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Gender neutrality improved completion rate for all

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Abstract

The purpose of the present study was to investigate if we could improve throughput by refurbishing an online programming course from a gender perspective, while maintaining the focus on preferable learning approaches. The study builds on results from an earlier study that investigated the relationship between approaches to learning and course completion and involves 1067 students that responded to the short version of the Approaches and Study Skills Inventory for Students (ASSIST) in 2010, 2012 and 2013. Three principles for course material design were identified; *gender neutral and non-biased messages, emphasize the interdisciplinary approach and link to everyday examples*. Responses to ASSIST were analysed in relation to performed changes in the course literature from a gender perspective. The probability to complete the course increased with 7 percentage points for all students, in particular for males, and decreased for students with a high score in surface approach to learning, especially among females.

Keywords: Gender neutral, course literature, online, assist, completion rate, higher education

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1. Introduction

Cultural and social stereotypes can produce self-fulfilling prophecies and traditional gender-based stereotypes can thus (unintentionally) influence the design of computer software (Huff, 2002). In a study where teachers designed educational software, it was found that the designer provides one social context of computing but another social influence comes from the situation and environment where the software is used (Huff, 2002). Games or software designed explicitly for girls, as well as how technologically savvy females are portrayed in popular culture, can reflect and sustain a simplistic and binary distinction between genders (Sele, 2012). By legitimizing gender differences it may also reinforce a gender-based concept of male technology use being the norm (Cassell, 2002; Huff, 2002; Magee et al., 2011; Rode, 2011). A social context is needed in order to understand gender, as well as to see gender in the context of social expectations of what women and men can do (Huff, 2002; Rode, 2011). The difference being about the situation rather than the ability in itself, where stereotype threat (being judged based on societal stereotype about one's group) may disrupt the performance and underperformance thus reflects the effect of lowered performance expectations (Spencer, Steele & Quinn, 1999; Huff, 2002).

Studies performed by computer engineering educators pin down the problem to be innate differences between male and female students, thus reproducing the view of women being homogenous exceptions from the norm (Salminen-Karlsson, 2011). A gender researcher see different problem areas, such as students being socialized in a masculine environment where their choices are rooted in their rationales of context practices and a cultural view where characteristics, mechanisms and ethos in computer education works as excluding (Salminen-Karlsson, 2011).

In this study we investigate whether the same can be said about course literature in a programming course. Is it constituted in a way that discourages the participation of females and/or students not identifying with the subject and if so, what can we do about it?

2. Background

2.1. Course

For this study we focused on a preparatory course in programming at university level, delivered online with self-paced learning. The course is offered during the whole year, but a large proportion (4/5) of participants attend it during the summer. It is designed to even the variations in levels of programming knowledge among new students applying to university programs containing mathematics in Sweden, which includes engineering students. The course contents correspond to initial studies in an introductory course in computer science at engineering programs in Sweden. A requirement for admission is for students to have a secondary school degree, which includes at least the third of five levels in mathematics. There are no requirements for prior knowledge in neither computer science nor programming. The course is an opportunity to gain a sense of experience and self-confidence especially for students with less experience of pre-college programming, which in general applies to women (Cohoon & Aspray, 2006). The course has been offered since 2006 and since 2011 the number of students have been 1400-1800 each year. Completion rate has been rather constant at 77 %, with males at 81 % and females 10 percentage points below.

The course introduces some basic elements of programming and computer logic thinking. It consists of four different examinations embedded in the course material to give a basic understanding of, for example, how a file system is constructed. All students have access to mentors who are available by either phone or email to assist with any questions that

may arise during the course. There is also a course forum where students have the opportunity to engage in discussion with their peers and mentors.

The examinations in the course use computer assessment, mostly generic questions (Bälter, Enström, & Klingenberg, 2013), as well as multiple-choice and fill-in the blanks questions. If the student gives an incorrect response, they receive immediate feedback after completing the test. This is designed to promote high levels of scholastic attitude and learning outcomes, and the premise that immediate feedback is related to student motivation (van der Kleij, Eggen, Timmers, & Veldkamp, 2012). The requirement for performance and completion is simple: when a student has successfully completed all four examinations during the course, they pass the course. Course completion is equal to passing the course; the only grades are pass or fail.

2.2. *ASSIST*

The short form of Approaches and Study Skills Inventory for Students (ASSIST) consists of 18 questions. The Swedish translation has been evaluated and validated in earlier studies (Heinström, 2005; Öhrstedt, 2009; Bälter et al., 2013). It was distributed to students in the preparatory programming course in 2010, 2012 and 2013.

ASSIST is an inventory to evaluate students' approaches to learning and studying. A deep approach to learning has a focus on comprehension; new knowledge is assimilated into pre-existing to create meaningful connections. A surface approach to learning is about producing what the teacher wants and nothing more through mechanical rote memorization, rather than improving knowledge. A strategic approach to studying is an organized form of approach where effective study technique is a tool to be successful and get good grades. Memorization and rote learning of definitions is sometimes a necessity in order to create

knowledge, what makes it deep or surface approach to learning is whether the intention is of seeking understanding and meaning or not (Entwistle, 1988).

A previous study on this specific course and student group revealed that males had significantly lower mean in strategic approach to learning, but no correlation between gender and completion was found (Bälter et al., 2013).

2.3. Motivation and hinders

The decision to study engineering is a mixture of and influenced by interests, ability, knowledge, self-image and perceptions of the subject (Barnard et al., 2012; Ngambeki et al., 2012). To encourage more females to subjects such as Computer Science may not only be to change the subject in itself, but to change the perception of the subject and through that women's perceptions of themselves in the field (Dempsey et al., 2015). A perceived misalignment between the subject and communal goals have been found to factor in with career decision and thus to the underrepresentation of women in the fields of science, technology, engineering, and mathematics (STEM) (Diekman, Brown & Johnston, 2010). A Danish study found no difference in intrinsic or social good motivation between genders' educational choice for students engaged in engineering programs related to computer, ICT or software (Kolmos et al., 2013), which could indicate a lack of diversity among students. Also, the lack of women in engineering in general and especially in ICT may only be the most obvious and easily measured sign of homogeneity that excludes not only women, but also other prospective students who fear they will not fit in.

Intrinsic motivation is an important factor for females to choose to apply and persist in computer science, varying cultural and socio cultural contexts can thus cause women to move on to other domains on which to base their identity and self-esteem, such as fields that emphasizes social imperatives (Barnard et al., 2012; Doubé & Lang, 2012). The masculine

culture that surround technology can also affect career choice for women who stay in the field, where they are drawn to areas less associated with the masculine stereotype, such as user interfaces, quality assurance or project management (Faulkner, 2007; Rode, 2011; Doubé & Lang, 2012). This cultural gender problem with the subject matter and the way it is organised can be reflected by a technicist orientation toward analytical problem solving without involvement of social complexity (Faulkner, 2007). Newly established programmes apply interdisciplinary content and methods as well as a more holistic and broader contextual approach, e.g. environmental engineering, health and medical technologies, media studies, systems engineering, design and biotechnology (Barnard et al., 2012; Kolmos et al., 2013). To make the technology more tangible can provide a connection to real life and thus provide a purpose and relevance to learn programming (Zimmermann & Sprung, 2008). Prevailing teaching methods add to the problem, reflected by a lack of student-centred learning, contextual issues, socio-technical approach and diversity in the engineering curriculum. It is not the content per se that is the problem, but how it is taught. To meet this problem, engineering must be transformed to make it more flexible, inclusive and appropriate for social and global realities (Mills, Ayre & Gill, 2010; Brawner et al., 2012; Sele, 2012).

Concerns about positive discrimination can also be a hinder in the question of encouraging women into engineering (Barnard et al., 2012). For example, if we focused on gender differences (as they are perceived today) and designed an education in line with what we thought that female students sought, it would only reproduce a gender division and reaffirm essentialist thinking (Frieze & Quesenberry, 2013). Women themselves can feel as if they are getting part of undeserved success or unwanted attention based on their gender, where their competence can be judged, while men may see it as females get special positive treatment due to their gender (Herring & Marken, 2008; Kolmos et al., 2013). Being continuously judged by or self-fulfilling the negative stereotype of women in the field as well

as having to explain why they are in the field can give women a feeling of not belonging and to disidentify with the field as well as working as a demotivator (Spencer, Steele & Quinn, 1999; Faulkner, 2007).

2.4. Stereotypes

Discrimination can be either of a more direct and active kind, or be perceived more as a gender bias with generally recognized gender roles (Viefers, Christie & Ferdos, 2006). In the latter, discriminating concepts are symbolic and sometimes even subtle, where the use of language is related to a perception of reality and is constructed in the context of a culture (Cassell, 2002). By continually being projected and recreated, a word's meaning gets authority as well as a character of truth. Central concepts become confirmed and fortified as male, which contributes to a process of alienating females (Erson, 1992). The issue of gender in engineering is thus not one of femininity, but one of masculinity (Beddoes, 2013).

Characteristics come from computer science being described as non-diverse and a male profession (e.g. Sele, 2012). This norm is, sometimes unconsciously and unwillingly, planted in the environment and continues to live on. Both the organizational structure and the cultural discourse of the occupation and education have been dominated by male values. Computer Science and Engineering traditionally has an ethos with deep-seated cultural values, where "cultural myths prevail regardless of the real characteristics of the environment" (Salminen-Karlsson, 2011). This culture in engineering departments is a contributing factor to why students leave engineering; they find it difficult fitting into engineering and don't feel comfortable or accepted (Amelink & Meszaras, 2011; Meyer & Marx, 2014). If students on the other hand have a sense of belonging in the environment it will improve their perception of their own ability in the field, since comfort level has been shown to be a positive influence on success in computer science courses (Wilson, 2002;

Veilleux et al., 2013). Females generally have lower self-efficacy regarding computer science, they do not identify strongly with computer science as field and subject and they tend to underestimate their knowledge and skills, so to change their perception of themselves in the field could be a way to increase their comfort level and self-efficacy (Zimmermann, Sprung, 2008; Dempsey, 2015).

Females are not solely affected by the stereotype of women in engineering; there seems to exist a distinction between women who enrols in engineering education and so called “normal” women, where the stereotype of women in technical education is differenced from other women. For many women, as well as for some men, the social construction of gender within engineering can be problematic (Rode, 2011). Women in male dominated fields tend to maintain contradictory views, by upholding the gendered stereotypes but also subscribing to ideals about the accessibility and inclusiveness (Powell, Dainty & Bagilhole, 2012). When constructing an identity, female students separate and distance themselves from "normal women" to be an exception from the rule, "one-of-the-guys", as not to be seen as an outsider, often by undermining and downplaying their femininity (Salminen-Karlsson, 2002; Barnard et al., 2012; Sele, 2012). In order to develop positive gender identities, perceptions of the gendered nature of engineering must be challenged on an individual level (Powell, Dainty & Bagilhole, 2012). To be a student in computer science should not require to conform or model one-self to the stereotypical norm, neither for women nor men (Fisher & Margolis, 2002). The solution to overcome the homogeneous student group should not be to help women to adapt to a traditional masculine education, since then the male hegemony will not be solved (Salminen-Karlsson, 2002; Kolmos et al., 2013).

Therefore, one way to reduce the problem with under recruiting of women to the field of engineering may be to make the instruction material gender neutral, as in the present study. To minimise the risk of alienating students due to gender or culture by aiming for a

heterogeneous target group initially, rather than making them stand out as opposed to an otherwise homogeneous group (Salminen-Karlsson, 2002). To interrogate the gendered dimension of engineering and the (re)construction of gender in this context is to broaden the diversity of the student population, which will benefit the field both in education and practice by broadening and increasing the perspectives (Vieffers, Christie & Ferdos, 2006; Beddoes, 2013).

3. Method

The present study was performed in three steps. Firstly, literature on gender issues in computer science engineering was reviewed and formed the basis for three principles of gender neutrality in course material. Secondly, the course material was reviewed after these principles and, when necessary, the course material was changed accordingly. Thirdly, this new course material was tested on 242 students similar to the 825 students who previously had attended the course and answered the ASSIST inventory. The reason for using the ASSIST inventory was that we wanted information on whether we encouraged the right study behaviour among our students. The examination in the course remained the same, which makes the results comparable.

3.1. Principles of gender neutrality

The literature study was based on a search in the Scopus database. It was performed with and limited to search criteria regarding gender and diversity in a computer science and/or engineering context as a basis, with a time limit of 2010-2015. The search was limited to title, which means some sources may have been excluded in this initial stadium. After excluding sources that were correct regarding search criteria but wrong regarding context (e.g. about physiology), 244 articles were set up as base result. A primary screening where articles were

excluded based on title (e.g. main theme was sound waves) as well as criteria of having been cited at least once (exception for articles from 2015) left 131 articles from 69 different sources. The last step was to read abstracts, which left 61 articles in 32 journals. This stage excluded articles that had a clear focus on grades in a CS course during K-12-education, only focused on the use of computers in the educational process, focused on correlation between minorities and outcomes, apprenticeship programs and mentors to create or retain interest during a whole program, faculty environment and involvement as well as gamification of the learning process. Socializers, particular regarding childhood, is hard to recreate for students in their twenties as well as a schoolteacher's en/dis-couraging role and the way society recreate an image of gendered hobbies for children (Powell, Dainty & Bagilhole, 2012). At university level it is also hard to encourage an interest in math and science during school (Barnard et al. 2012), we had to appeal to those already in our target group.

The study resulted in three principles that were used to analyse the course literature from a gender neutral and non-biased perspective: Gender neutral and non-biased messages, Emphasize the interdisciplinary approach and Link to everyday examples.

3.2. Statistical Analysis

The course results and the answers to the ASSIST questionnaire were analysed to determine the independence of samples, correlations, and effects of each study approach through regression analyses. Kendall's tau coefficient (τ) was used to measure the strength of association between course completion and different factors. The nonparametric Wilcoxon rank-sum test with continuity correction was used to compare groups and to see if they were the same. Once we established the existence of association and correlation, binomial logistic regression was used to evaluate the effect of each study approach in relation to course completion. The three approaches acted as independent variables, and pass-or-fail acts as the

dichotomous dependent variable. For all of the statistical analysis, a significant level of $\alpha = 0.05$ was used.

4. Results

This study concerns a short online course with no contact with the students, which made suggestions such as faculty involvement and support groups for minority students not applicable in the context, see table 2. In an effort to make principles that were supported by literature as well as easy to apply for someone not an expert in gender research, three principles were found to be suitable for our context. As seen in table 1, each principle could be said to have several subcategories, which if used would defy easy-to-apply in a practical setting concerning the course literature.

<Table 1>

<Table 2>

4.1. Literature changes

1) Gender neutral and non-biased messages: It is of importance that the text is general in both language and examples, so that as few students as possible would feel alienated from the material. There is no such thing as a cultural or gender-neutral design, but it is possible to implement a design that is inclusive and does not reinforce or endorse traditional values and stereotypes (Cassell, 2002; Viefers, Christie & Ferdos, 2006; Mills et al., 2010; Magee et al., 2011; Doubé & Lang, 2012; Cheryan, Meltzoff & Kim, 2011). The literature should be written from a student perspective, rather than male or female, so as not to marginalize any gender; when all students are central and diverse, so are female students (Cassell, 2002). The history of computing was not to be falsified or hyperboled but widened and broadened, where students were given examples from different aspects of the field.

The literature was cleansed from jokes about coders and coding that reflect a traditional stereotype of the field, which the course is not intended to amplify, in order to increase interest and anticipated success as well as a more diverse feeling of belonging (Cheryan, Meltzoff & Kim, 2011). The examples were also reviewed and were made less abstract as well as less gendered. Where there had been an example of the if-else control structure about a mother who did not want her little boy to freeze, is now a more gender-neutral example based on a students' desire to sleep in in the morning. This was a larger change, since it involved multiple instances over several pages (see table 3).

2) *Emphasize the interdisciplinary approach*: Since the course is intended for students without any prior programming experience there should be no phrasing that enhances the stereotypical role of a programmer as a lone male, but to give a more modern and broadened picture of the subject and the profession. In order to go beyond narrow and deterrent stereotypes of programming and programmers, the subject should not be presented and represented as a male interest and career, but rather as a practice and a craft that often is creative and social and where the coder is in a constant learning process (Doubé & Lang, 2012; Cheryan, Master & Meltzoff, 2015). A more faceted view of the subject that challenges incomplete and incorrect notions about the field could help enhance the perception of and interest in the subject, which in turn can have an impact on motivation and the decision to persist (Barnard et al., 2012; Ngambeki et al., 2012; Meyer & Marx, 2014; Dempsey et al., 2015). In chapter 1 the students get information about computers, programming and the application of them. Two sub-chapters were added: first of all one that focused on what it is to code as well as the width of career opportunities and one about the specific programming language used in the course. This was written with a focus on communication in and about coding and how coding is an activity where both technical and social expertise is required,

contrary as to described in popular culture (Faulkner, 2007; Sele, 2012).

Links to actual research, such as social robotics, was included in order to demonstrate the subject's interdisciplinarity and the width of ways coding can be used, as well as to spark an interest for increased motivation after the course. An example of a smaller change (table 3) was to introduce the Jacquard loom, to show one important step in computing that is not that commonly known among non-programmers.

3) *Link to everyday examples*: Bringing in contextual issues and emphasising real-world examples has been shown to increase the understanding and motivation for learning (Cohoon & Aspray, 2006; Kolmos et al., 2013). Examples should be permissively designed considering interplay between complex gender identities and technology as to establish a more equal culture and not to re-construct and consolidate concepts for a normative gender structure and symbolism (Erson, 1992; Magee et al., 2011; Sele, 2012).

Programming is (simply put) problem solving with the help of different tools. For a student who has never seen a code editor or compiled even the simplest "HelloWorld" program it is an abstract and strange new world. So it is important to make them understand what code is, how it looks like, what it does and why, with examples from a more familiar environment. Instead of explaining computer software in terms of knitting we made the analogue cooking, which all students should be able to relate to better. Examples were generally made less abstract, in order to make them more relatable.

<Table 3>

On the page with general course information, a video was added where a newly examined female engineer in computer science working in the field and spoke about her interest in

coding and why it is fascinating (“The fascination of programming “, 2014). Having a female was partly due to her merits and partly to balance the fact that the course leader welcoming the students to the course in a video is male. Also, the visibility of successful women in the field could act as an encouraging influence by creating female role models (Zimmermann & Sprung, 2008; Rosenberg et al., 2010).

4.2. Sample

Approximately 4039 students attended the specific course in 2010, 2012 and 2013, of these 1067 students (26%) responded to the ASSIST inventory. In Sweden it is difficult to know who is really participating in a course, as there are no fees to apply, nor any consequences of not resigning from a course you have signed up to. The tradition at this university's programming courses is therefore to consider all students who complete the first examination as "registered" and we use the same definition in this paper.

There were no significant differences between the students in the old and new course; they were similar when it came to gender (approximately 1/3 females) and age (median age of 22 and mean age of 24).

4.3. Changes in outcome

The percentage of students who passed the course has increased between the two groups (see Table 4) as whole ($p < 0.01$) and for males ($p < 0.05$). The increase in throughput for females is not significant. In the old course there was a difference in that the males completed the course in a significant higher rate than females ($p < 0.05$), a difference that disappeared in the new course.

<Table 4>

4.4. Changes in approach

A surface approach to learning was found to be associated with whether the student has completed the course or not, in that the higher score in surface approach the less the probability to complete the course (see figure 1).

<Fig. 1>

The association between a surface approach to learning and probability to pass the course was most significant for females, where those who passed the course went from an average score of 11.4 to 10.2 ($p<0.05$) and the median changed from 11 to 10. Females who failed the course went from a median of 12 in the old course to 14 in the new. In the old course a mean of 11.4 for students who passed the course has decreased to 10.7 in new course ($p<0.01$), while males' score has decreased from 11.4 to 10.9 ($p<0.1$). This means that the probability to pass the course increases with a lowered score in surface approach to learning. Differences not mentioned were insignificant.

4.5. Changes among students who passed the course

In the old course, there were differences in number of tries between genders for part 2-4 and total number of tries ($p<0.01$), see table 5. In the new course females had increased number of tries on part 1 compared to their male counterpart as well as old females ($p<0.05$), but this did not lead to a significant increase in total number of tries.

<Table 5>

In the old course, males completed the course in an average of 22 days which was significantly faster than the females' 32 days, see table 5, ($p<0.001$). Even though there is no difference between males in the old and new course, nor females in the old and new course, in

the new one males and females have evened up and the difference is now less significant between genders ($p < 0.05$).

5. Discussion

Our aim with the course redesign was to increase female completion rate. We did succeed with increasing completion rate for males, as well as to remove any significant difference in completion rate between the genders. In both courses the percentage of women who complete the course is around 2 percentage points lower than the percentage of women who are registered for the course. The proportion of women who completed the course increased with 5 percentage points, compared to 7 percentage points increase for men. Throughput increased for all students, men as women. The increased completion rate is not part of a pattern of increase over the years; especially for males the throughput is a significant increase.

We did succeed to increase the negative correlation with course completion and a surface approach to learning. Since a surface approach can be a pragmatic reaction to badly constructed courses and material, the fact that we succeeded with this suggests that we are on the right track to orient the students to a more deep approach to learning. That students completed the course in a shorter rate of time could suggest increased motivation among the students, which is a key element for success and persistence (Kolmos et al., 2013).

An objection to our study may be that it only involves implementing good pedagogy, instead of actively trying to affect the gender problem. In line with Frieze & Quesenberry (2013) we want to argue that factors built on diversity rather than innate gender differences can help to promote participation and motivation. Focusing on an inclusive course literature broadens the material from a narrow binary view to a more complex composition. Diversity in computer science and engineering is not only about gender, but to get its practitioners to reflect society at large. If a student has a positive experience in their first computer science

course, their intention to take another is stronger (Beyer, 2014), which indicates that to improve an introductory course like the one in this study is important for long-term effects in the field.

6. Conclusion

Huff (2002) claims that it is possible to eliminate gender bias in software design, but since the outcome depends heavily on the context of usage this is not the most straightforward way to reduce gender differences in the choice of computing as a career. To ensure a width of technology applications and solutions encourages innovation and attraction for all (Cassell, 2002). The same could be said about curriculum design, it is not about trying to make an education woman friendly; it is about making it accessible and more diverse in order to attract a heterogeneous student group and an inclusive curriculum can and should be both gender and culturally inclusive (Mills, Ayre & Gill, 2010). As Salminen-Karlsson (2011) puts it: “the measures should have their starting point not in the special characteristics of women, but in the special characteristics of computer engineering education”. We did meet our primary aim, to increase completion rate for everybody, but while female students increased their completion rate as well, we could not support this with statistical significance. The success was not at the expense of another group, seeing as gender equity is more complex than just increasing number of females. Whether this should be interpreted as successful or not depends on the examiner’s attitude and point of view. Since the changes implemented were supposed to be gender neutral, and we increased the completion rate, we interpret it as a success.

7. Future work

Total number of attempts in examination did not change. Since the assignments were the same, this was not expected either. Next step would be to go through the assignments

according to the principles defined in this study, to see how that affects number of attempts as well as students approaches to learning. It would be interesting as well to investigate if all males were favoured by the new course, or if we managed to catch a specific sub-group.

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Table 1. Literature study summarized, factors influencing changes in this study

Themes and factors found in articles	n	Gender neutral and non-biased messages	Emphasize the interdisciplinary approach	Link to everyday examples	Purpose of the course
Discrimination; positive discrimination; (subtle) bias; prejudice; (damaging) stereotypes	20	x	-	-	-
Perspectives about subject matter; contains broader elements; more contextual approach; link across disciplines; creativity	19	-	x	x	-
Confidence; low self-assessment; self-efficacy	16	-	-	-	x
(Hostile) culture; curriculum structured around masculine values	13	x	x	-	-
Career expectations; social responsibility; social good motivation	9	-	x	-	-
Mentor; role model; belonging; identity	8	-	-	x	-
Increased knowledge of misconceptions and misperceptions (portraying)	6	-	x	-	-
Identity construction	3	-	x	-	-
(Processes surrounding) design of technology	3	-	x	-	-
Little experience; less experienced than peers	2	-	-	-	x
More concrete, less abstract	1	-	-	x	-

Table 2. Literature study summarized, factors not used in this study

Themes and factors found in articles	n	Reason not included
Diversity consciousness; awareness regarding social and socio-ethical issues	5	Too big of a question to be able to involve it in the course literature without making it part of the course.
Care and respect for students; interaction with faculty; verbal encouragement	3	Already part of the training for the online mentors in the course.
Future family plans; degree not career	3	More of a political issue, which is related to the culture in the field as well as prejudices.
Overseeing student interaction during group work; collaboration	2	Requires a change in the examination of the course, which would make pre-post comparisons difficult.
Future family plans; degree not career	3	More of a political issue, which is related to the culture in the field as well as prejudices.

Table 3. Changes in chapters of the course literature related to principles. L) Larger changes s) Small changes -) Not applicable.

	Chapters			
	1	2	3	4
Link to everyday examples	L	L	L	s
Emphasize the interdisciplinary approach	L	-	-	-
Gender neutral and non-biased messages	L	L	L	-

Table 4. Number of participants, percentage of students that completed the course and response rate.

	All			Females			Males		
	n	passed	resp.rate	n	passed	resp.rate	n	passed	resp.rate
Old	825	81 %	32 %	299	77 %	35 %	526	83 %	31 %

New	242	88 %	30 %	72	82 %	31 %	170	90 %	30 %
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Table 5. Mean and median value for total number of attempts for all four examinations and total number of days for students who passed the course.

		All		Females		Males	
		mean	median	mean	median	mean	median
Attempts	Old	25	18	28	21	24	16
	New	25	17	27	20	24	17
Days	Old	25	22	32	28	22	16
	New	21	20	25	23	19	17

Fig. 1.

Probability of passing the course for females as a function of surface learning score. Higher score means higher level of surface approach. Old course represented by dotted line, new course by solid line. Additional lines denote the mean score for each group (x-axis) and the throughput in the course (y-axis).