Integrating mobile orienteering to team forming activity in a software engineering course

H. Väätäjä[1]
Postdoctoral Researcher
Tampere University of Technology
Tampere, Finland
E-mail: heli.vaataja@tut.fi

A. Ahtinen
Postdoctoral Researcher
Tampere University of Technology
Tampere, Finland
E-mail: aino.ahtinen@tut.fi

Conference Key Areas: Open and Online Engineering Education, Attractiveness of Engineering Education, Engineering Skills

Keywords: Mobile learning, soft skills, team work, collaboration, physically active ways of work, well-being

INTRODUCTION

Building and maintaining a well-functioning team in software development as well as functioning as a cross-functional team throughout a software development project is one of the skills that software engineering students should possess when entering the work in companies after studies. Therefore, they need to learn these skills during their studies. Beyond technical skills computer science students need to master soft skills when graduating, including experience in working in projects that provide varying big challenges, and communication and organizing skills [4]. According to the report by World Economic Forum [16] the core work-related skills in the future include cross-functional skills such abs coordinating work with others, which is essential in software engineering projects, as well as monitoring self and others as a basic process skill.

A study in industry reveals that one of the most important skills engineers themselves value is working in teams [2]. Interviews and observations of engineers and managers revealed that much of the work is related to non-technical issues and dealing with them [2]. According to the studied engineers, the most important skills are communication and coordination skills [2]. All team members participate in coordination, not only the formal manager [2]. Solving complex problems needs efficient interaction with others, as well as identifying and utilizing the right channels for influencing. Based on the findings, authors suggest that the learning experiences should 1) be problem solving

and based on team work, 2) integrate technical and communication skills, 3) include the constraints based on business, like time and budget, and 4) be based on the identity of engineers as problem solvers. They recommend that implementation projects are suitable for this purpose. To be effective these projects need to be authentic, the client needs to be involved, they need to be complex, taking into account other information, and the evaluation strategies need to be efficient.

Engineering students themselves emphasize similar characteristics. When studying the ideal characteristics of engineers based on student essays in the course of engineering ethics, interpersonal skills were emphasized as one of the key characteristics [9]. Interpersonal skills covered both communication skills and effective teamwork [9]. Prior research supports these findings [10, 12].

As communication and team working skills are essential for software engineers they are set as goals in the curricula as well as included in learning objectives and outcomes of various courses. Therefore, educators need to include team working as content of teaching, or at least choose appropriate teaching strategies and learning activities to support the gaining of the skills. In addition, it is desirable to build at the same time the capability of reflection on own and team functioning and learning as a team.

On the other hand, the educational methods in universities are quite sedentary. Sedentary lifestyle has negative effects on health and well-being of people in many ways [3], Other way round, even light-weight physical activity during the day have positive impact on health [3] as well as creativity [11]. There are also clues that physical activity in the form of walking meeting would also have positive influence how people interact and communicate [15]. Walking during the day can increase the activity level of people in the work context [6] and it suits to almost everybody as it is light-weight activity and does not need special equipment.

This paper describes a case study in a course on software engineering, in which the students used a mobile orienteering application aiming to support their team building related activities in physically active ways. The application was implemented on the ActionTrack platform [7]. Our trial was driven by the question: *"How could we support the team forming in its initial phases within weekly exercises so that it includes team building activities combined with physical activity at the campus area?".* We aimed to support forming functioning teams and initiate their agreement related to the practicalities for their group work activities within the weekly exercises and for a larger design assignment. We wanted to utilize physically active ways of work as we assume that walking have potential role in enriching interaction and communication in the educational context. We propose that team building activities combined with physically active educational methods could be used more in the university education.

1   CASE STUDY

The case study focuses on a course in software engineering at a Finnish university of technology. Course brings together a postgraduate student pool with varying disciplinary backgrounds in engineering as well as with highly international student background. The number of enrolled students to the course is yearly about 60. In the studied implementation, two weekly exercise groups were arranged, with a total of 45 participants in the first session with the mobile orienteering exercise. In total, 16 groups were participating the activity, equally divided to the two exercise sessions.

One of the goals of the course is to support building skills to work in a cross-functional team. The course includes as a learning objective the capability to function in such a team, contribute to the work of the team, and to be able to analyse the functioning of

such a team. To support this, the learning content of the course includes the theoretical and practical aspects related to the work in multidisciplinary and cross-functional teams. Themes covered include skills needed in group working, communication in group working, aspects that influence team work effectiveness, possible problems in team work and team decision making, and how to solve these problems, and theory related to the phases of group formation.

The challenges in practice seen by teachers guiding the work of student teams as well as encountered by student teams themselves within software engineering courses include, e.g., the equal division of work, communicating with the team members in general and about status of own contribution to the team's work, and handling the conflict situations arising from unequal workload or cultural differences, for example. Due to this the teacher of the course decided to start the course weekly exercises with the theoretical content related to stages of group forming [13] and practical aspects related to working in teams, including communication skills and how to solve conflicts.

To support the team building and formation activities, a mobile orienteering application (Action Track) for teams was chosen to be used as a practical tool to support the initial phases of group forming. The content and tasks of the implementation aimed at helping the first two phases of the team formation, especially forming, but also aiming to help overcome some challenges of the storming phase. In addition, it brings a novel way of getting out and changing the dynamics of typically physically inactive classroom sessions.

Physically active ways of work has been researched in the university context. Variety of different kinds of interventions to increase physical activity on the work context has been published, e.g. [5], There exists also a mobile technology mediated walking meeting to promote physically active ways of work [1]. Physically active ways especially in the educational context has been utilized for example by Wickson et al. [15]. They utilized a method that they call "walkshop" in a course of science and technology ethics. In that method, the intellectual discussion among students and teachers was transformed from lecture rooms to outdoor spaces. Their experiences of the method expresses that walkshop promotes interaction with each other, enhances the experience of togetherness, helps in trust building between people and lowers hierarchies between people.

The ActionTrack platform [7] has been used for educational purposes in the university context for teachers' training [8]. Its use in the lower level of education for learning mathematics has also been reported [14]. The learning results were slightly better for those who learnt with ActionTrack when compared to those who learnt with ordinary methods [14]. The ActionTrack learners liked the aspects of being outdoors, being physically active and working with a pair.

Our interest was to trial a mobile orienteering platform to support the team building activities in a software engineering course. Our specific interests are the following: *How does this approach support team building activities in the initial phases? How does it fit these type of activities in education? What are the benefits gained in educational context?* We next describe the implementation of the activities with the mobile orienteering application based on ActionTrack platform, and the tasks that were implemented to support the team formation goals. We then report the student feedback and their own reflection.

2   IMPLEMENTATION OF THE MOBILE ORIENTEERING

The mobile orienteering was implemented with ActionTrack platform for location-based activities [7]. ActionTrack is designed for different outdoor and indoor activities where people move between checkpoints by navigating with a map (outdoors) or by other instructions (indoors and outdoors). ActionTrack includes a web editor tool and a mobile application for the implementation of location-based activities. The web editor is used for the creation of the routes and other content. The actual end-users access the content by using the mobile application, which is downloadable from the application store (iOS and Android). The checkpoints are automatically activated outdoors and the content of them is revealed to the users when they move to the right place within a certain range of GPS coordinates. Indoors, where the GPS data is not usually very reliable, the content of the checkpoints is revealed after the user scans a QR-code on the checkpoint.

Teachers have a web-browser based dashboard for creating of the map (Figure 1), tasks and their characteristics as well as for the management and follow-up of the student groups and their submissions from mobile devices. A mobile client software for Andoid and iOS mobile devices (mobile phones and tablet pc's) is available for students to download to their devices. One mobile device is needed per participating group.

Fig. 1. Overview of the map for
orienteering check points.

Lecturer of the engineering course planned the exercise to include in the beginning of the trial session first a theoretical background on team formation stages [13] and practical aspects of working in teams, such as communication and conflict handling issues. Approximately 20 minutes was used for this part in the beginning of the 2.5 hour weekly exercise. The mobile orienteering focused specifically on supporting the team formation for the course in question as students would work in teams during the semester on their assignment. Due to the time of the year (January), the orienteering was done indoors, with QR-codes at the check point to unlock the task. Photo tips from the checkpoint, and the map aided in finding the checkpoints. The tasks were time constraint, varying from 1-5 minutes, depending on the task, and with decreasing points after the permitted maximum time. This aimed at supporting working efficiently and to meet the time constraint of the whole weekly exercise.

The aim of the activity was first to get to know each other by name at the initial check point launching the activity by a QR-code (yellow Flo point in Figure 1). On the way to one of the three randomized Start points for teams, each team member was asked to give a short introduction of themselves to others (Figure 2). After ideating jointly and submitting a name for the team at one of the Start checkpoints (Figure 3), the remaining five checkpoints were opened and available to be carried out in the order of group's preference.
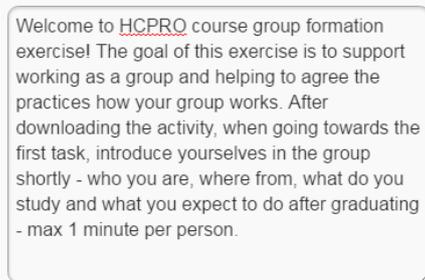

Welcome to HCPRO course group formation exercise! The goal of this exercise is to support working as a group and helping to agree the practices how your group works. After downloading the activity, when going towards the first task, introduce yourselves in the group shortly - who you are, where from, what do you study and what you expect to do after graduating - max 1 minute per person.

In this first task ideate a team name for your group . You have 2 minutes time for completing the task. After 1 min your points will decrease.

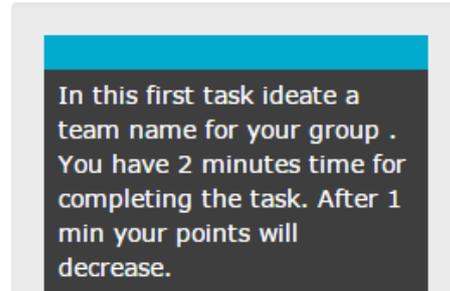*Fig. 2.* Introductory text in Action Track to the mobile orienteering activity.

Fig. 3. First task at three randomized Start checkpoints.

One of the three team work related checkpoints had a task aiming to support work as a team towards a goal through a hands on team innovation and build task (Figures 4-6). In addition, a team selfie was asked to be taken at one checkpoint. This selfie was aimed to be used in the team report front pages during the semester – aiming to help the lecturer and course assistants to learn and connect easily faces and names to the submissions due to the participant size of the course.
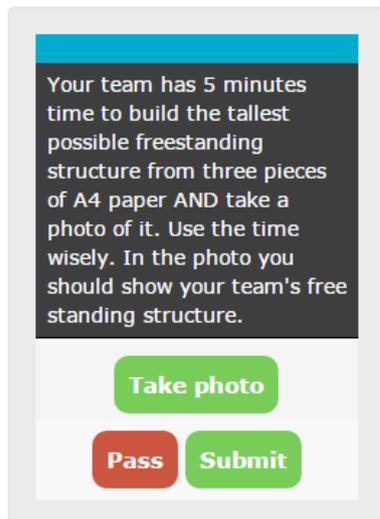

Your team has 5 minutes time to build the tallest possible freestanding structure from three pieces of A4 paper AND take a photo of it. Use the time wisely. In the photo you should show your team's free standing structure.

Take photo

Pass **Submit**

meemu
100 / 100   ⏱ 05:08
12.01.2016 11:05

Group 16
100 / 100   ⏱ 04:14
15.01.2016 10:33

*Fig. 4.*Team building task description.

Fig. 5. Example of innovative solution with tables giving height to the structure.

Fig. 6. Example of a typical solution.

Three tasks specifically aimed to start off the agreement on how the group works in practice and how typical conflict themes – work division, communication, and contribution – would be agreed on and handled in the team. The three tasks therefore included agreeing on the tools for collaboration and communication the group uses

(Figure 7), how contributions to the joint work are acknowledged and reported (Figure 8), and how does the group plan to agree on the work division (Figure 9).

Fig. 7. Task on agreeing on collaboration and work tools of the team.

Fig. 8. Task on agreeing how the work in managed and distributed in the team.

Fig.9.Task on member contributions.

The mobile orienteering activity took on average about 40 minutes to complete. Two weekly exercise groups participated in the activity during the same week, one on Tuesday and one on Friday. Many of the students had installed the mobile client on their mobile device prior to the exercise, but installing took only couple of minutes in case it was done in the exercise session and no problems occurred. After the mobile orienteering the students were asked to write a report based on the activity and reflect on it as a team as well as give feedback on the implementation of the activity. This report consisted of the texts, and photos submitted as answers to the mobile tasks with the mobile application at the orienteering check points as well as by team's written notes. In addition, feedback for the activity was asked for. We report next the teams' reflection on the activity and feedback on the content of the activity based on the team reports.

The instruction for reflecting on the experiences of mobile orienteering in the team formation activity were the following:

"Reflection on the exercise as a group: Include everyone in the group into discussion.

- What are your thoughts, ideas and/or feelings on the group forming activity and exercise?
- How did the activity support starting to build the ways of working for the team?
- What did you learn during the activity?
- What are your thought, ideas, and/or feelings o the mobile application (ActionTrack) and its fit to group formation activity?
- Ideas for improving the activity or other feedback on the exercise, application or its use?"

Sixteen groups returned the report, with the number of team members varying between 2-4, and with a total of 45 participants participating either of the weekly exercise groups. The answers in the reports were analysed with data-driven approach by categorizing the answers and giving them thematic names. We next report the main findings related to the student perceptions on the activity based on the reports as well as by the verbal feedback given in the classroom.

3   RESULTS AND DISCUSSION

3.1   Fun, informal and different

The descriptive feedback on the activity and approach was very positive. Reports characterized the activity as fun, good, interesting, exciting, new, positive, different, cool, interactive, and informal. Only a few negative comments were given, and related to minor usability issues with the solution, not the actual activity and approach. For one time activity as this, and specifically in the first stages of team formation, the approach seems to work well and students clearly liked the activity.

The verbal feedback from the students after the activity was enthusiastic. They mentioned it heightened their expectations for the entire course. They also mentioned that getting out of the classroom was refreshing and fun. However, using the mobile orienteering approach in several exercises within the same course might wear off the novelty during a course. The fit to the learning objectives and especially problem solving type of exercises needs special attention in higher education to plan the tasks for the orienteering checkpoints, compared to using the activity in simpler learning activities. This is worth further work to investigate and needs further trials in practice to create guidelines for planning the learning content and the fit to the learning objectives.

3.2   Break the ice and get to know each other

One of the most often mentioned themes in student reports was that the activity made it easier to break the ice to start conversation and cooperation. It supported getting to know team members' names and backgrounds. Many of the students were not familiar with each other prior to the exercise, so the activity was mentioned to help getting to know each other. Also, reports highlighted that the activity revealed the group members expectations on the group work. Teams also got the first experience of working as a team and how each of the team members work and contribute in a group,

Reports overall highlighted that the activity enhanced team building. Especially the challenge task, which was specifically included as a team building and ice breaking activity, was mentioned as good. More similar type of tasks were wished for. Results indicate that the forming phase [13] was supported by the physical activity combined

with team building activity. A comparative study in the future with two groups, one using mobile orienteering approach, and another doing the same tasks in classroom context, could reveal similarities and differences between different approaches and the impact of including physical activity in team formation phase. A third control group could be included with no intervention other than the theoretical background and a long-term follow-up study for all groups throughout the course on team functioning could be included.

3.3 Support for agreeing the ways of working

As was the aim of the activity, groups reported that the activity supported making agreements on used collaboration and communication tools, collaboration as a group, and creating general rules for the team, One of the groups mentioned that the questions were good reminders of the important things to consider. One group described: "[…] *we decided how we will communicate and collaborate in assignment works and how to divide activities.*" Activity therefore seemed to support the team formation and agreements as was intended.

3.4 Learnings from the activity

Reports revealed different types of learnings by the groups. Two teams commented that the timed tasks gave a time constraint and emphasized the importance of timing of working and decision making. One team emphasized that a good group needs both communication and cooperation skills. Another team raised the importance of every group member contributing to the work. The rest of the raised learnings were related to learning to work as a group towards a goal, every member contributes with their strengths, and learning to share expertise. Learnings therefore covered a wide variety of themes that are related to team formation and work in teams. This seems to indicate the usefulness of the activity.

3.5 General feedback

"It was a great activity at the first time of group making and we really enjoyed it. Everything worked well and we hope there were more funny tasks in the activity". This quote from one of the teams highlights two commonly raised aspects. First, the students truly enjoyed the activity, and there was a wish for more team forming type of tasks, which in this activity was the building as a team from three sheets of paper, highlighting tasks with a common challenge that the team works on jointly. In addition, a couple of teams commented on that the tasks and their descriptions should be short in this type of activity and a bigger pool of tasks was wished for. Furthermore, the students commented in the class that the group formation, communication, and collaboration issues are not discussed in the courses otherwise and they saw this activity as useful since group assignments are included in many of their courses.

4 CONCLUSIONS

We presented a trial to support the initial phases of team formation in a software engineering class by using a mobile orienteering activity with checkpoint tasks aiming to support team formation. Overall, the feedback and our experiences were so positive that we plan to use similar types of activities at least for group formation in the upcoming courses. We will consider trying out the mobile orienteering activity in regular higher education exercises as well. This calls for new type of approach to planning the exercises and the types of tasks and challenges to be solved. We will investigate this

further in our future teaching as well as explore other opportunities to include physical activity and out of classroom activities in the learning activities and implementations.

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