

Reducing Free-riders by Individual Achievement Tracking in Group Work

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Abstract—Most people involved in courses with group work, both as students and as teachers, are aware of the problem of free-riders. In courses where group work is combined with forms of individual examination, e.g., an exam, the result may manifest in a discrepancy between the number of students approved on group work and students passing the exam. This examination structure may in this regard be seen as successful as a strategy to catch free-riders. However, combining an exam with group work may work for certain courses, but for other courses it may be infeasible. In this paper, we present our experience of using an adaptation of the Achievement Unlocked approach, with individual achievement tracking, in the context of a project course on Agile Software Development, heavily focused on group work.

Index Terms—Achievements, Group work, Free-riders

I. INTRODUCTION

GROUP WORK is common in many courses and with group work there is a risk of free-riders [1], [2], [3], i.e., students who do not do their fair share of the work in the group but still get credit for the groups joint work. In some courses, examination of group work may be combined with individual examination, for instance, using a written exam. In such a setup, free-riders can be caught on the exam, but likely depending on the extent there is an overlap of the examination forms.

An alternative strategy for individual examination is to use individual hand-in assignments or demonstrations during a course. An example of such a strategy is the Achievement Unlocked approach [4] used in a programming course at Uppsala University. In this paper, we describe how this achievement-based approach has been adapted and integrated into the project course on Agile Software Development (EDAG05) for individual assessment in group work.

II. UNLOCKING ACHIEVEMENTS

The Achievement Unlocked approach was presented in a course experience report by Wrigstad & Castegren [4]. The approach has been used in a programming course at Uppsala University with 120-140 students. Using constructive alignment [5] as an inspiration, they organize their course around a list of achievements and students can “unlock” these achievements via demonstrations during labs, assignments, and a course project. The idea of unlocked achievements connect to mastery learning [6], where students need to achieve a level of mastery (to at least 80%) before moving on to subsequent knowledge. There is also a connection to flipped classrooms [7], where students consume material outside the

EDAG05 Structure Spring 2023

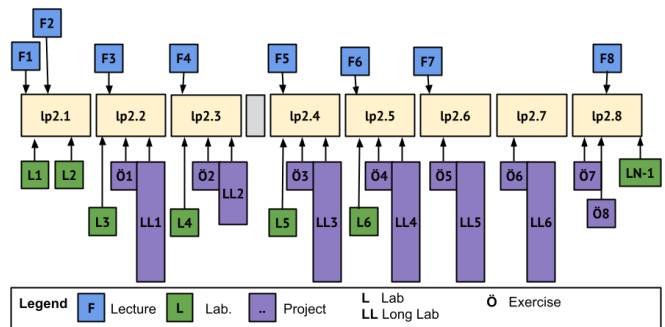


Fig. 1. EDAG05 structure

classroom and work on assignments and discuss in the classroom.

In the course described by Wrigstad & Castegren, there are around 70 achievements (presented in groups of connected achievements) and each achievement is connected to a grade (3-5). A student must unlock all achievements for a grade to get the grade. Students decide when they want to demonstrate achievements, and they are responsible for matching achievements that go well together. There are plenty of opportunities for demonstrations, but the number of slots are limited to around 30. The outcome of a demonstration (with typically one teaching assistant and two students) is one of three; pass, fail, or fail with pushback. Students can retry as many times as they want during one slot (except if they failed with pushback when they need to wait until the next slot). During a demonstration students state which achievements they wish to unlock, why and how these will be demonstrated together, and what evidence they will use in the demonstration.

III. AGILE SOFTWARE DEVELOPMENT (EDAG05)

The course on Agile Software Development, with the course code EDAG05, is a project course teaching agile software development to students not specifically focused on computer science or software engineering as their main topic [8]. The development of the course started in 2020 and the course has run in three course instances (Fall 2020, Fall 2021, and Spring 2023), gradually with more students (10, 15, and 76). In the last instance, the majority of the students were from the second year of the Industrial Engineering and Management (I) engineering program, but also PhD students and students from several other engineering programs, e.g., Mechanical Engineering (M) and Information and Communication Engineering Technologies (C).

The course runs over one study period and the majority of the course is focused on a project carried out in groups of 6-8 students (in earlier instances groups were smaller with 4-6 students) in each group. The project is structured around weekly iterations, with customer meetings, developer sessions, and retrospectives in line with the agile software development practice. In addition to the project, there are lectures and labs to introduce and practice concepts used in the project. Fig. 1 gives an overview of the structure of course activities in EDAG05 during the Spring 2023 course instance. The project begins in week two and is then interleaved with lectures and labs during the first couple of weeks. In the final week, there are presentations and demos to wrap up the project.

The project groups are responsible for scheduling the development session for each project iteration in a way that works for the members of the group, and the group should also have 1-2 members as coaches each week. The scheduling, coach assignments, and agreed upon work practice in the group is documented in a social group contract in the beginning of the project.

IV. ACHIEVEMENTS IN EDAG05

The starting point for the course project in EDAG05 is that a group should develop a product based on requirements provided by a customer. The customer and the group meets each week to let the group demonstrate the product to the customer and to receive further and more refined requirements for the product. The group should finish this task together and deliver a source release of the project for review, they should also review another groups source release, and demonstrate their product in a joint demo session.

While the goal of the project is to develop a product in line with the customers needs, the goal of the course is to teach the methods of agile software development. In theory a subset of the members of a group can implement the product and hand in for the whole group. How do we engage each member in a group to work with the methods in the course (up to a level where it is suitable for a passing grade)?

The approach explored so far in this course has been an adaptation of the the Achievement Unlocked approach. Students are given a list of achievements at the beginning of the course with the instruction that when they have unlocked those achievements they have passed the course. Students are free to decide what evidence they would like to use to unlock an achievement. The tasks in the labs and the work in the project will generate material that they can use as evidence, e.g., commit logs from the Git version control system, or comments from the code review system in GitLab.

Achievements are either skill-based (e.g., "show that you can provide a constructive code review") or reflections (e.g., "reflect on what you learned in the planning lab", "reflect on what you learned in the course"). The skill-based achievements are closest to the achievement kinds used in the original Achievement Unlocked approach. The reflection-based achievements were added to encourage self-reflection, which is also a part of the agile practice of retrospectives, used in the project work in the course.

In the Spring 2023 instance of the course, we also introduced the concept of group achievements. This was to fold in some project tasks that were not captured well in previous instances by the individual achievements. For instance, any hand-in by the project group was reformulated as a group achievement, but also the weekly group retrospectives were now listed as a group achievement to put more emphasis on the importance of this task. The responsibility of the group achievements were also assigned to the weekly group coach or coaches,

To help students get familiar with achievements, time is spent on describing the approach in the first lecture and the first lab. In the first instances of the course, achievements were tracked via issues and milestones available on the GitLab platform for management of Git projects. This strategy of reporting achievements required more explanation and was abandoned in the Spring 2023 course instance, in favour of using the Canvas platform which provides sufficient support for hand-in of material and review iterations on hand-ins.

On the Canvas platform, students hand in material for achievements when ready and then teaching assistants (TAs) and teachers provide feedback. With the larger student group in the Spring 2023 instance, the responsibility of reviewing achievements was split up between the TAs and the teacher. In total the Spring 2023 instance had 26 achievements, 11 group achievements and 15 individual achievements (6 reflection-based and 9 skill-based). Students submitted 1926 submissions during the course and 72 students uploaded a submission for the last achievement¹. In the first two course instances, we had 37 individual achievements.

V. EXPERIENCE AND LESSONS LEARNED

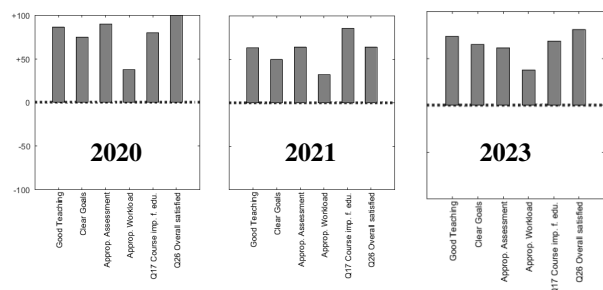


Fig. 2. Summary from the anonymous course evaluation questionnaire (CEQ) for 2021-2023, left to right. The response rate for each year was 5/12 (42%) for 2020, 7/14 (50%) for 2021, and 13/74 (18%) for 2023, with regard to respondents in relation to students registered on the course.

Considering the student feedback on the three course instance, the course has generally received a positive evaluation. Fig. 2 shows the summary for each course instance as collected by the anonymous course evaluation questionnaire (CEQ). The work load in the course (e.g., labs taking too much time) stands out as the main negative feedback, while for instance

¹We had a couple of more students submitting to the first couple of achievements, before they fully had decided to follow the course. The full number of expected submissions for 72 students would otherwise be 1872 and not 1926.

the relevance to students' education (Q17) has received clear positive feedback.

With regard to achievements, students have mentioned them explicitly in the free text qualitative feedback included in the CEQ (one explicit comment in 2020, two in 2021, and three in 2023). For instance, one student expressed that the achievement unlocked model helped with understanding ("*I also liked the achievement unlocked approach. Almost all courses should have it! I learned a lot more this way because it put more focus on really understanding what everything means*", satisfied student 2020 on best things with the course), another student described the approach as helping with organisation ("*Achievement has helped me stay organized and helped me to split up a problem*", satisfied student 2021 on best thing with the course) and a third with getting an overview ("*I like the way we have worked with achievements on Canvas, because it helps you to get a clear overview of where your are in the course*", satisfied student 2023 on best thing with the course). On the negative side, two students described the achievements as being unclear (e.g., "*To clarify achievements and be consistent in the correction*", satisfied student on what to improve in the course) and one of these students also expressed that the achievements can be stressful ("*Above all achievements, they were unclear, you did not learn from them and it became stressful when everyone need to gather evidence for the same assignment common to the group*", satisfied student on things to improve).

From the teacher side, the main question when preparing for the Spring 2023 instance was to what extent the use of achievements would scale to the expected larger student group (from 14 to 74 students, an increase by roughly x5). The estimate was that we needed to reduce the number of individual achievements, which were reduced from 37 to 26, but even with this reduction we received 1926 submissions. In the first two instances, all reviewing of achievements could be done by the main teacher (the author) but this was not expected to work in the Spring 2023 instance. Instead, the responsibility of the reviewing was split among the TAs and the main teacher. This strategy worked in practice, but to some extent introduced the challenge of coordination among the reviewers, both with regard to when to pass and with regard to the expected turn around time for a review.

The time to review an assignment can, as with many hand-in assignments, vary a lot in the effort needed for each iteration of a review and also in the number of a review iterations for an assignment. The number of review iterations could likely have been reduced in the Spring 2023 instance if some of the achievement descriptions were clarified, an issue also highlighted in the qualitative feedback from two of the students in the Spring 2023 instance. One aspect to keep in mind here is that we can strive for clarity, but ideally there should be an element of choice in how to demonstrate an achievement to encourage reflection (how can I demonstrate that I know how to do this?). How to find this balance is another challenge that we will continue to work on in the course.

One positive aspect of using achievement, as continuous examination in the form of micro assignments, is the feedback it provides during the course; feedback with regard to how

well the content of the course is understood by the students (e.g., have they understood how to use a method from the course?) but also feedback on how well the course material is working (e.g., do students understand what the task is?). With this continuous feedback we could more quickly adapt and try to improve the material during the three instances of the course. We also got a chance to have more one-to-one "conversations" with the students via the reviewing, even though the interactions may be short. We see this point of feedback and interaction as a positive aspect that would be difficult to get from a written exam (we acknowledge that an oral exam may provide some of this, but typically at the end of the course and not during).

With regard to free-riders, which is one of the motivations for exploring this approach, the outcome so far has been that in the 2021 and 2023 instance, not all members of all groups were immediately passed when the project was finished. In almost all cases, the remaining members were passed at a later stage after redoing or completing achievements after the course.

VI. CONCLUSIONS

We have presented how we have applied an adapted variant of the Achievement Unlocked approach in the project course on Agile Software Development (EDAG05). Our overall assessment of using this approach is positive; it provides a point of feedback and interaction with the students, it introduces more individual examination in a course focused on group work, and it seems to reduce the free-rider problem. The main challenge when scaling up the size of the course has been to find a balance in how many individual achievements to include and how to best describe the achievements.

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