INTERNATIONAL SYMPOSIUM ON PROJECT APPROACHES IN ENGINEERING EDUCATION

Aligning Engineering Education with Engineering Challenges

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Natascha van Hattum-Janssen
Rui M. Lima
Dinis Carvalho

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Editors
Natascha van Hattum-Janssen
Rui M. Lima
Dinis Carvalho

Research Centre in Education (CiEd)
University of Minho
and
Department of Production and Systems
School of Engineering of University of Minho
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Peer-Assessment in Projects: an Analysis of Qualitative Feedback

Natascha van Hattum-Janssen[+], João Miguel Fernandes[*]

[+]Research Centre for Education, University of Minho, Gualtar Campus, 4710-057 Braga, Portugal
[*]Department of Informatics, School of Engineering, University of Minho, Gualtar Campus, 4710-057 Braga, Portugal

Email: nvanhattum@ie.uminho.pt, jmf@di.uminho.pt

Abstract

Learning through projects can increase involvement of students in the assessment process, especially in the assessment of the development of transferable competencies. The responsibilities in the assessment process can be shifted from the teacher to the students, so that the students become engaged in a process that helps them to analyse and understand the way they perform in a group project and how this performance contributes to the final result of the project. In the context of a 15 ECTS course at the second and final year of Informatics Engineering Master´s Degree programme, students had to carry out a project in the first semester. The performance of each student was evaluated through peer assessment in subgroups. This paper describes the peer assessment schedule that was used, analyses the qualitative comments that were given and reflects on the impact of the peer assessment scheme on the results of the project.

Keywords: peer assessment; feedback; team work.

1 Introduction

Assessment of learning in project-based approaches is often considered complicated. For both teachers and students involved in project-based learning, free riding is the focus of many complaints (Brooks & Ammons, 2003). Free riding or social loafing (Powell & Weenk, 2003) means that not all students do a fair part of the work that has to be done for a project. Some students contribute much more than others, although all may end receive the same final grade for the group work, which can have a moderating effect on the final individual grade (Almond, 2009), an effect especially not wanted by the best students, who tend to receive a lower grade in this case. Another aspect of assessment of projects is the assessment of both the final result of the project as well as the individual learning results of the students. On the one hand, students have to work on a real problem that needs to be solved by in the end. The project requires a working solution, a prototype, a report etc. On the other hand, the students have to develop a number of technical and transferable competencies at the individual level. There can be tension between these two outcomes, as the project work itself does not necessarily guarantee the development of technical and transferable competencies and formative and summative assessment are usually used to assure that students develop competencies in the different disciplinary areas related to the project.

Projects provide learning experiences for the development of both technical and transferable competencies and both need to be assessed. The instruments that are used for the assessment of technical competencies can, partly, be used for transferable competencies as well. A final report, for example, can be used to assess the quality of the solution for a specific technical problem. At the same time, the report provides information that can help to assess the students' writing skills. With just one specific assessment instrument, one cannot easily test other transferable competencies. Leadership, interpersonal communication, teamwork and time management can hardly be tested by a formal written test, which would be appropriate for specific technical competencies. As a response to these and other difficulties, peer and self assessment methods have been implemented in project-based learning in many ways. This paper discusses the characteristics of peer and self assessment methods in group work and describes a project experience in which those methods were used in large groups of students.

2 Peer assessment in group work

Peer- and self assessment of learning shift responsibilities from teachers to students. In peer and self assessment, students are responsible for the complete or partial assessment process, starting with the definition of the assessment method, the definition of criteria, continuing with the evaluation and feedback process and ending with the grading, if required. Topping (1998) defines peer assessment as 'an arrangement for learners to consider and specify the level, value or quality of a product or performance of other equal-status learners' (p. 20-21). In his review on peer assessment, the author gives a typology of peer assessment in higher education, identifying 17 parameters of variation between peer assessment projects reported in the

literature. In this study, the peer assessment component of the project was used to assess the development of transferable competencies related to group work. The goal was mainly formative, but the peer assessment scores also led to a final grade that serves as a correction factor for the project grade.

Peer assessment in project approaches is used for the assessment of technical as well as transferable competencies. The use of peer- and self assessment methods for transferable competencies often happens in project approaches. Many of the transferable competencies that are developed through the teamwork are not visible for teachers, so students themselves need to monitor the development process through peer- and self assessment. Leadership or communication within the student team cannot easily be assessed by someone who is not actively participating in the team work. Therefore, the team members themselves assess their own performance and the performance of their peers. They are the only ones who can obtain a realistic perspective on the performance of team members within the team. Although questions can be raised on the validity and reliability of peer- and self assessment for transferable competencies, most students are able to assess themselves and their peers, so students participate actively. The shift or responsibilities from teachers to students though, can be almost complete or rather limited. In some project experiences, students are limited to filling out a small number of questionnaires developed by their teachers. Other projects allow the students to think about the assessment methods and instruments themselves and making them plan most of the process. In this way, students experience an increased responsibility and are no longer carrying out activities that are planned by others. Their sense of ownership of the processes increases.

Peer and self assessment make the learning approach of students more profound (van Hattum-Janssen, Pacheco, & Vasconcelos, 2004). Students learn less superficial, as they need to reflect on the material several times, in order to be able to make a meaningful judgment on the work of the peers. Making these reflections explicit as part of the grading process, helps on the one hand to prevent inflation of grades and on the other hand serves as feedback to those who receive the grades. A team of students or an individual student grades a peer and subsequently justifies this grade. The justification serves as information for the teachers on the motives of the grade and also serves as feedback for the student who receives the grade. In this way, the process of grading and giving feedback is intertwined. Cheng and Warren (1999) use a number of studies to illustrate that peer assessment excels traditional methods of assessment in a number of ways. They refer to more valid, reliable, practicable, fair and useful assessment, to the contribution to student-centred learning through the training of students to judge the quality of the work of others objectively, and to the critical reflection of the learning experiences. In the context of engineering programmes, peer assessment has shown to contribute to greater student involvement in the subject, enhance motivation and deepen student learning (Fernandes, 2010). Liu and Carless (2006) make a useful distinction between peer-assessment and peer feedback, the latter being primarily about rich detailed comments but without formal grades, whilst peer assessment denotes grading (irrespective of whether comments are also included).

Creating more opportunities to provide feedback to students through peer-assessment is perhaps its most important feature (Topping, 2009). Students receive comments on their performance from more than one peer at several moments during a project semester. A difficulty with peer-assessment and in particular with peer feedback can be the reluctance to criticise peers (McMahon, 2010). Students do not feel at ease criticising their peers and may have a tendency to make rather general comments that do not help their peers to improve their performance. In this study, the comments of students were analysed to establish what types of comments students make and to what extent the nature of the comments changes along the process of project work.

3 The project at Informatics Engineering

The peer-assessment and feedback as used in this study took place in the context of a 15-ECTS course in the Master´s Degree programme in Informatics Engineering. In this course, students attend seminars given by invited speakers, both from industry as well as academia, they write a state-of-the-art report on a topic they choose, and they carry out a software project in a large team of students. The development of a realistic and product-focused software project, sufficiently complex and requiring the development of competencies that can only be fulfilled by a reasonable large team, is one of the main goals of this course. The project was aimed at developing both technical as well as transferable competencies. Teams of around 15-20 students were created in order not to exceed a maximum of four teams in total. In the teams, students were supposed to:

- Organise themselves and find the best people for all tasks
- Promote team leadership, internal reporting and project management practices, making students reflect on the team role that suits them best, given their personality, background and experiences.

- Hold weekly management meetings with the teachers –that act like managing directors of a company–, in order to assess the project overall status and to raise issues that needed to be tackled by the teachers.
- Dedicate one full day a week to the project on-site, although collaborative electronic work was encouraged.
- Use wikis and other collaborative tools extensively, in order to create the necessary documentation support to the teams.
- Work on project planning and issue tracking, to allow the team management to have an overall view of the project status.
- Organise weekly reporting to the management.
- Held regular meetings with the clients to ensure validation of the requirements.

Projects were either proposed by students or proposed by external customers, the latter providing a better simulation of the conditions that students will find in their professional lives. Four projects were developed: external customers proposed three and the other was suggested by a group of students. The first project was the development of a virtual tape library (VTL) proposed by a local company. VTL is a data storage virtualization technology used for backup and recovery purposes. The second project was the development of a module for floating insurances for integration with the ERP system of a insurance broker. The third project aimed to develop a software application for managing the digital signage of an organisation. The client of this project was the Department of Informatics of the University of Minho, although the students were challenge to make the solution as generic as possible. A group of students, all members of a local student association, proposed the final project. They developed a web-based application for the management of student associations, including support for managing the members, for managing and planning activities of the group, and for providing a web presence for the group.
The student teams were formed randomly and the leaders of each team had the possibility to exchange students between groups. Most teams were around 15-20 students and the team members chose the leader of the team. Each team divided itself in sub-teams, dedicated to specific tasks.

4 Peer assessment

At the very beginning of the project, the teacher explained to the students that peer assessment would be part of the assessment method of the project, focusing on processes that are mostly visible to the students. They received a brief explanation on the characteristics and the use of peer-assessment in team work. In order to increase the involvement of the students in their assessment, they were given the responsibility to define criteria for the assessment of their peers with regard to the team work. According to the instructions of the teacher, students had to

- Define five to seven criteria for the assessment of the team work of their peers;
- Establish relative weights for each of the criteria; and
- Describe the criteria in such a way that interpretation by all team members is likely to be similar.

They had a limited amount of time in the lesson to work on the criteria and they had to send the criteria and the descriptions to their teacher by e-mail before the end of the week. Students were informed that peer-assessment would take place four times during the project and that the result would lead to a correction factor that would be applied to the grade that the student team would receive at the end of the project. Web-based forms to carry out the peer-assessment sessions were developed, based on the criteria of each group. In each group, sub-groups were created and students had to decide on a schedule of who is assessing whom. As the goal of this peer-assessment is formative, students were asked to not only grade the performance of their peers, but also to give comments that would help their peers to improve their performance.

At the end of the semester, students completed a questionnaire on the whole course, including 7 specific items on the peer-assessment method adopted in this course.

5 Results

The four teams defined criteria and relative weights of the criteria. The criteria were sent to the teacher together with a short description that helps the students during the peer assessment process. Team 1 established punctuality (0,10), transparency (0,30), complying with deadlines (0,30), proactivity/initiative (0,20) and critical attitude (0,10). Team 2 also defined five criteria and sent the following list to the teacher: effort (0,30), assiduity (0,10), quality of work (0,25), team work (0,20) and complying with deadlines (0,15). The third team also included assiduity (0,20), complying with deadlines (0,20) and team work (0,20) and have

established organisation (0,15) and conclusion of tasks (0,25) as well. The fourth team proposed conclusion of tasks (0,60), assiduity in meeting (0,10), number of working hours (0,10), proactivity (0,10) and creativity (0,10) as criteria for peer assessment.

Students graded each other in sub-teams and wrote a justification of the grades they attributed. These justifications also served as feedback as they were available to the students who received the grades. The comments of the students that accompanied the grades at each one of the four assessment moments were analysed and categorised. Four apparent categories were defined at first, based on the intents of formative assessment as defined by Topping (2009): identify strengths, identify weaknesses, target areas for remedial action and the development of professional skills. The remaining comments were divided into six different categories. The following table describes the categories as used for the content analysis:

Table 1: Categorisation of comments

Category	Description	Examples
1. Identification of strength	Identification of a strength in the behaviour of a student in the project team	*He is very punctual and has taken initiative.*
2. Identification of weakness	Identification of a weakness in the behaviour of a student in the project team	*Always too late. Works less than the rest of the team.*
3. Remark on specific task	Comment related to specific tasks in the project	*Worked on the codification. Did the Wiki's, Took care of the wireframes.*
4. Remedial action	Comment aiming to improve the behaviour of the student	*He should take more initiative.* *She needs to worry more about the deadlines of the tasks she is doing.* *He must communicate much more.*
5. General encouragement	Comment aimed at praising a student for his or her effort	*Good work!* *Congratulations!* *Please go on like this.*
6. Justification of grade	Comment explaining why a certain percentage was attributed to a student	*There is nothing to improve in terms of team work, so I gave 100%.*
7. Specific comment on transferable skills	Comment aimed at the development of a specific transferable skill	*He is a good leader.* *Needs to work on critical attitude.*
8. Not enough information	Statement of inability of assess due to lack of information on the behaviour of a student	*The student has not done enough yet to be able to assess this criterion*
9. No comments	Observation stating that a there is nothing to say about a student's behaviour	*Nothing to say.* *Nothing to add here.*
10. Other	Remaining comments	*He recently arrived in our team.* *He changed from one team to another.*

Table 2, 3, 4 and 5 show the distributions of the type of comments over the different categories. The identification of strengths is the most used type of comments in each team and at each assessment moment. The second most mentioned category varies between the identification of weaknesses, remarks on specific tasks and recommendations for future performance.

Table 2: Comments 1st Peer Assessment Moment

Category	Team 1	Team 2	Team 3	Team 4
1. Identification of strength	32%	58%	46%	64%
2. Identification of weakness	12%	3%	10%	12%
3. Remark on specific task	11%	27%	7%	23%
4. Remedial action	24%	1%	8%	1%
5. General encouragement	4%	3%	0%	0%
6. Justification of grade	6%	0%	5%	0%
7. Specific comment on transferable skills	4%	1%	1%	0%
8. Not enough information	5%	4%	17%	0%
9. No comments	25	3%	5%	0%
10. Other	0%	0%	1%	0%

At the first assessment moment, most teams mainly made comments on strengths, apart from Team 1, that also dedicated a large percentage of the comments to recommendations. Members of Team 3 made clear that they did not have enough information to assess their colleagues properly.

Table 3: Comments 2nd Peer Assessment Moment

Category	Team 1	Team 2	Team 3	Team 4
1. Identification of strength	47%	63%	66%	61%
2. Identification of weakness	15%	3%	11%	11%
3. Remark on specific task	4%	7%	0%	11%
4. Remedial action	27%	13%	10%	2%
5. General encouragement	2%	1%	0%	0%
6. Justification of grade	0%	2%	2%	1%
7. Specific comment on transferable skills	0%	1%	1%	6%
8. Not enough information	0%	6%	1%	0%
9. No comments	3%	2%	8%	0%
10. Other	2%	1%	2%	8%

At the second peer assessment moment, Team 3 had enough information to carry out the assessment and the main part of the comments consisted of strengths and weaknesses. Team 1 still dedicated a relatively large part to recommendations.

Table 4: Comments 3rd Peer Assessment Moment

Category	Team 1	Team 2	Team 3	Team 4
1. Identification of strength	53%	68%	73%	44%
2. Identification of weakness	10%	14%	13%	36%
3. Remark on specific task	2%	0%	0%	10%
4. Remedial action	23%	13%	7%	4%
5. General encouragement	0%	1%	0%	0%
6. Justification of grade	0%	0%	1%	0%
7. Specific comment on transferable skills	0%	0%	0%	0%
8. Not enough information	2%	0%	0%	1%
9. No comments	2%	1%	3%	0%
10. Other	9%	1%	2%	4%

The third assessment moment shows an increased number of weaknesses identified by the members of Team 2 and 4. This is the penultimate assessment moment and the teams prepare for the final activities of the project.

Table 5: Comments 4th Peer Assessment Moment

Category	Team 1	Team 2	Team 3	Team 4
1. Identification of strength	54%	59%	72%	78%
2. Identification of weakness	28%	14%	14%	6%
3. Remark on specific task	0%	1%	0%	7%
4. Remedial action	10%	20%	3%	3%
5. General encouragement	0%	1%	0%	2%
6. Justification of grade	0%	1%	3%	0%
7. Specific comment on transferable skills	0%	0%	0%	0%
8. Not enough information	4%	1%	1%	1%
9. No comments	4%	1%	6%	1%
10. Other	0%	3%	1%	2%

The fourth and last assessment moment was mainly focused on strengths, although Team 1 had a high number of weaknesses to identify.

6 Discussion

All teams defined criteria and described the criteria in detail. Through an online platform, they submitted the grades and the comments for each one of their peers in the sub-team. The results as presented in the previous section indicate that students express themselves in different ways, varying from general remarks to specific suggestions for the improvement of performance. Most comments are pertinent, but the comments are not yet well balanced between the different categories that can be distinguished. Out of 16 peer assessment moments, four for each team, 12 are characterised by comments that consist for more than 50% in the identification of strengths. The high frequencies for the category identification of strengths possibly indicate a certain reluctance of students to be critical towards their peers.

Only Teams 1 and 3 at the first assessment moment, Team 1 at the second and Team 4 at the third moment attributed more than half of the comments to other categories than the identification of strengths. Identification of weaknesses and remedial action are also categories that students use a lot to express their opinions on their colleagues. Especially Team 1 makes many comments containing suggestions or recommendations for future performance. The high frequencies for 'no comments' and 'not enough information' at, respectively, the first assessment moment in Teams 1 and 3 are likely to be related to the start off of the project. Some of the sub-teams did not start right away at the beginning of the project, so it was not possible to assess all members of all teams properly.

7 Conclusions

The four peer-assessment moments have proven to be useful in different ways. Students received feedback from their peers in a way that the teachers could not have provided by themselves, due to lack of time and lack of inside information on the functioning of each team member. The quantity of feedback is by far larger than the quantity of feedback that could have been given by a teacher. For a teacher, it is practically impossible to give relevant comments on different criteria to around 80 students at four different moments.

The lack of critical comments, like the identification of weaknesses and suggestions for improvement at the first moment and especially in Group 3 and 4 at the last two assessment moments, does not reveal much of a critical attitude of the students towards their team members. A more balanced set of comments and the identification of weaknesses that students can work on could be helpful to give students more insight in their role in team processes and in project work.

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