

# Individual examination in project courses: How to relate student performance to learning objectives?

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**Abstract**— Several of the technical educational programs at Malmö University department of Computer Science include project courses at the end of each program year. The pedagogical base for these courses have several parts; Students practice the application of theories and methods learned in earlier courses and students further students' understanding of development and integration of different parts to a solution. Practical work gives students new perspectives and understanding, as well as hands-on training in teamwork and group dynamics.

Constructive alignment is a model that ties learning activities and assessment to so called Intended Learning Objectives (ILOs) and the model is applied on the courses in Malmö Högskola.

We want to examine how this model can be applied to project courses. The goal of the education and the demands from industry require that students, after completed studies shall be able to work effectively in groups comprised of different competencies working on open-ended problems. These demands are beyond the goals of the academic world, but deserve to be considered.

The requirement for legal certainty in the assessment of students' fulfilment of learning objectives indicate that individual assessment is required and this is not always easy to do in project courses. The size of the groups, the objective of the projects and the assigned teacher resources can make individual assessment a challenge.

We have investigated how individual assessment is performed in four project courses at Malmö Högskola. All four courses are based on problem based and situated learning, but the courses have different character; project courses during the first year of studies are executed internally, while project courses during year two and three are run in collaboration with industry. Two examples of assessment that we have tried are individual time sheets and individual e-portfolio.

Through a literature study we have found a number of papers containing methods and results based on pedagogical research. There is a focus on a small number of methods, e.g. "Peer Assessment." Our study indicates that more research and development work is needed within this area. For example through evaluating methods referenced in literature regarding how well they support individual assessment in project courses. Most methods are not clearly related to how different learning objectives that are assessed, which make it difficult to evaluate the connection between assessment and learning objectives.

**Index Terms**—individual assessment, project courses, constructive alignment.

## I. INTRODUCTION

Several of our technical educational programs at Malmö University include project courses at the end of each program year. We believe that this is good way to practice the application of the theories and methods learned in earlier courses and to further the students understanding of development and integration of different parts to a solution. Our students come from varying backgrounds and many of them are not especially at ease in more abstract worlds. For them project courses are a way to understand the theory, to re-gain motivation regarding their studies and to establish a new role in peer-relationships which may result in more self-esteem. Practical work gives students new perspectives and understanding, as well as hands-on training in teamwork and group dynamics.

Since we believe that project courses are advantageous to our students, we are constantly trying to improve the quality of these courses and to evolve our ways of running them. Compared to common classroom courses we are faced with special challenges when it comes to project courses. Recurring challenges that we struggle with are: how to form groups (size, constitution, leadership), which kind of problems to propose (different problems or the same problem for all groups, open ended problems or more defined and manageable ones), the role of supervision (monitoring group dynamics, technical advisor, formative evaluation), and the evaluation of the student's individual learning objectives (individual vs. group evaluation, final result oriented or process oriented evaluation).

We would therefore like to analyse our courses and compare them with other project courses. The most important variable is whether the students reach the learning objectives and to which degree, i.e. quality. Hence, we would like to find ways of individually assessing our students in a way that monitors their advancements towards the fulfilment of the learning objectives and evaluates the level of the fulfilment. We have used different approaches for student assessment but it appears that they are either not reliable enough or resource-wise not realistic.

In this paper we are discussing challenges and some open questions regarding how to individually assess and grade students participating in project courses based on our experiences and findings in literature studied on this topic.

The first question regards the need to assess students individually in project courses. Our experiences indicate that students were traditionally assessed based on the results produced by the group, which resulted in common grades for group-members. In cases of extreme differences between the performance or contribution of individual students and

the rest of the group, the responsible teacher could modify individual grades either up or down. Several reasons exist why we consider it important to assess and grade students participating in project courses individually:

- Legal certainty requires that the students individually get a fair assessment in relation to their achievement. So called “free riders” are more likely to pass in project works without individual assessments [4].
- Evaluations of educational programs carried out by the Swedish Higher Education Authority (UKÄ) focus on assessing if students, at the end of their studies, have reached the learning objectives defined for the study program. If the individual progress is not assessed and monitored it will not be possible to say whether a student fulfils the final objectives or not.
- Research indicates that formative feedback given to students individually during the course can improve their learning [1]. This implies that students’ contributions should be assessed individually.

We looked at four project courses regarding individual examination. The courses are problem based and include situated learning. However, the courses are of different types: projects carried out at the end of the first year are run internally, while most of the projects at the end of the second and third year run in cooperation with companies. Examination types span from reporting individual time sheets to e-portfolio evaluations.

## II. HOW TO EVALUATE THE DIFFERENT TYPES OF PROJECT-COURSES – LITERATURE STUDY

We also looked at existing literature to try and find appropriate methods for individual student evaluations to compare with the experience from our project courses. Alden categorizes four different types of how to assess students in project-work courses [4]. Coppit describes the implementation of very large software engineering projects (20-30 students per group) and a hierarchically structured assessment system based on issue tracking [5]. Buzzetto-More & Alade mention some best practices while praising the generation of possible assessment data by ICT tools used in e-learning [3].

We recognized our own problems running project courses in many of the articles studied. While different interesting aspects regarding the individual assessment of students participating in project courses are covered, we did so far not find straightforward answers to our questions. This might be an indication that we did not manage to find the relevant scientific contributions or that more research is needed in this area. What we did find is that there are several areas of dialectic perspectives of research results that span a discourse from different points of view.

## III. ASSESSING LEARNING OBJECTIVES OR PROJECT WORK RESULTS? (WHAT SHOULD BE ASSESSED)

Since project work can be assessed in many different ways, the articles found in the literature study are very different at this point. However, two main categories were found that were used for differentiation. In most of the

papers students’ final grades are evaluated based on the work and results performed by the whole group, weighted by the assessed individual participation, motivation and engagement. Only few papers describe the assessment of the individual fulfilment of learning objectives as part of for example constructive alignment or CDIO-courses [2], [7], [8], [9].

An interesting question is whether the two ways above differ in the type of resources needed for running the course and for assessing the students. A hypothesis could be that project courses focused on technical results are easier to coordinate together with external partners, such as companies, with relevant technical expertise. Another question is whether students working in a group that does not succeed in solving the tasks nevertheless can fulfil learning objectives. The possibility to learn from mistakes should not be neglected.

Since learning objectives of a given course relate to the overall objectives of the study program, the task of assessment and the providing of relevant feedback to the students not only requires technical knowledge but also insight about the pedagogical structure of the educational program [6].

## IV. INSIDE VS. OUTSIDE THE LOOP, (WHO IS ASSESSING AND WHAT IS THE PURPOSE OF ASSESSING)

Project courses in higher education are found to enable deep learning to close the gap between theory and its application and (in our experience) to integrate parts and components to a whole [3], [4]. Applying fragmented and theoretical knowledge taught in courses during the year, the students are forced to understand the practical problems and are forced to integrate different bits and pieces towards a working solution. Since this require special skills that are not taught in normal classroom courses, students get a second chance to prove themselves in new settings. It is not unusual to see students less talented in theoretical subjects surprise their teachers by shining in project courses.

For this to happen, project courses should contain a certain degree of complexity, preferably as real-world problems, authentic and based on real situations. Large, unstructured, complex, real-world problems are usually solved in larger groups with a higher degree of specialization. This is not that easy to handle in project-course settings. Some of the drawbacks are illustrated in [5]: groups need to be hierarchically structured, tasks are generated based on an issue tracking system. This strongly confines students’ participation in the process.

The assessment scheme used in large groups is often not coupled to learning objectives but to available data that can be evaluated by teaching assistants. The only way for the teacher to be able to handle such a course is to step “out of the loop” [1].

Trying to assess individual learning objectives in authentic, real-world open-ended projects add another dimension. As a consequence of the division of work and the need for different roles within a project group, students can fulfil the learning objectives in many different ways. Hence, learning objectives must be formulated in a flexible-enough way so that they allow to be reached by different paths. Combinatorial effects may make it very difficult to account for all the possible ways in the evaluation criteria. It may therefore be more realistic not trying to assess the end result but to monitor the progression of each student towards

the learning objectives in a form of “coaching”. This is described in [1] as “closing the feedback-loop” by having more interaction between teachers and students so that feedback becomes reciprocal and influences both students and teachers. This is in accordance with the very basic ideas behind constructive alignment as well as the approach to teaching where the teacher is enabling the students learning.

In comparison to the assessment of authentic real-world projects that are not focused on learning objectives, such a coaching-style could also be characterized by the teacher stepping “in to the loop” instead of out of it. As shown in [1], due to restricted teaching resources, formative assessment and feedback sound better in theory than it works in practice. Torrance argues in [1] that formative assessment easily can become “deformative” and even keep the students away from the critical and creative thinking. Students should be given the possibility to become self-regulated learners. This requires that students understand the learning objectives and take responsibility for them and can judge their own progression towards them.

Authentic, real world problems are already complex by definition. But to focus on solving the problem or to become self-regulated learners are two different tasks. This can be seen as a progression in project work - for the students as well as for the teachers! Digital e-learning tools may play an increasingly important role here. The digital data generated by students using these tools may enable teachers outside the loop to define quantitative assessment methods and to automate as much as possible of the assessment task. For the teachers and students inside the loop the quantitative data collected by the tools can be used to qualify the trajectory of student learning.

#### V. STUDENTS PREFERRED STYLE OF ASSESSMENT VS. RESPONSIBILITY FOR LEARNING OBJECTIVES

Alden [4] proposes four different methods used for student assessment:

- A) shared team grade,
- B) faculty review of records,
- C) faculty review of student-generated portfolio,
- D) peer assessment of team member contributions.

The criteria used for the comparison in [4] were: validity of grades, ease on students, ease on faculty, encouragement of active participation, perception of fairness, utility for formative feedback, and impact on group dynamics. The results showed that “faculty review of records” and the “faculty review of student-generated portfolio” were perceived very much alike one another and scored the highest in almost all of the criteria. (None of the methods seemed well adjusted to support group dynamics). Interestingly method “B) faculty review of records” was perceived more popular amongst student while staff preferred “C) student-generated portfolio”. The main difference between the method B) and C) is that portfolios are thought to be edited and composed by the individual students from their own records to show the progression and own reflections about their work.

This result appears to illustrate the tendency that students expect teachers to evaluate their learning objectives. Not only is this easier for the students but it is also what they are used to from “normal” courses. Students should be made responsible for reaching their learning objectives in all of their courses, not just in project courses. A necessary requirement for being able to take on own responsibility for

learning objectives is that students can monitor their individual learning trajectories in an adequate way.

#### VI. CONCLUSION

We think that it is important to assess students’ results in project courses on the process of their work as well as end products produced by the projects. To prepare students for real world challenges the problems solved in the projects need to be open ended. This introduces a higher level of complexity not only to the project but also in how to phrase learning objectives and how to assess them.

Many questions arise, e.g.: How can these aspects be balanced and individually assessed fairly when artefacts are produced through collaboration and how a team meet their challenges depends on the way individuals influence each other? How to make the learning objectives understandable by students and the evaluation process transparent? How to phrase learning objectives that can be assessed individually and also encourage creativity and not impose restrictions?

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