INTERNATIONAL CONFERENCE ON ENGINEERING AND PRODUCT DESIGN EDUCATION
8 & 9 SEPTEMBER 2011, CITY UNIVERSITY, LONDON, UK

EFFECTS OF TEAM ROLE ASSESSMENT IN PROBLEM BASED GROUP WORK LEARNING

Mikko VANHATALO[1], Timo LEHTONEN[1], Antero HÄLIKKÄ[2], Jarkko PAKKANEN[1] and Tero JUUTI[1]
[1] Tampere University of Technology, Finland
[2] Innovo, Finland

ABSTRACT
This article is about the findings and observations made at a Product Development Project Management course. The course is aimed for the students at the later phase of their Master studies, and its structure is based on lectures and on a large scale group assignment which processes management of a product development project about given case.
The main learning factor in this course is the large group assignment which the students work on. The assignment is in same scale of realistic challenge they will face in industry. The assessment resembles the real life situation better compared to typical course assessment. They do not receive any extra points from the amount of work done or how much they can memorize different topics lectured at the course. In this case the students are evaluated by the final outcome of the group work. Each group have to evaluate how much information and/or value each group member has brought to the assignment, and then the assignment grading is weight based on this factor. Thus the students who actually influenced to the quality of the assignments final outcome get the better grading.
The amount of this work has two different kind of influence on the learning. Firstly students focus on the work at hand and to manage it they have to embrace the theories and methods relevant to product development project. Previously the same things were taught purely by lecturing. Secondly the students have to learn how to operate in a large group. The work load is such that there are no room for free riders, which is the case often in assignments.
To ease the students working in this challenge a new way of forming the student groups was adopt in this course implementation. Previously students were allowed to choose freely the structure of the group, but this time a team role self-assessment was used. The test reveals the characteristics of each student and based on these characteristics well balanced groups were formed. The results of this were excellent compared to assignment results from earlier years. As the course grading is based mainly on the end results of the assignment and its mid-term returns, it is crucial for good performing that the group works well and can produce required and innovative results. Structure of the course' assignment and students groups' guidance makes it strongly problem-based-learning event. Instead of lecturing different aspects of product development process the students are made to go thru this process. Thus they see every step on the way, they learn about the problems and challenges in large projects and also the assignment guidance and timing of the given information makes the project work even more realistic.

Keywords: Team role self-assessment, group work, problem-based-learning

1 INTRODUCTION

The research made on the problem-based-learning has found multiple different advantages in teaching using this method. [1] PBL works well on minor learning tasks, but especially on large scale multidisciplinary topics, such as product development projects, which are practically impossible to teach by just lecturing about the topic. The theories behind the topic can be lectured, but when students have to thru the actual process on their own they learn much more efficiently the black spots and other issues related to the process. The own experiencing gives better basis for deep learning. For example reflections about one's own actions are more effective than warnings. This phenomenon is most apparent at small children. Even if you warn them about hazards, like hot stove, they will hurt themselves on very high odds, but it is very likely that they won't do it again.

Uden & Beaumont [1] states that: "*Advocates of PBL argue that it provides an effective environment for future professionals who need to access knowledge across a wide range of disciplines.*" This statement goes well with the CDIO syllabus [2] which is more or less a list of engineering skills that the new graduated engineers should have. Uden & Beaumont [1] also lists different benefits of PBL found by researchers in this area, e.g.:

- More realistic learning environment
- Better collaboration between students and staff
- Wider view of the problem.

In our product development project management course the students' guidance is minimal to push them to find out the solutions for the set problem by themselves. Some of the lectures at the course are reserved for presenting different theories of product development project, but mainly the focus is in discussing with the students how their own project proceeds and what kind of observations and/or problems they have faced.

To maximise the groups' efficiency the groups was structures based on the team role self-assessment. This method is developed by Belbin [3] and we used a modified version of this method. Previously the students were allowed to form the groups by themselves but as in the real industry environment, one can seldom choose the workmates. Instead one valuable skill is the ability to work and communicate well in a group. This is often required even in the job applications. That is one reason why we tested this way of forming the groups. When the group includes as heterogeneous persons as possible the more efficient the group is. In our case this could be well seen from the better quality in the outcomes of the student groups.

Based on the student feedback we can say that students value more a course in which they have to take greater responsibility of their assignment in sense of forming the problem/task to be solved and the solution for that. In many courses the given problem is described in very detailed way by the teachers and also usually there is a right or wrong answer. Our problem description is fairly open and the mid-term tasks, which students have to do, do not have precise correct answer. Instead the groups are rewarded for innovative usage or modification of the suggested tools and about the effort they have put in to the task.

2 THE COURSE

The core of the learning in this course is the students' group assignment and its mid-term tasks: Work Breakdown Structure, Design Structure Matrix, Gantt chart, Project scheduling Risk analysis, final report and the "sales presentation". In addition to these the groups have to define a project plan of their own working method during the course. At the beginning they define the responsibilities, tools to be used, and time tables. Then at some point of the course the groups are asked to give proofs to confirm that they have worked according to their plan or not. The teachers' role is to pretend a customer and the student groups are e.g. ship builders. This imaginary situation is explained at the beginning of the course to the students and an attempt is made to emphasise this arrangement so that their outputs would correspond to this situation.

At the beginning of the assignment a comprehensive amount of different material is given to the students, and from this they can scrape all the necessary information. The material includes information about project management [4, 5] and naturally a case sensitive material is given like the latest course implementation had container ship as the case, so the presented material included Atkinson & Evans ship building spiral [6], information from different existing real ship yards, engine specifications, and short info about the restrictions and obstacles on the ocean and harbour paths [7 - 12]. An attempt is made to keep the directing minimal and the students' questions are not answered with the "correct" answer, but giving some thoughts about the right direction. This way the students themselves have to think about their own solutions and about their validity rightly from the point of view of the work.

The assignment of the course is extremely challenging on purpose. Its contents have been chosen so that it will be outside the students' know-how's and thus they have to gather and absorb new information fast. Just like in real life industrial development projects, the students have to decide by themselves what the abstraction level of the needed information is. They do not have enough time to go into the details, yet they have to find enough information in order to reach the required level in the project planning task.

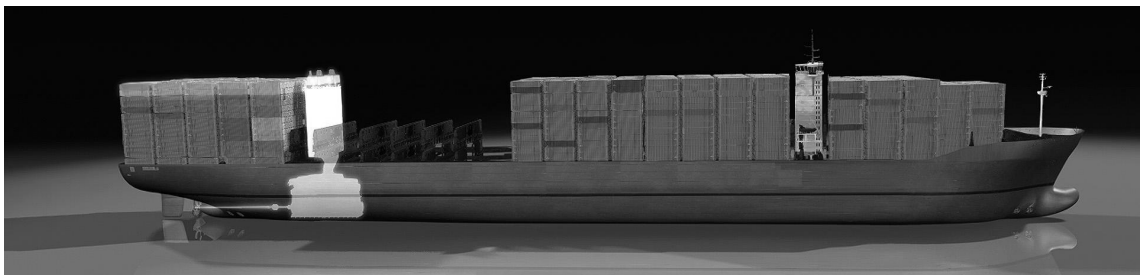

Figure 1. An image of a container ship defined by a student group

There are three specific features about this course: viable working groups, open attitude to the tools to be used, and encouraging the students to good final results by the grading.
The teams' structure is based on the Belbin's [3] team role self-assessment (presented more detailed in chapter 3). This had great enhancing effect on the student groups' efficiency and to the final results. Compared to earlier years results, the groups formed by the team roles, were able to achieve very good results and the level between the groups was more equal.
When the course precedes different possible tools for each stage will be briefly shown to the students. The students are not compelled to use these tools, in particular but they are given the opportunity and even the using of other alternatives is encouraged. Some of the groups also have edited into a more suitable than the proposed tools for its own needs.
The students' grades consist of two elements: from grades of mid-term returns and from amount of work made by them for each mid-term return. Every mid-term return is estimated and carefully commented by the teachers. With the feedback an attempt is made to direct the groups to evaluate their own decisions and results. Naturally in case of obvious mistakes teachers intervene more directly to the group's outcome, but as they are allowed to use any method which they find most suitable, there is no ultimately correct answer. In the grading system, which has been presented at the beginning of the course to the students, the innovativeness and excellence of the answer are as one section. With the innovativeness the students are challenged to look for the different tools for the solution of the problem. As presented in [13] the way of the assessment directs greatly how and what matters students learn and where they focus during the course. It can be seen from the groups' results that when they understand that good results can be achieved only by efficient group working they put lot of effort in it.
The final grading is discussed with the project leaders. Firstly the grades are calculated as explained above. Then the project manager must comment on each group member's grades and justify if they are correct, and if not they have to say whose grades needs to be changed and on what basis. Thus the project manager gets one more demanding task and at same time we get the final opinion from a insider of every group.

3 TEAM ROLE SELF-ASSESSMENT

In order to divide the students into effective project teams an appropriate team role self-assessment test and questionnaire was applied. Meredith Belbin [3] has created a team role theory based on role behaviour in team work. For this course there was applied a questionnaire mainly followed the Belbin's principles. The role questions were edited in a way that compared to the Belbin's original roles, the "Co-ordinator" and the later introduced "Specialist", were neglected. Therefore the remaining roles are (comparable Belbin's roles in between parenthesis):

- "Realizer" (Implementer)
- "Coach" (Shaper)
- "Mediator" (Team worker)
- "Contact Person" (Resource Investigator)
- "Innovator" (Plant)
- "Appraiser" (Monitor Evaluator)
- "Completer" (Completer Finisher)

Additionally those seven roles were visualized by branches of a star pattern on the map with four quarters (figure 1). Each seven role branches on the pattern indicate whether the interest of a person favours either human or rational and/or either practical or theoretical work.

The Belbin's role “Specialist” may stay in any member of the team. Furthermore the “Co-ordinator” should have made in the inquiry such questions that do not serve the dynamic nature of equal team members.
The four team-groups were built of the population of fifty students so that each of them contained the most comprehensive roles collected according to the personal role patterns. The leader of each team was recommended to be elected so that the more centralised the area of priority of the role pattern of the member locates in, the more likely he or she is applicable for leading the project. The assumption is that by that means the most flexible member of the team system can be found.

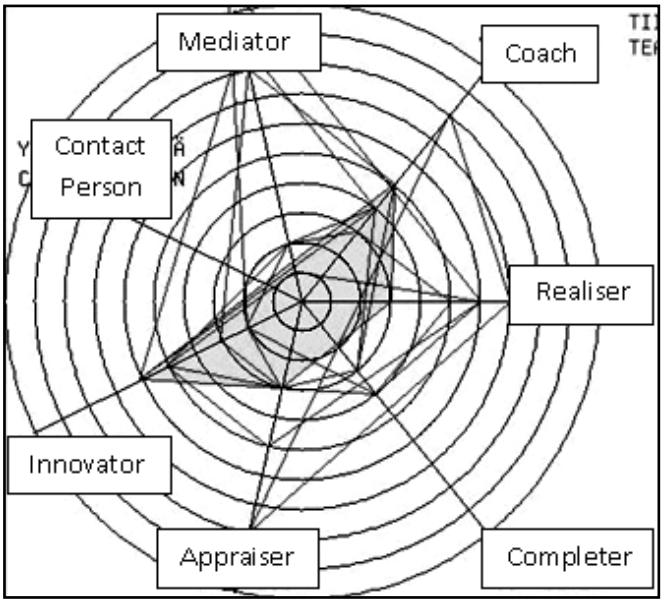

Figure 2. Star map based on the team role self-assessment questionnaire.

The figure 2 is an example of the patterns of the members' team roles of one group. The colored pattern is belonging to the leader of the team on the project.
This way of forming the groups have enhanced the quality of their work. In this year’s course implementation three out of four groups succeeded excellently, but one group had few persons who had very strong opinions and they presented those also in a very strong way. This led to unbalanced situation which further on reduced the efficiency of the group working because some of the group members were not able to present their view about the topic. The improvement which needs to be done for the next course implementation is to tell to students about the uncertainty what is involved at the assignment of the course. Teachers will not give direct and the “correct” answer to students, but they have to find it. This situation has not been presented very clearly and some of the students find this kind of working method stressful, yet on the same time others finds it nicely challenging.

4 OBSERVATIONS

There were several experiences discovered about this kind of course execution. It was found out that the students were able to easily find a way of action for the achieving high-quality results, which were as good as or better than at the previous years. Division of the groups according to team role mapping analysed by the teachers seemed to equalize and improve the success of the groups. It seems to be that the division of the work and co-operation inside the group is more efficient. The given task stayed mainly as it was and also no major changes were made to the guidance of the groups, actually the amount of guidance was less. Another observation was that the difference in the groups performing compared to each other was reduced.
In the following sub-sections are the viewpoints of the teachers and the students.

4.1 The opinions of the teachers on the course

There were several experiences discovered about this kind of course execution. It was found out that the students were easily able to find a way of action for the doing of the high-quality result. All of the

groups succeeded in doing of as high-quality or more high-quality assignment work than the best student group in the previous year. Dividing of groups according to team role mapping that was analysed by the teachers seemed to equalize and improve the success of the groups. If the only purpose of the practical work would be to get high quality project plans this would be a "correct" method to implement.
At the previous course implementation there was a doubt that some of the students learned only a specific areas taught at the course. All of the students probably experienced a process of deep learning but only in some parts discussed in the whole course. In the latest course implementation the assignment was structured differently. This time four "technology sectors" were determined for the students groups. Thus there were four time two person technology sectors which were responsible for their own area in all the above mentioned mid-term tasks. The project manager naturally saw all the tasks and their outcomes.
The method of implementation of the course did not give anything for seeking out the goodness of the students. By executing a course this way it is not possible to compare the personal know-how of the students. Conclusion is that the method of implementation of the course should be developed in that way that the focus should be moved to learning instead of just aiming for the good result that was in this course a good project plan. After the course the students filled feedback forms that included both open and closed questions. In this paper these forms are also analysed.

4.2 The opinions of the students on the course

After the course, students filled in a questionnaire on which both open and closed questions were included. In the closed questions a satisfaction degree was asked to different matters. The level of satisfaction included six alternatives to be chosen which are listed below.

0: Very dissatisfied
1: Dissatisfied
2: Fairly dissatisfied
3: Fairly satisfied
4: Satisfied
5: Very satisfied

The summary of the subjects of closed questions and of the averages of answers is shown in a Table 1. In the table the number 5 *Teaching instrument* is in this course a project management tool which is used also in industry. As there also among student the system faced a lot of resistance at the beginning as it was totally new for all the students.

Table 1. Averages of the closed questions evaluated by the students

1.	Achieving of the course objectives	3.6
2.	Attractiveness of the topic	4.2
3.	Usefulness of the course	4.0
4.	Learning method "learning by doing"	4.3
5.	Teaching instruments	2.8
6.	The learning content of the assignment	3.8
7.	The arrangement of the assignment (self-organization of the groups)	4.2
8.	The assignment as a measure of the learned	3.5
9.	The determination principles of the grade	3.3
10.	Learning atmosphere	4.5

The students opinions were between fairly satisfied and satisfied (3.82) on average. Students were also asked to give comments or development proposals with open questions. The open questions dealt with the realization and usefulness of the course. The questions were:

1. Should the realization of the course be continued in the same way or in the different way?
2. What is necessary or unnecessary and why? Is there something missing from the course?
3. Did you learn something that you believe is helping you in the working life?

The approach to the teaching was considered as a good matter. Also the discussion chance from the matters was positive. The students considered the contents of the course versatile. This helped students to understand the planning and project activities of the project. The planning tasks of the project were

considered useful from the point of view of the future.

5 CONCLUSIONS

The product development course presented in this paper is about teaching students to face real life situations. The assignment is very large scale thus the students have to decide on their own how much information they need to find from literature. We have also paid significantly attention to provide as efficient conditions to group work as possible. This is done by forming the groups based on Belbin's team role self-assessment test. Based on the test results four groups were made and they were as balanced as it can only be in practice. Both, the feedback that has been received from the student and the results of student groups showed that Belbin's team role self-assessment functions well in the courses like this. Also the team leaders were chosen by the team role self-assessment test. The third motivating issue is the assessment. Students' ability to memorise taught matters was not measured at all, but the final grades is calculated on the level of the outcomes and the amount of additional value brought to the assignment by each individual. The accomplishments of groups were better compared to earlier years and furthermore, the results of groups were distinctly of more uniform quality than earlier.

The evaluation of the course has to be changed because now the focus is on the final result too much and too little in the learning. The presented evaluation method does not measure the goodness of the individual student in a traditional way so the method does not support the students' mutual comparison. On the other hand, our purpose indeed is to get the students to concentrate to the assignment and to as good final result as possible in it.

In the end it can be said that the very challenging assignment, technique for forming the groups, and chosen assessment method drives students to work hard to obtain the best possible results and on the basis of received feedback we can assume that the students have learned valuable and viable skills on the view point of eventually working in industry.

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