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LACK OF GENDER DIFFERENCES IN ENGINEERING STUDENTS' ASSESSMENT OF GROUP-BASED PROJECT EXAMS

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ABSTRACT

At Aalborg University in Denmark, engineering, science, and mathematics students usually spend half the time each semester working in groups on projects within a problem-based learning (PBL) curriculum. These projects are assessed through group-based exams where students receive individual grades. A previous survey of all engineering, science, and mathematics students showed significant differences in how they, respectively, view various aspects of the group exam. However, students also differ when comparing engineering programmes. This paper focuses on potential gender differences in perception of the group exam. Studies of other exam types showed, e.g., that female students report higher levels of text anxiety, have different reactions to exam pressure, and are less overconfident than male students. The present survey was answered by 915 students (617 males, 298 females) from all semesters and study programmes in engineering, science, and mathematics. The analysis showed that on the majority of questions, there were no significant differences between males and females. However, female students are significantly more in favour of an individual exam, and significantly more often experience they need to speak before having finished thinking. Significantly more male students find that participating with their peers during the group-quizzing phase of the exam gives a sense of security, and they are significantly more tactical about when to speak. The paper discusses the areas of significant differences among males and females and the areas without such differences, and concludes that a group exam might be a more gender neutral type of exam for engineering students.

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1 INTRODUCTION

1.1 Problem-based learning (PBL) and how they are assessed

At Aalborg University (AAU) in Denmark, problem-based learning (PBL) is the comprehensive curriculum model and PBL-projects usually take up half the study time each semester. Students here work in groups of up to seven participants. In PBL, projects evolve through a process starting with an ill-structured initiating problem, through an analysis of this problem leading to a specific problem formulation, and finally the problem solving [1].

At AAU, PBL projects are currently assessed through oral group-based exams. At the two engineering faculties, the rule is 45 minutes per students, but the exam should never take longer than five hours in total, including giving students the grades. The group-based project exam consists of three phases in which both an internal examiner (the project supervisor) and an external examiner (usually from another university) take part: (1) Group presentation of the project where students take turn. (2) Group-quizzing in which the examiners asks the group questions, students voluneteer to answer, and the students may comment on each other's answers. (3) Each individual students is asked questions aimed specifically at them, either by polling a random question or by being given a question within an area in which the examiners have noticed that the student has not yet talked about. Each student then receives an individual grade, and the grades may not be similar. During 2006-2012, the Danish government banned group exams. AAU PBL-projects continued as before, but the projects became assessed by an individual oral exam of around 30 minutes per student. When the group exam was again allowed in 2013, the third phase mentioned above became a new addition [2].

The present paper focuses on potential gender differences in this type of exam. A previous study [3] argues that PBL, including engineering programmes with more contextualised content, could result in increased recruitment of women. However, as exams play a central role in any curriculum, a part of an assessment of PBL from a gender perspective, must also include the type of exam.

2 THEORETICAL FRAMEWORK

2.1 Assessment of the PBL group-based project exam

The banning of the group-based project exam was researched by, e.g., [4] who concluded that the students, the academic staff, and the external examiners preferred the group-based project exams. It was also concluded that the individual exam could not assess core PBL process competencies such as collaboration and teamwork, which created misalignment between PBL and its assessment method.

Studies done after the reintroduction of the group-based project exam again found that the majority of students were in favour of the group-exam, but with significant differences in how engineering, science, and mathematics students, respectively, viewed various aspects of the group exam; and students also differ when comparing

engineering programmes [2]. These studies, however, did not have a focus on how male versus female students experience the group-exam.

2.2 Studies of other types of exams and the issue of gender differences

Some studies focus on achievement, where, e.g., [5] argues that exams define achievement as the type of work which is valued higher may be areas in which either boys or girls are more able. UK upper secondary education in English is used as an example where boys are better at keeping to the point, take more risks, and show more confidence, which is valued higher, while girls, take less chances, write more lengthly, and are less courageous to discard irrelevant material.

Not only achievement is studied, but also emotional aspects such as anxiety and confidence. As also indicated above, female students appear more cautios than males, which is also the case for university students where females usually report higher levels of test anxiety than males even though they do not have lower academic achievement than males [6]. Emotial aspects are also seen with female students having a lower level of overconfidence in terms of grade expectations than males [7]. Emotions may also impact achievement as studies on secondary students found that females perform relatively better on low stake tests, but this difference is reduced or disappear when stakes increase. Males perform slightly better than females on high stake test such as national exams [8]. Other studies did not find gender differences, e.g., [9], who compared performance when switching from a traditional paper-and-pencil exam to a computer-based exam.

2.3 Research questions

Given that gender differences exists in many other types of exams, which gender differences, if any, exist in the students' assessment of the group-based project exam in PBL? This paper therefore re-analyses the questionnaire from 2013 as this was not part of any of the previous analyses of the questionnaire.

This paper focuses on the differences among male and female students taking all the engineering and science students as a whole. One might also have chosen to focus on differences and alikeness between male and female students in each study programme, or engineering versus science versus mathematics. This would be interesting, also given that previous research shows some differences between these student groups. However, given that the students answering the questionnaire came from 38 different programmes, and given that the female student population is often a lot smaller than the male, some programmes were only represented with very (female) students making statistical analysis irrelevant. For instance: Computer Science (34 males – 5 females), Physics (7 males – 4 females), Mathematics (6 males – 8 females), Software engineering (47 males – 4 females), Energy (39 males – 10 females), Electronic (47 males – 1 female), Building (49 males – 14 females).

3 METHODOLOGY

The quantitative survey from summer 2013 reused some tems from a previous study from 2006 [4] in order to (1) compare results now and then, and (2) enhance the

validity of the present study by building upon items that previously worked well. In addition, new items were formed, some of which were based on comments from a survey to all first-year engineering, science and mathematics students after the January 2013 exams. The January survey functioned as a pilot study prior to a larger study in June 2013. An email provided the link to the questionnaire in SurveyXact to all 4,588 engineering, science, and mathematics students at all semesters after the June 2013 exams. 1,136 answered the questionnaire of which 928 completed the whole of it. 915 of these indicated gender (not a mandatory item). This gives a 25% response rate, which is low. This is usual for online surveys, but still relatively efficient compared with paper-based surveys, particularly for cohorts above 300 [10].

The questionnaire consisted of 20 items, of which most had several sub-items where respondents should indicate their level of agreement on Likert scales. In total 97 items. Five of these asked background questions about study programme, semester, gender, physical campus, and if they had experienced the previous individual project exam. Hence 92 items were directed at their experience with the group-based project exam. The analysis uses chi-squared tests of independence to assess the relationships between the male and females variables.

4 RESULTS

Of the 92 items, there were significant differences among male and female students on 32 of them. Below items with and without significant differences are analysed.

4.1 Items with no gender differences

On the three items where students were asked about their overall experience of each of the three phases of the group-based project exam, there was not any significant differences between the male and females students (e.g. Figure 1).

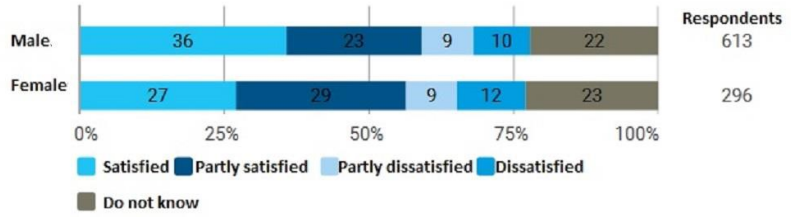

Fig. 1. Item: Are you satisfied with how the individual questioning took place? $X^2(1, N = 705) = .576, p = .448$

Each of these three phases had several subitems, and in terms of the first presentation phase, most items showed no significant differences among the male and female students. For instance: the items asking if they had enough time to talk about central phases in the project, if the distribution of topic was made more difficult by the fact that the presentation counts towards the grades, if the presentation became better knowing that this part counts towards the grades, that one can show one's competencies, it gives a sense of security to present together with others in the group, and that the presentation made one relax more.

Concerning the second phase, the group-quizzing, around half the items showed no significant differences. For instance: the items about if you can hide, some students dominate through their personality, the examiners asked questions about my deeper understanding, experiencing that others said something they themselves were about to say, and that the group-quiz more shows the individual student's initiative in answering question than showing group-work.

In terms of the third individual phase, on most items, the male and female students agreed: the presence of the other group members gives sense of security, I do not need to understand all the content, I can show my knowledge, there was too much difference in the level of questions asked to each group member.

Concerning the students' view of their assessment and grades, there was not a significant difference on items asking if all students got the assessment they had expected, if the assessment shows who is good at selling themselves at the exam, and that there is a correct spread of grades in the group.

In particular, on issues relating to anxiety, students agreed on many items, which is different from the results of the studies referred to above. When looking into some of the details of the phases, and the grading, some differences appear between the male and female students, which are discussed below.

4.2 Items with gender difference

In terms of the first presentation phase, only two items showed gender differences: Group members mainly present things they wrote themselves (males agree more), and they learn something new through doing the presentation (Figure 2). Although the majority of all students agree, the female students agree significantly more.

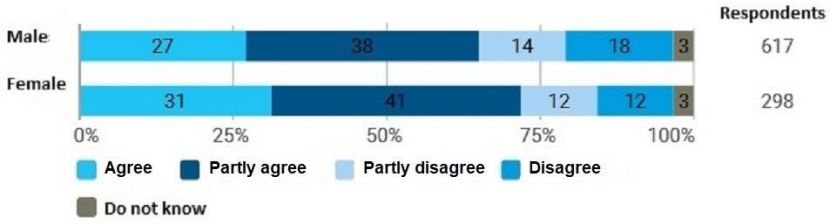

Fig. 2. Item: I learn something new through doing the presentation? $X^2(1, N = 884) = 4.525$, $p = .033$. The legend is similar below, unless otherwise stated

In terms of the second group-quizzing phase, there was significant differences between the male and female students on items asking: sitting together with ones group gives a sense of security, you do not need to know all the content, you can follow up on what others have said, there is time for me to tell my knowledge (males agree the more on these items), I feel I should say something before I have finished thinking (females agree more; Figure 3, top) and I am tactical about when I offer a comment (males agree more; Figure 3, bottom). These two items are somewhat connected with males perhaps better at being tactical while females somewhat being stressed during this phase.

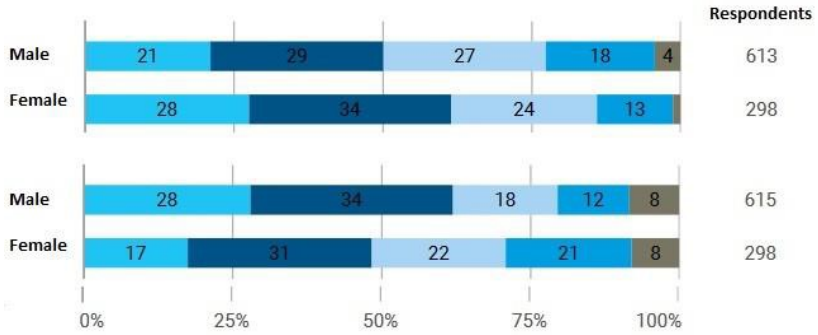

Fig. 3. Item (3, top): I feel I should say something before I have finished thinking. $X^2(1, N = 880) = 7{,}706$, $p = .006$. Item (3, bottom): I am tactical about when I offer a comment. $X^2(1, N = 837) = 18.017$, $p < .001$

In terms of the third individual questioning phase, males and females answered significantly different on items such as: I would prefer that the other group members are not present during this phase (females agree more; Figure 4), and there was time enough for me to tell my knowledge about the project (males agree more).

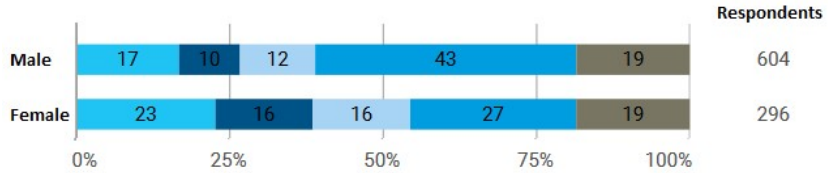

Fig. 4. Item: I would prefer that the other group members are not present during this phase. $X^2(1, N = 733) = 14.668$, $p < .001$

Concerning the item illustrated in Figure 4, only a minority of students do not want the other students present during the individual phase, however among these, the female students significantly more often prefer this.

In relation to the students' view of their grade assessment, there was a significant difference on the item asking if all group members had received a fair assessment (males agree more) and the item that some had received a better assessment than they had deserved (females agree more; Figure 5).

Fig. 5. Item: Some received a better assessment than they had deserved. $X^2(1, N = 866) = 8.324$, $p = .004$

4.3 Overall – individual versus group-based project exam

In terms of an overall assessment of individual versus group exam, although only a minority of the students preferred an individual project exam, female students were significantly more in favour of an individual exam (Figure 6).

Fig. 6. Item: I would prefer an individual project exam. $X^2(1, N = 840) = 6.935, p = .008$

In exams, the opportunity to get a fair assessment is essential. Above showed mixed views about grades. On the items asking students who had experienced both the individual and the group exam about the grades, there was no difference among males and females about the opportunity to get a fair grade (Figure 7):

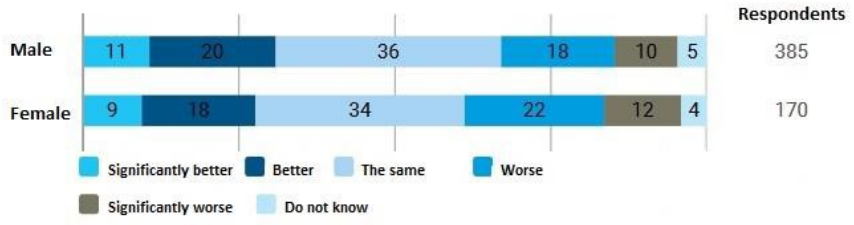

Fig. 7. Item: If you compare the new group-based project exam with the previous individual project exam, how did you experience the opportunity to receive a fair grade? $X^2(2, N = 530) = 2.225, p = .329$

The students were also asked if they experienced a bigger differentiation of grades in the new group exam compared to the previous individual project exam, and again there was not significant difference between males and females (Figure 8).

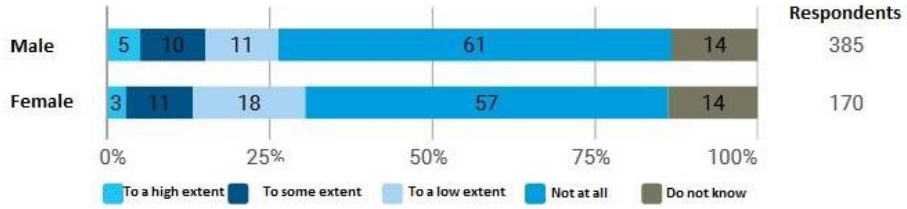

Fig. 8. Item: Have you experienced a greater differentiating of grades at the group-based project exam compared to the individual project exam? $X^2(1, N = 489) = 0.319, p = .572$

Combining the results shown in Figures 5, 7, and 8 suggests that females are more sceptical about the fairness of the group exam compared to the individual exam, including that the differentiation of grades may be less in group exams. The latter was also seen in some of the comments provided in the questionnaire. Some also mentioned that larger groups may make grading more difficult than smaller groups.

4.4 The sense of security

Sections 4.2 and 4.3 showed that in terms of the first phase of the group-based project exam, the students overall agreed (73%) that sitting together with their group members, gave a sense of security, with no gender difference. However, concerning the second phase, the group-quizzing, there was a significant difference in the male and female answers (Figure 9). Overall the students agree (75%), but with the males students agreeing significantly more than the females.

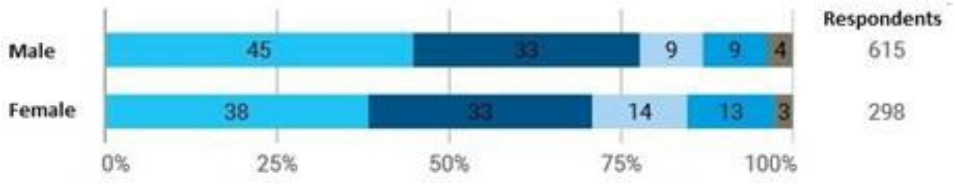

Fig. 9. Item: Sitting with the group members give a sense of security [about the group-phase]? $X^2(1, N = 882) = 7.26, p = .007$

In terms of the individual phase, again there is no difference between male and female students, with overall 46% agreeing and 35% disagreeing that it gives a sense of security having the other group members present.

5 CONCLUSION

Does this study show that the group-based project exam is a more gender neutral type of exam? The analysis showed that on most of the items (approximately 2/3), there are no gender differences. Also, the items asking for an overall assessment of each of three phases showed not gender differences. This indicates a type of exam that is at least relatively gender neutral.

Some items, however, showed gender differences such as being tactical (males agree more) or feeling rushed (females agree more) to say something during the second group-quizzing phase. The second group quizzing phase is the one with most differences between males and females. The majority of females favoured the group exam, however significantly more females than males prefeered the individual exam. Hence, the picture is not unambiguous. Significantly more males find that participating with their peers during the group-quizzing phase of the exam gives a sense of security, which may be surprising giving that the studies refeered to in Section 2.2 pointed to that males are less cautious than females and more willing to take risks. Compared to the studies in Section 2.2, this study found that females did not appear to have more anxiety than the males.

These results provide insights for examiners on design of a group exam, e.g. should all group members be present during the individual third phase, optimum size of groups for fair assessment, etc. The study points to areas in which examiners may need training to be able to administer a group exam, e.g. how to make sure all have time to tell their knowledge, that students do indeed need to know the content, etc.

A limitation of the study is that females are very likely to have been the minority in the groups, which may or may not have affected their answers more than the fact that they are female. I.e. “minority” students might feel more comfortable in individual exams than “majority” students. A further study might reveal this.

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