Student Collaboration and Independence from Day One in Higher Education

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INTRODUCTION

This study describes how a novel course structure at the beginning of engineering studies influenced the way students approach challenges during their studies. The study was conducted at Helsinki Metropolia UAS, Finland and focused on two groups of information technology students with diverse nationality backgrounds, and two groups of information and media technology students with Finnish background. This research examines student self-reliance and collaborative practices in project-based learning and the results as well as student feedback are further analysed. Student collaboration and independence were found to increase overall satisfaction and boost learning in project teams.

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1 BACKGROUND

1.1 Socio-cultural paradigm in teaching and learning

In the socio-cultural paradigm, human activities are considered as socially mediated, and learning takes place in human interaction and in interaction with mediating objects [1]. Learning is embedded in the social processes of knowledge construction rather than being an individual venture [2]. A central viewpoint in the socio-cultural approach is the concept of interdependence between individual and social processes. Learning is achieved through a progressive inquiry process where the study community of teachers and students collaborates with the aim of building shared objects and shared knowledge. The pedagogical development described in this paper has been done in cooperation with the EU-funded KNORK project, which aims at providing easily applicable pedagogical approaches supporting new competencies required for knowledge work [3]. The educational approach is based on the ideas of trialogical learning that define the principles for sophisticated collaborative knowledge creation practices, building on the socio-cultural approach, and project-based learning.

1.2 Role of self-regulation in student success

A number of studies have shown the importance of metacognition in efficient learning. Metacognitive skills include setting goals for studies, choosing appropriate learning strategies, self-reflection, and monitoring progress. According to a meta-study of educational interventions by Coffield et al. [4], advantageous and effective approaches tend to include development of metacognition. Improving instructional quality and formative assessment also belong to cost-effective intervention types. Sternberg stresses that an individual's ability to develop his or her content-specific knowledge and apply it in varying situations often co-evolves with the development of general thinking skills and metacognitive strategies [5]. The achievement of high-level expertise depends on self-reflection, and becoming aware of one's working habits and learning strategies. Writing has been found to be an efficient tool in developing metacognitive capability. At the same time, writing also helps to acquire deeper understanding of the subject matter [2].

Moreover, meta levels of mind incorporate emotion and an awareness of cognitive and emotional states. Therefore, full self-regulation includes regulation of cognition, motivation, and emotion [5]. The better the students can to control these in long-term as well as in a particular situation, the better they manage their learning. Optimally, a student enjoys his or her studies and has confidence in them, and considers effort to be an essential element for success. Therefore, to ensure good performance, teachers should strengthen students' metacognitive capabilities and encourage motivation.

1.3 Aims of the study

This study explored what the outcomes of project-based learning for first year students are. The basic investigative approach in this study is the so called mixed method research which is considered as an emerging research paradigm in educational research that combines both qualitative and quantitative research [6]. In the present study, two academic courses with multiple implementations are investigated from a qualitative point of view, and combined with quantitative data.

2 RESEARCH

2.1 Setting and participants

At Metropolia UAS, each student takes four different modules during the first academic year. The international groups start with an Orientation course designed specifically to familiarize them with engineering studies in Finland and the basics of information technology. This study discusses experiences gathered from two different modules: the Orientation course for the foreign students and a Games course focusing on programming and software development project. Each of the courses gave students 15 ECTS and took seven weeks of full-time study plus one week for exams and possible resits. Study groups ranged from 26 to 32 participants. In the Games course students had a varied amount of experience in programming prior to the course. Some of them had never programmed with any programming language, whereas some had written applications with more than thousands of lines of code and were part-time employed in programming related jobs.

In the Orientation course, as discussed in Lukkarinen et al., studies were organized into several small projects, each taking no more than one week to complete [7]. Project assignments were as follows: a small group presentation, a description of Metropolia UAS services for students, PC assembly, Linux installation on personals laptops, homepage creation, and photography. In the Games course, schedule in *Table **1*** was followed.

Table 1: Games course project schedule

Week 1: Team building	Preliminary game concept, giving presentations in English, Java introduction
Week 2: Game idea	Game concept presentations, Java objects, variables and control structures
Week 3: Development start	Java I/O, development process, first game development sprint starts, game story in English
Week 4: Game skeleton	Game structure, Java collections
Week 5: Prototype	First prototype game ready, reading and analyzing current gaming news in English
Week 6: Getting ready	Documentation, Java advanced topics as needed - for example serialization and threads
Week 7: Final presentations	Documentation and final presentation in English

Apart from providing interactive lectures and lab challenges to support learning the key concepts of object oriented programming and Java programming language, teachers operated in consultancy mode: new topics were addressed based on student needs. This provided the possibility for those with advanced programming skills to take up more challenges for their projects.

2.2 Course evaluation

Students received a single grade for the whole 15 credits course. Components in the grade were: project result 20%, project work 20%, Java exam 15%, web design and development 5%, English communication 20%, and mathematics and physics 20%.

Java exam had questions on object oriented programming principles and questions that required skills in understanding object-oriented Java applications. To pass the exam students had to get 50% of the total points. Project grading was done by the lecturers teaching project work and the English teacher. The game was evaluated based on the project review during the last week of the course and code review of the final application. Project work was evaluated by observing each team's project work during the course and by the final report.

2.3 Methods applied to build student competences

The aim of the first semester courses was to build a solid background for the development of professional competences such as teamwork, planning and following the progress of a project, as well as presenting and discussing ideas with other people. Moreover, a student's reflection and self-regulation skills and metacognition were systematically developed. Writing is one of the most efficient ways to develop metacognition and study skills in general. Several writing tasks were given during the courses:

1. In the Orientation course, for international students, students were asked to present themselves in a team poster: How am I different from my team members? What makes me unique in my team? What is it that connects us as a team?
2. In the Games course, students wrote a blog where they recorded their learning on daily basis.
3. Students documented their projects at the end of the Games course.

Moreover, smaller tasks to analyse the progress and learning were introduced weekly: the games course had a weekly Scrum meeting inspired by the Scrum agile development method [9] every Friday afternoon. In this meeting, students discussed in groups of five or six their progress during the week (by answering the question "What did I accomplish?"), their plans for the upcoming week ("What am I planning to do next?"), and impediments ("What is stopping me from achieving my goals?"). Impediments were discussed together with the instructors, sometimes resulting in changes in the course schedule or fine-tuning the content. There were two feedback sessions by the Metropolia study advisor in addition to the final feedback discussion with the instructors at the end of the course. Naturally, students had a chance to write down their impressions on the course in a formal on-line feedback questionnaire.

Formative assessment was practiced through ongoing feedback during the course: after each small exam, teachers discussed student performance with each student if necessary. Also, laboratory assignments were discussed during the classes and after they were completed.

The project topic was not fixed beforehand by the instructors in order to encourage collaboration in project teams right from the beginning. Also, fixed project work methods were not imposed by the teacher team, although some Scrum-related practices were promoted [9]. Furthermore, students were given the responsibility to install and maintain their own laptops and make sure they have all the needed tools (relevant Java SDKs and Eclipse or Netbeans development environments) available and up to date.

Student collaboration took place in the classroom, as well as in the networked environment.

- Classroom had a flexible physical setup that allowed arranging tables into groups or for individual work. Movable whiteboards were also available.
- Online learning and writing tools such as wiki, home pages, and shared writing on google drive were employed.
- Two online programming courses were used in some of the Games implementations: one group practiced programming first with MIT Scratch [10] and one group used University of Helsinki online MOOC on Java [11].
- The internal learning platform Tuubi environment was utilized for course assignments, discussion and teacher announcements, and distribution of material.
- Moreover, some student groups employed Git, Trello planning tool, as well as Facebook as communication devices.

3 DATA COLLECTION AND ANALYSIS

3.1 Blogs

Student blogs contained a varied amount of reflection, because no template or specific instructions were given. Also, students had a free choice for the technical format of the blog in the two Games implementations. As a result, the blogs varied from simple Wordpress implementations to elaborate HTML5 based customized sites. The amount of text ranged between 300 and 2600 words, and some blogs contained also photos and drawings.

Students commented very positively on collaborative practices: the “Games fair” event and visiting another group to examine their projects were particularly warmly received. Some teams reported of problems in coordinating project work and decision making. Quotes (unedited):

- “Just before the game fair which is tomorrow, our games still have bugs, we have really nice team spirit and team work, so I think we can overcome it:)”
- “The afternoon game fair is really great. Finnish students worked seriously and all three group I met made classic text base game which is a good thing to improve programming skill. Unlike my strange game, they concentrate on OO. Theirs games are very big. It must be the result of intensive teamwork. I really admired them.”
- “In the afternoon I try to help my teammates to create object by themselves but unfortunately I failed.They lacked motivation and I did not have enough patience to teach them everything.”
- “I have made friends, S., A., D. and of course O. In some sense it will be pleasant to work with them in future, I learned how to value other's contribution, ideas, comments and also how to comment on their work too.”
- “Two Finnish game group visited our class and they shared their ideas with us. It was really good time for me and I guess that it's same to other students. I could draw a big picture from their advices and games.”

The quotes above contain reflection on understanding, which is an indication of metacognition. Metacognition was discussed in the classroom and students were advised to include self-reflection in their blogs. Many surpassed the level of simple statements such as “this is difficult”, and mentioned ways to improve themselves and

their study habits. In fact, nearly all blogs contained self-reflection to some extent. This was in some occasions combined with the assessment of teaching methods:

- "We also announced a homework before the test, this is the interesting way to review our lectures."
- "This problem solving stuff is great and make you study a fun ,maybe its only for me thats math is fun or maybe for all."
- "THE MOST AMUSING THING ON UNIVERSE, THE SCRUM MEETING !!! which actually discuss the advancement and the path of the project as considering all the impediment."
- "…to express my feelings towards the blog writing habit. I was really against it in the first place because I feel like this habit is taking over my already tight schedule. However, I have been feeling differently lately. I started to appreciate this, and consider this little space a place to store my thoughts during the class hours."

Technology students tend to have a slight aversion against writing, which is shown in the brief statements in the blogs. However, these blogs are in accordance with the findings on metacognition and study success: the better the students apply reflection in their writing, the better they seem to perform during the course.

3.2 Course feedback

U Student feedback on collaboration and independence aspects in the courses was mainly positive. There were, of course, some individual students who said working alone on the project would have been their preferred method. This is in line with expectations: based on earlier experience, collaborative work was assumed to be hard for some engineering students.

All student teams managed to complete their project within the given schedule. The games created by the students did, with a few exceptions, exceed the teacher expectations. The same was true about student expectations: in general students noted that at the beginning of the course they never thought they would be able to create games with such high levels of functionality and complexity.

- "Amount of new knowledge and experience, making a program (game) by yourself that actually works."
- "Working in a group created pressure to get your own part done because you are responsible for the success of the whole group and not only on your personal success"

Interestingly, in their feedback students claimed that they had learned to work in a team and collaborate to create the application together.

- "Working in a group was a good way to do the project work and motivated my group members and me."
- "Most positive was how efficient, instructive and meaningful working in a group was especially compared to just attending lectures.
- "Especially I could learn how to cooperate with other team members. Each person has an different idea, ability and a schedule. So we need to concede sometimes, discuss our ideas, consider them sometimes. I think it will be helpful for us in the real working life"

Especially those students who were not familiar with programming before the course, noted that working in a team made it possible for them to learn more than they thought would have been possible when working alone. Working on the project in parallel with learning programming caused also expressions of anxiety.

- "If I were alone, I could not learn a lot like in this course."
- "In general, I think that I have gain much experience in programming new language. I know how to work with other better in a small group and divide work for them to do."
- "After the initial shock, I was pleasantly surprised by how fun and instructive it was to create the text-based adventure game."
- "It was hard to start the project after so little programming practise. Planning the application without prior knowledge about programming was challenging."

An encouraging finding can be seen in the following student statements: a seemingly loosely defined project seems to result in a feeling of independence and self-governance.

- "freedom in working out an own idea and implementing was positive"
- "Having so few assignments created a willingness to learn independently."

3.3 Results

As can be seen in *Table **2***, there is quite little variation in the grade averages for different course implementations. According to teacher notes, in Games B course, students had some difficulties in finding efficient ways to collaborate, which might partially explain the lowest average grade. The pass rates in general, however, are remarkably good and do suggest that the approach described in this paper is an effective one.

Table 2: Grades

Course implementation	Passed / All	Average grade
Orientation A (Engl)	22/22	3,9
Orientation B (Engl)	25/26	3,8
Games A (Fin)	29/31	3,9
Games B (Fin)	25/25	3,6
Games C (Engl)	22/24	3,7

4 SUMMARY AND ACKNOWLEDGMENTS

Collaborative work towards a shared goal has proven to be an efficient and inspiring mode of study, and in this case, it was introduced immediately during the first courses. The teachers involved with the game project were prepared to support and encourage collaboration in all tasks. However, the students quickly adopted a self-directed mode of operation, helping each other instead of asking teachers. One surprising finding was the fast speed of adopting team working skills even though most of the students had not worked in teams in their previous studies.

Furthermore, students did not depend on university PC installations but they were in charge of their own laptops, which they learned to administer fluently. Students could demonstrate and use their previous IT knowledge and enhance it in collaboration [1]. The instructors recognized that students had previous knowledge and skills that they were able to use creatively when assignments were structured in an open way.

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