motive for their study choice may be much weaker compared to the interest of their male fellow students.

About 31.5% of the female and just over 46% of the male students had taken a technical or computer-related special course during their school education. However, the greater proportion of trained male students is noticeable. Women chose physics as a special course significantly less often and biology significantly more frequently, which fully corresponds with other study findings (BMBF 2008). They also possessed fewer experiences in repairing and handcrafting. The greatest confidence with regard to being successful in their studies in future is drawn by both genders from the conviction that they are capable of understanding facts easily and that they have always succeeded in doing things up to now.

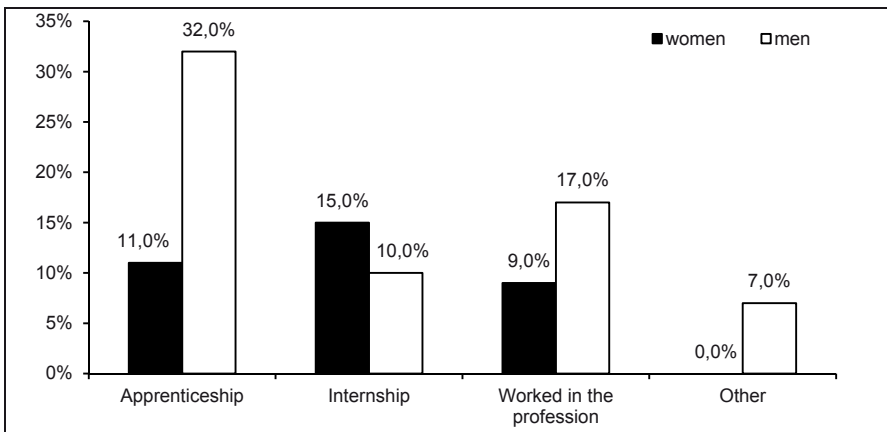


Figure 1: Vocational education background according to gender

Moreover, men had significantly more confidence in completing their studies based on their practical technical competences, while women based this on their mathematical competences.

Of the total sample, two-thirds (67%) of the male students had completed a vocational training before taking up their studies, and just more than half of the female students (52%). Almost 40% of all respondents had a specifically technical or computer-related qualification – with a significant gender difference: in contrast to 43% of male students, only 28% of female students had a technical or computer-related background. As figure 1 illustrates, the proportion of male students with a completed vocational training is, at 32% almost three times as high as for females. With 17%, almost twice as many men as women had already worked in a job. Finally, in contrast, 15% of women, 5% more than men, had completed a study-related internship. In conclusion, male respondents had far more practical, job-related experience than women from which they might benefit during their studies and which women still had – if at all – to acquire.

3.2 Reasons for study choices

Study motives can be distinguished into extrinsically and intrinsically motivated choices. While extrinsic motivation arises from outside the individual, intrinsic motivation arises from within. From a variety of motives in this survey, more than half of the respondents gave extrinsic motives for their subject choice, namely, good career and good income prospects as well as many job opportunities; intrinsic motives were primarily related to interest in the subject, the hope of obtaining a managerial position and personal affinity/talent. However, subject choice at school, as indicated above, was of minor significance (see Table 3).

Several studies provide evidence for a dominance of intrinsic motives with regard to study choices (cf. Willich et al. 2011; Brahm/Gebhardt 2011). Yet, it is said that in universities of applied sciences material motives (such as a good salary) occur more frequently than in universities; hence, our results corresponded with this finding.

Table 3: *Motives for subject choices, agreement*

Motive for subject choice/all	Agreement %	Motive
Good career prospects	78.9	extrinsic
Good income prospects	54.9	extrinsic
Many job opportunities	54.5	extrinsic
Subject-specific interest	45.5	intrinsic
Obtaining a managerial position	36.8	intrinsic
Affinity/talent	27.8	Intrinsic
Relative/acquaintance has a similar occupation and has inspired me	17.3	extrinsic
Personal development	16.5	intrinsic
Particular career aspirations	13.9	intrinsic
Testing one's own abilities/skills	12.4	intrinsic
First study choice could not be realised	9.0	extrinsic
Subject choice at school	9.0	intrinsic
Good work-life balance	3.4	extrinsic
Other	2.6	

According to Lojewski (2011), there are gender-specific differences in terms of the importance of extrinsic and intrinsic motives; for women it is supposed that intrinsic motives are more important than for men. Hence, our interest in students' reasons for subject choices was based on the assumption that the women in the sample tended to have intrinsic and men tended to have extrinsic motives for their individual choices. However, Fisher's exact test with Bonferroni correction showed no significant differences between the two genders with one exception: among the intrinsic items 'subject-specific interest' stood out. This item was affirmed by only 22% of the female but by 51% of the male students. Here, the Fisher test was significant through the Bonferroni correction minimised alpha level ($p < .0001$) and indicated a significant gender-specific difference between male and female students.

3.3 *Satisfaction with studies*

Our interest in study satisfaction was based on the question as to whether female and male students differ in their study satisfaction and, if so, in terms of which

aspects, namely, study conditions, course programme organisation, course programme quality, social aspects and university services. We assumed that female students would show in particular greater dissatisfaction with social aspects because of the male-dominated environment. Furthermore, we were also attentive to faculty-related differences. The survey measured satisfaction by 20 items (some general items, specific course programme-related items, as well as some personality-oriented items) on the Likert scale in forced-choice format with four levels, that is, 'satisfied', 'rather satisfied', 'rather dissatisfied' and 'dissatisfied'. From a maximum of a total score of 60, a score of 18 to 58 was reached. The average in the sample was 40.04, which means that across all items respondents were 'rather satisfied' with studies and the overall assessment of the study conditions, course programme organisation, course programme quality, social aspects and university services was very positive. The highest scores received, which for us was a bit unexpected, were the items 'lecturers' acceptance of women' and 'fellow students' acceptance of women', both affirmed by more than 94% of respondents. These positive scores gave proof of the fact that despite the male-dominated environment in BIS, TMM and ISE, female students did not feel discriminated against. The highest shares of dissatisfaction were for the items 'contact with students in other study courses' (59%) and 'overall faculty communication and cooperation' (55%), both attributable to aspects of study organisation and not social disharmony. In terms of gender differences, the assumption that female students' satisfaction differs from that of their male fellow students was tested with the Mann–Whitney U test and came out as not significant ($p > .2$) for all items.

3.4 Sense of achievements in studies

Study success is perceived as one of the most powerful conflict factors in terms of termination of studies. Aspects of achievements considered in the survey concerned the period of study, grades and certain individual experiences in terms of achievements (self-assessment). The latter was captured with the items 'can cope with assignments', 'regular success in exams', 'received praise', 'can present well', 'study is congruent with personal abilities', 'well connected with male fellow students' and 'well connected with female fellow students'. First-year students were deliberately omitted from answering this question because they lacked experience.

All respondents were studying during the prescribed period of study. The mean value of respondents' grades was 2.5 with a wide range from 1.2 to 4.5.

We assumed that study success factors such as successful exams and assignments or positive feedback from lecturers lessen intentions to drop out of studies and that the sense of achievement of female and male students differs in such a way that women underestimate their performance.

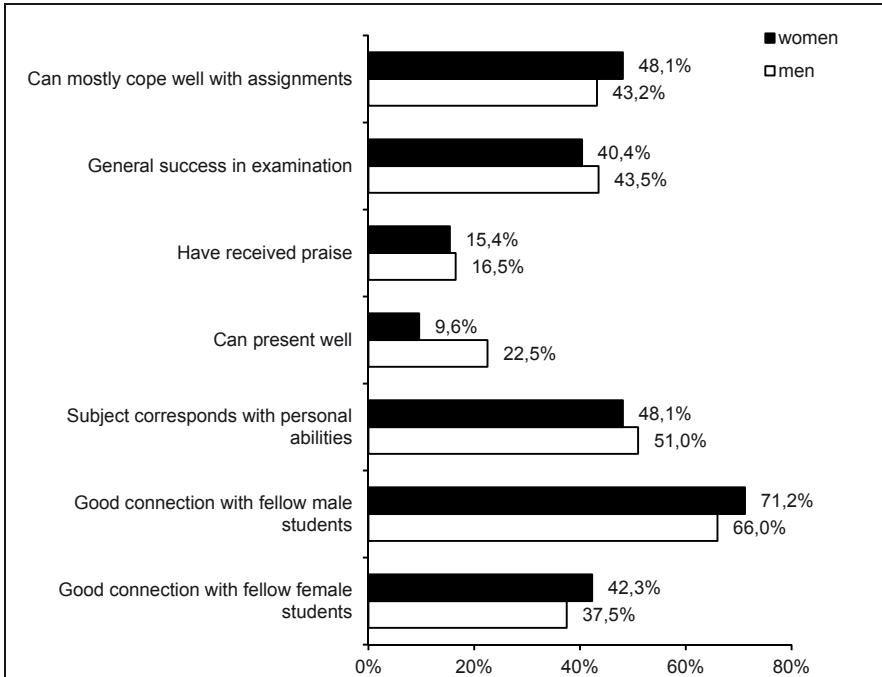


Figure 2: Sense of achievement in studies according to gender

Except for the item concerning presentation skills, all other items were more or less equally distributed. Women seem to be a bit better networked (social integration is a supporting factor to remain in study) and can cope better with assignments. Men do a bit better in exams and for more than half of male respondents the subject corresponds with their personal abilities, while this was true for just 48% of the female respondents. Across all study programmes most students did not assess their presentation skills as good. However, with only 9.6%, significantly fewer women than men, with 22.5%, assessed their presentation skills as

good. Measured with Fisher's exact test this was the only significant gender difference regarding sense of achievement in studies ($p = .005$).

3.5 *Study problems and demands*

Working against study success is the question of study problems and demands. Generally, study problems refer to preparing for exams and study planning (cf. BMBF 2008: 23-24). A research study on causes for termination of studies (Heublein/Spangenberg/Sommer 2003) found differences in the problems experienced by university students and students of universities of applied sciences. In universities of applied sciences two problems stood out, namely, financial problems³ and job-related reorientation which is linked to the strong practical orientation of this group of students (ibid: 111). Our interest in study difficulties and demands was based on the assumption that study-related stress or personal problems can burden students and result in their dropping out and that male students feel less burdened than their female counterparts. We investigated the question of to what extent performance standards, orientation within the subject, contacts among each other or interaction with lecturers or finances created problems for the students and whether gender differences were detectable.

The most pronounced problems in our survey concerned study-relevant factors, namely, workload, preparing for exams, finances and, in this context, the reconciliation of study and gainful employment.⁴ Clearly more men felt stress and experienced problems in particular with performance requirements, workload, finding structure in their studies, regimentation, timely submissions, and lack of working groups. More women were aware of the burden of trying to reconcile their studies with their family life.

3 Students of universities of applied sciences often have a less affluent family background compared to university students and depend on gainful employment alongside their studies, which in turn conflicts with study demands.

4 It is supposed that gainful employment of more than eight hours per week can impact on the study process and possibly delay it (BMBF 2008: 22). Fifty-two per cent of the students in this sample (140 out of 270) stated that they were working in gainful employment along with their studies. Of these the majority worked more than eight hours per week: 37% up to ten and 47% up to 19 hours per week. However, 15% worked even more than this: 11% between 20 and 25 hours and 4% more than 25 hours per week.

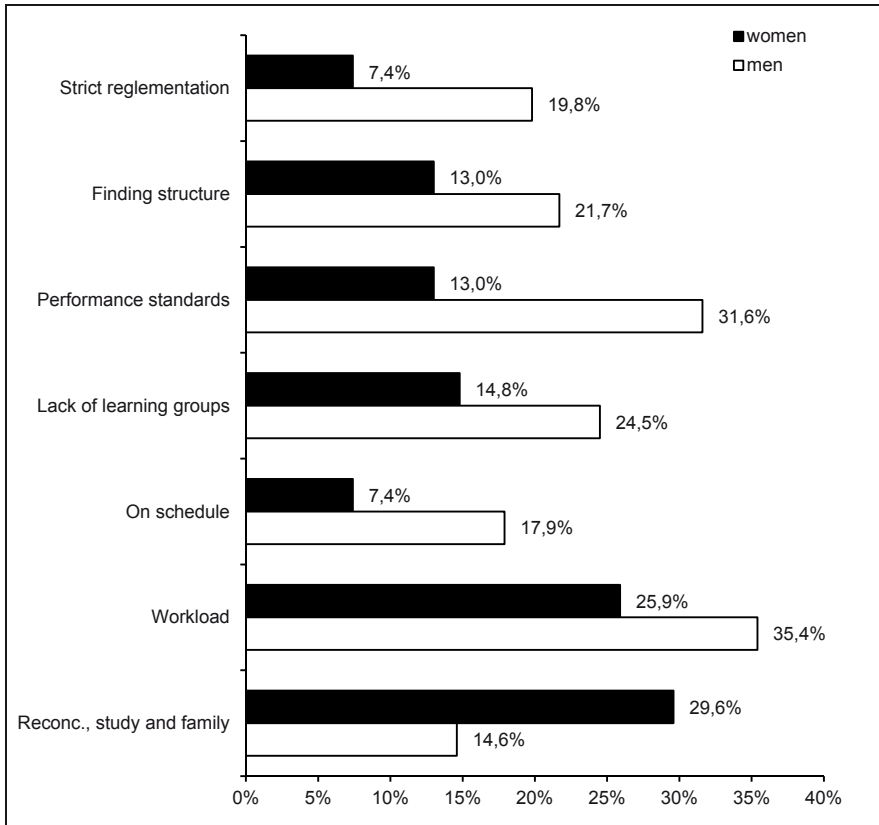


Figure 3: Problems and demands experienced in studies according to gender

3.6 Thoughts about change of subject/change of university/ interruption of studies or termination of studies

In the context of problems and demands during studies, as well as in terms of study choice decisions, thoughts about change of subject, change of university, interruption of studies, or termination of studies are serious matters. In the whole of Germany, 8% of university students and 6% of university of applied sciences students had seriously considered terminating their studies, while another 14% considered it from time to time. Since this was primarily as a result of individual rather than institutional causes (cf. BMBF 2008: 25), it was recommended that

termination of studies should not be taken as an indicator for the ‘study quality’ of a study programme (ibid). A study conducted at the Hamburg University of Applied Sciences found that there is no outstanding single cause for termination of studies but many overlapping causes (Richter 2006). Although there no gender differences were revealed with regard to causes for the termination of studies, the priorities of causes differed. While the lack of subject-related and personal integration into the faculty was pivotal for women to terminate studies, it was the pressure of gainful employment alongside with studies for men.

By means of a three-level scale (‘frequently’, ‘rarely’, ‘never’), students in BIS, TMM and ISE were asked in our study if they had ever thought of changing the university or the subject, or of interrupting or terminating their studies. In cases where students answered ‘frequently’, they were asked to state reasons.

Only small percentages of respondents stated having thought ‘frequently’ about changing the university or subject or about interrupting or dropping out of their studies:

- Change of university: 4.4%
- Change of subject: 8.8%
- Interruption of study: 4.1%
- Termination of study: 6.3%

In addition to personal reasons (e.g. illness), reasons for a possible university or subject change, an interruption or even termination of studies were linked to dissatisfaction with the quality of studies and/or lecturers. Thoughts of termination of studies were not explicable in terms of students’ possible deficient study requirements (for both genders). There was also no correlation between thoughts of termination of studies and length of working hours outside university ($r = -.019$ ($p > .41$)), although students had mentioned in the context of another question that the reconciliation of studies and gainful employment is a constraint. Finally, there were no conspicuous differences in any of the items with regard to gender distribution.

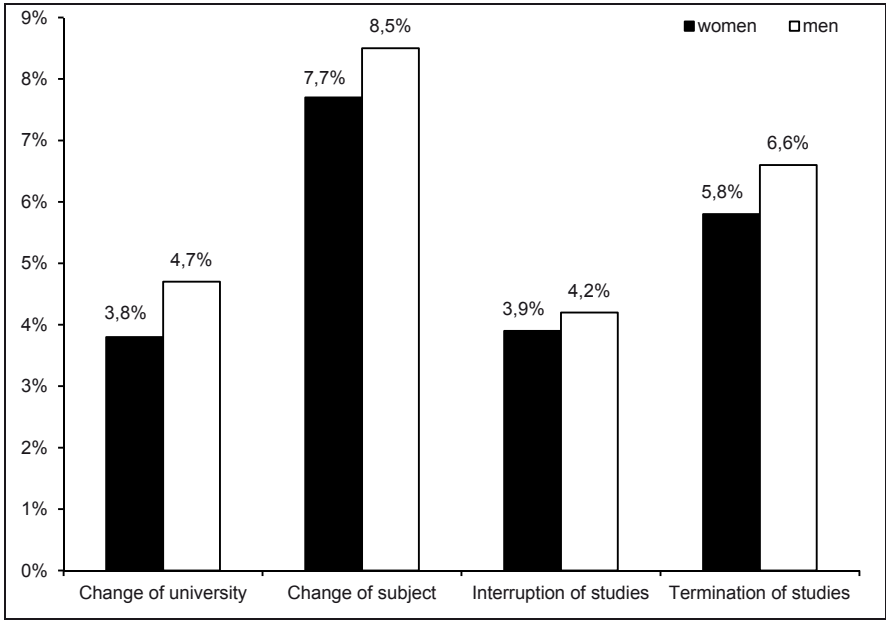


Figure 4: Thoughts of subject and/or university change, interruption or termination of studies according to gender

4 Conclusion

Three cross-disciplinary programmes offered at the Kiel University of Applied Sciences combining business management and engineering attract more female students than pure engineering subjects. In the winter semester of 2011/2012 about 18% women were enrolled in Business Information Systems (BIS, Bachelor/Masters), Technology Management Marketing (TMM), and International Sales and Purchase Engineering (ISE). Thirty-four per cent (N = 270) of all 787 registered students in these three cross-disciplinary study programmes took part in the research, which investigated possible gender differences in relation to study satisfaction, study success, study problems and dropping out of studies.

The small research study sought to explore correlations between study motives and educational choices or job experiences prior to the study, on the one hand, and study success or, in contrast, study problems, on the other. Three ex-

trinsic motives led in the ranking list of the most pronounced reasons for study choice; firstly, good career prospects, secondly, good income prospects, and thirdly, having many job opportunities. With one exception no gender differences occurred and women studying BIS, TMM or ISE did not show greater intrinsic motivation than men. In contrast, the intrinsic motive 'subject-specific interest' was affirmed by only one-fifth of the female but half of the male students, denoting one significant gender difference in study choice motives. The study confirms that women's 'subject-specific interest' as a motive for their study choice was much weaker compared to the interest of their male fellow students.

Another significant gender difference occurred in terms of a technical or computer-related qualification. A far greater proportion of male students had either a technical or computer-related school or vocational education background and job-related experience before studying than their female counterparts. Yet, in relation to their (self-assessed) study successes women's less pronounced qualifications prior to their studies did not impact negatively on their performance.

Apart from the item concerning presentation skills all other items for study success were relatively equally distributed and not significant. Although the majority of students across all study programmes assessed their presentation skills as weak, significantly fewer women than men assessed their presentation skills as good. Measured with Fisher's exact test this was the only significant gender difference regarding sense of achievement in studies. Pronounced study difficulties and demands, on the other hand, were tested as significant: more men than women felt stress and problems, in particular with performance requirements, workload, finding structure in their studies, regimentation, timely submissions, and lack of working groups, while more women felt the burden of balancing their studies with their family life.

In conclusion, women studying BIS, TMM and ISE felt remarkably less burdened by study requirements compared to men. In accordance with the overall positive assessment of their studies only a few students stated having thought 'frequently' of either changing university or subject or to interrupt or drop out from their studies. Reasons for this were personal or related to dissatisfaction with the quality of studies and/or lecturers. No conspicuous gender differences in any of the items became evident.

In sum, the quantitative survey could not provide evidence for discriminatory practices against, or indications of disintegration and exclusion of, female students in the three cross-disciplinary course programmes. Hence, subsequent to

this study a qualitative research study would be beneficial in order to provide deeper insights into the dynamic processes of the teaching and learning cultures in the three course programmes. Particular attention should be paid to investigating in more detail and depth the finding of this survey; that is, the rejection of any discrimination against female students.

5 Lessons to learn for women in science

Technical or computer-related education prior to the study of Business Information Systems, Technology Management/Marketing, or International Sales and Purchase Engineering is certainly desirable and helpful especially at the beginning of the study. Yet, it is not a determining factor for study success. If women pursue a career in these sectors, they still have a good chance of succeeding in their studies without preparatory training. Likewise, weaker intrinsic motives do not impact negatively on study success. Social acceptance of women by male fellow students and lecturers in a rather male-dominated study environment, and good social integration, seem to be crucial support factors for women's study success, as well as general satisfaction with study conditions and the quality of study. Comprehensive courses combining engineering and management are attractive to both genders since they offer good job and career opportunities. By attracting far more women than pure engineering study courses they have the potential to support change to a less traditional culture in the faculty.

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