



Implications of Client Involvement in Student Projects

**Comparative Study between Project without a Real Client
and Project with a Real Client**

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ABSTRACT

Context. A student project in higher education in software engineering is essential to introduce students into a real world situation. In a student project, students are able to practice their knowledge gained from their education and enhancing their skills in project management. Many pedagogues believe that using a real client in student project is necessary to reflect a real world situation.

Objectives. The study aim is to find the implications of client involvement in student projects by exploring students' experience on student project without a real client in comparison to student project with a real client.

Methods. The study was conducted using case study method. The data was collected from the interviews with 4 student groups with 4 different projects in Blekinge Tekniska Högskola, Karlskrona, Sweden, which divided by 2 student groups in each project types.

Results. 12 challenges are found in student project without real client, and 9 challenges are found in student project with real client. 9 of the challenges are common for both project types. The result is presented into 3 comparison tables, which are comparison in challenges, lessons learned and students' perception of having a real client.

Conclusions. We conclude that challenges in student project with real client and student project without real client are common, which are mainly the challenges in project management and software development process. The benefit of having a real client in the student project is related to networking and job opportunity, as well as additional soft skills on communication. Although, the benefit trades-off with some potential problem that should be address by the teachers when conducting the student project with a real client. The implications of the study can be used as a benchmark for pedagogues in deciding whether to a real client or not in a student project. Moreover, there is a need for further empirical research to extend the data collection and to assess the different kind of project settings that reflect real world situations.

Keywords: software engineering education,
student project, client involvement.

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1 INTRODUCTION

A student project is essential in giving students a chance to apply the knowledge that they received during their education. It is also beneficial in order to enhance students' skills and experience in software development before they enter a real industry. The joint task force between The Institute of Electrical and Electronics Engineers (IEEE) Computer Society and The Association for Computing Machinery (ACM) recommends student project in their undergraduate curriculum guide published in 2004 [1]. Although the curriculum guide addresses undergraduate studies, it is also appropriate to apply student project for graduate studies.

Few studies imply that the availability of a real client in the student project is necessary to reflect a real world project and a real world problem, so that the students' motivation is increasing and students are more engaged in the student project [5][7].

However, there are only a few studies found that discussed specifically on the implications of client involvement in a student project. Furthermore, there is no study in software engineering education that compare student project without a real client and with a real client in order to explore the benefit of having a real client in the student project.

This thesis presents the comparison between student project without a real client and student project with a real client. The study was conducted using case study method. The cases are the student software projects in Blekinge Tekniska Högskola, Karlskrona, Sweden. The results present 12 challenges from student project without a real client and 9 challenges from student project with a real client, in which 8 challenges were common in both project types. Lessons learned and students' perceptions on having a real client in student projects are presented as well.

The study is presented as follows. Section 2 describes background studies on client involvement in student projects in software engineering. Section 3 describes the research method. Section 4 and 5 describe the results and analysis, the implications of the research, and suggestion for future research. Section 6 gives the conclusion.

2 BACKGROUND STUDY

Higher education in software engineering provides the advanced knowledge and early experience in software development. The students with the education gain technical skills in the field, together with the soft skills in project management, risk management, social communication and problem solving.

The joint task force of The Institute of Electrical and Electronics Engineers (IEEE) Computer Society and The Association for Computing Machinery (ACM) has published the curriculum guideline for undergraduate degree programs in software engineering in 2004 [1]. The guideline recommends the university to provide a student project for students in their last year, in order for the students to apply their skills and knowledge that they received previously during their education. A student project is furthermore essential to enhance students' skills before they enter the real industry.

Although the joint task force emphasizes the curriculum for undergraduate degree programs, students from graduate and even higher study programs may as well gain benefit from a student project. Students from graduate or higher study programs, who continue their study directly from their previous study programs may have never had the experience working in a company. Thus, student project still applies as their first experience in a software development project, and probably their first experience to work in a group.

Software projects are initiated to address client's needs, which are the requirements that have to be provided in the final product. It is commonly known that these requirements are changing fast and often unexpectedly, due to the changing needs of the client, uncertainty of the requirements, or from the negotiation with the software developer in consideration to the developer's resource and knowledge base to develop the final product. Thus, the relation between developers and clients is important to the success of a project.

Many universities are including a real client in the student project to reflect a real world situation of software development project [2][3][5][6][7]. Pedagogues believe that project with a real client increases students' motivation and exposes students to the experience that cannot be replicated in a controlled class situation [5][7].

Despite this belief, there is no study found that specifically compare the difference of student's experience between student project without a real client and student project with a real client, in order to actually find the benefit of having a real client in the student project. Hence, there is a need for more empirical studies to find out the implications of client involvement in a student project in software engineering.

3 RESEARCH METHOD

3.1 Research Questions

The research aim is to find out the implications of client involvement in student project in software engineering. In order to achieve the aim, the researcher needed to find the similarities and differences between the student project without a real client and student project with a real client. Hence, the researcher explored students' experience that occurred in the projects, such as the emerging challenges, means to overcome the challenges, and lessons learned. The students' experience became the base knowledge to compare the two student project types in order to analyze the implications of client involvement in the student project. Therefore, the research questions are:

RQ1. What are the similarities and the differences of students' experience between student projects without a real client compared to student projects with a real client, from the perspective of students?

RQ1.1. What are the challenges and learning outcomes in the two student project types?

RQ1.2. What are the means to overcome the challenges?

3.2 Method Selection

There are five commonly used research methodologies in software engineering context [10]. Case study aims to investigate a particular phenomenon happening to individuals, groups and organizations from a real world situation in natural setting [8][10]. In software engineering context, the cases are software organizations, software projects, software developers, etc. Controlled experiment method aims to test theories in controlled environment [10]. Survey method aims to study phenomena in population, thus it is suitable for research that aims for quantitative data result with a large data sample [10]. Simulation method aims to study the behavior of the replication of a real world situation, which focuses to a measurable result [10]. Action research aims to introduce an intervention in a real world setting to observe the implications of the intervention [10].

The research aim is to gain an in-depth understanding of the students' experience in the two student project types in order to find the implications of client involvement in a student project. Therefore, case study is the most suitable method to use in this study in comparison to the other methods. Thereafter, the study used guidelines for conducting research with case study from Runeson et al. [8], Robson [4] and Petersen [10].

3.3 Case Selection and Units of Analysis

This thesis used a holistic multi-case study, as two cases were needed to compare one to each other. The two cases were (1) student project without a real client and (2) student project with a real client. The units of analysis were the experience of the students during the project. Blekinge Institute of Technology (BTH) in Karlskrona, Sweden, provides courses in software

development with variety types of student projects. Thus, BTH is suitable to find the cases needed in this study.

A systematic review conducted in 2008 [11] reported that there were less student projects that using Scrum [13] despite the evidence of the popularity of Scrum in industry. Thus, the study chose student projects that were using Scrum, to follow the suggestion from the systematic review.

The study used experience from four student projects, which consisted of 4-11 students in a group. There were two student projects in each case. The students were coming from Computer Science, Game Development and Software Engineering, Technical Artists, and Web Programming departments. There were groups with students from the same year and same department, and there were groups with students from different year and/or different departments.

The student projects are given the code as follow.

- GP11: First student project in Project without a real client.
- GP12: Second student project in Project without a real client.
- GP21: First student project in Project with a real client.
- GP22: Second student project in Project with a real client.

Table 1 shows the natural setting of the cases.

Table 1. Case Description

<i>General Information</i>	<i>Student projects without a Real Client</i>	<i>Student projects with a Real Client</i>
Course	30 ECTS	15 ECTS
Project Duration	7 Months	5 Months
Group size	GP11: 8 students GP12: 11 students	GP21: 4 students GP22: 5 students
Student Background	GP11: Consisted of students from Master and Bachelor studies with different majors. GP12: Consisted students from Master study in the same major.	GP21: Consisted of students from Bachelor study, from the same student year. GP22: Consisted of students from Bachelor study, with different student year.
Students' other responsibility	There was no course in parallel with the project course.	Some students had another course in parallel with the project course.
Allocation of client	None	Teacher assigned client to each student group.
Clients' background	None	GP21: Small mobile software company. GP22: Large company in software and telecommunication industry.
Product Description	Create game or game engine	GP21: Mobile application for iOS and Android. GP22: Not stated – The software would be used for the company.
Product Requirement	There were soft technical requirements set by the teacher.	Requirements depended on the clients.
Requirement gathering procedure	There was no fixed game theme. The students created their own requirement for the	The students and the clients worked together. Creativity and innovation depends on

<i>General Information</i>	<i>Student projects without a Real Client</i>	<i>Student projects with a Real Client</i>
	product. Student allowed being creative and innovative. The teacher was not included in the decision.	agreement with the clients. The teacher was not included in the decision.
Expected product deliveries	The students are required to deliver demo of the game. Full functioned game is not necessary.	Agreement on a partial or full functioned product decided between the students and the clients.
Final product deliveries	GP11: expressed that the final product is not 100% complete. GP12: expressed that the final product is complete, although different that the expected result in the beginning of the project.	GP21: final product is not 100% complete. GP22: complete the final product.
Teacher role	Teachers acted as technical assistant and project management (agile) mentor.	One teacher acted as Head of Development (HOD). The students would contact HOD if they had internal problem and question, such as general agile implementation method and project planning.
Frequency of coaching from the teachers	Teacher came in every two weeks to the project room to check progress and give feedback. Nevertheless, teachers were available for question and help anytime.	There were four seminars for the students to present their progress. Three consecutive seminars were between the students and the teachers. The latest was for the presentation of the project result to the client, and was an open seminar for public. Nevertheless, teachers were available for question and help anytime.
Work environment	<ul style="list-style-type: none"> - Student groups had their own project room. - Dedicated project, thus student had time to work in the project with a fixed schedule. 	<ul style="list-style-type: none"> - Student groups had their own project room. - Students were doing the project along with another course, thus they did not have fixed schedule to work on the project.
Agile Method Used	<ul style="list-style-type: none"> - Scrum - Kanban [14] 	<ul style="list-style-type: none"> - Scrum
Students' Agile Background	Agile has been taught previously. Some students have had individual project with Agile in advanced.	Agile has been taught previously. Some students have had individual project with Agile in advanced.

3.4 Data Collection Procedures

Runeson et al. [8] wrote that interview is important as data collection method in research with case study method.

In this study, the interviewees were random student groups who were willing to volunteer. The interviews were collected from the same amount of groups for each case in order to balance the findings. All the members of the groups were invited to attend the interview session, to collect as many experience as possible. However, there were 1-2 people in a group that were not able to join on the agreed interview time. Furthermore, for one group in project without real client, the interview was conducted only with two people out of eleven members, and it was on separate occasion. However, the interviews on this group was confirmed with each interviewee.

The interview was conducted using semi-structured and open questioning method [4][8] divided into 5 parts. The first part was to collect the student project's setting and description. The second part was to collect what the students experienced in the project. The third part was to get better understanding in students' experience, such as the cause of the problem, the effect of the solutions, the role of clients and teachers in solving the problem, and what the students learned from the process. In the fourth part, the students were asked about the importance and lessons learned in accordance to the presence/absence of a real client in a student project. The last part was to confirm the students' statements and the students were asked to share other information that has not been asked previously.

The interview was recorded and transcribed to aid data analysis.

3.5 Data Analysis Approach

We separated statements from interviewees according to the types of student project, which are project without a real client and project with a real client. The data analysis was conducted as follows.

1. The statements from each student group were separated according to the interview questions. Each statement was given identity-number in order to assure traceability. The information was maintained using matrix of statements.
2. We summarized each statement into short sentences. Then we mapped the sentences to abstraction level such as challenge, the cause of the challenge, solution for the challenge, the advantage and/or disadvantage of the solution, student's opinion, and lesson learn. Each abstraction level was given identity-number in order to assure traceability.
3. We applied step 2 sequentially from the first statement to the last, and sequentially from the first student group to the last. By using this step, we could determine if the next sentence was related to the previous sentences. Thus, we ensured that there were no duplication of challenge, solution, and so on. From this step, we could find out if one challenge was related to another, if one solution might created another challenge, and so on.
4. We grouped the sentences based on similar issues, and then we reevaluated the abstraction level in order to categorize the challenges.
5. We compare both student project types based on the challenges, lessons learned, the advantages of having a real client, the disadvantages of having a real client, and the risks of having a real client.

3.6 Threats to Validity

Threats to validity were classified using guideline from Runeson et al. [8], which divided into 4 types: construct validity, internal validity, external validity and reliability.

Construct validity concerned the threats that might cause misinterpretation to the research aims. There is a risk that the interviewees might misinterpret the interview question. Thus, the researcher should recognize the misinterpretation and explain the questions more unambiguously to the interviewees. Misinterpretation might also come from the researcher when analyzing the data. Thus, the interviews were recorded and transcribed, allowing the researcher to listen and check the interview if some parts were unclear to interpret. Follow-up conversations between researcher and the interviewees were conducted when necessary. Other threat in construct validity is the reactive bias. There is a risk that the interviewees would not express all the necessary challenges to give only a positive outcome of their project. To reduce this threat, interviewees were selected using convenient sampling method where interviewees agreed to be interviewed on their own will. Furthermore, the interviewees were informed that the information they gave would be treated confidentially and would not have any effect to their grade in the project course.

Internal validity is concerned when examining causal relations. In this study, challenges and solutions might affect one another. There is a risk that not all the causal relations are found, thus become the internal validity in the research. To mitigate this validity, data analysis were conducted sequentially and iteratively, and mind-map drawing was used to minimize the missing relations.

External validity concerned the generalizability based on the research results. This study was conducted in one university, thus the result may not be appropriate to generalize the findings for all student projects, particularly in software engineering education.

Reliability. There is a risk that the result is affected by the interpretation of the researcher, thus when the replication of the same study is conducted, the end result might be different. To mitigate the replication threat, the data analysis was managed using matrix and the steps were explained carefully in the data analysis approach section, thus support the audit trail of the research.

4 RESULTS

This section answers the research questions as follows.

RQ1.1 and RQ1.2 answered by section 4.1, which lists the challenges, solutions of the challenges, lessons learned and students' perception on having a real client. The results are presented in two parts, the experience in student project without a real client and the experience in student project with a a.

RQ1 answered by section 4.2, which summarizes the results presented on section 4.1 to compare the two student project types.

4.1 Student Experience

4.1.1 Student Project without a Real Client

4.1.1.1 Challenges and Solutions

The challenges in the student project without a real client is identified into 5 categories, which are challenges in project management, estimation, requirement engineering, group dynamic and supporting technology. There are 12 challenges in total, with 15 solutions. There are 6 challenges with the same solutions applied by both student groups, 3 challenges that experienced by only one group, and 6 challenges experienced by both groups with different approach of solutions. The challenges and solutions are summarized in Table 2, and then detailed description is provided.

C101: Challenge in task management due to sprint duration. GP11 experienced this challenge as the sprint duration affected their task management. When the sprint duration was too long, all tasks completed before the end of the sprint. In order to fill the remaining time until the next sprint, they added extra tasks that were prepared based one their tasks prioritization. However, the extra tasks that they added could be actually unnecessary, and the work for some extra tasks might overflow into the next sprint. Afterward, GP11 changed their approach into using shorter sprint duration.

“In the beginning we didn't know how long the sprint should be. It is more trial and error. We were trying to do 3 weeks, and that did not work.”

– GP11

C102: Applying proper agile method and practices. Both student groups decided their chosen agile development method based on the experience of some group members. Nevertheless, it was challenging to determine which method was most suitable for their project management characteristic. Both groups experienced this challenge earlier in the project. GP11 only used Scrum at the start of the project, then they combined Scrum with Kanban when they experienced challenge in task distribution, as they found it beneficial to use Kanban approach in order to split tasks. GP12 was doing the opposite, Scrum and Kanban were used at the start of the project, then they

decided to use only Scrum. For GP12, it was essential to focus on project management.

“It took a little while for us to actually get used to it, maybe like a third or fourth of the project or something before we actually starting get into it.”

– GP12

Table 2. Challenges and solutions in student project without a real client

<i>ID</i>	<i>Category</i>	<i>Challenges</i>	<i>Solution</i>	<i>GP</i>	
				<i>11</i>	<i>12</i>
C101	Project Management	Task management	Changed the sprint duration.	✓	
C102	Project Management	Applying proper agile method and practices	Changed/combined the agile methods.	✓	✓
C103	Project Management	Task distribution	Divided members into subgroups.	✓	✓
C104	Estimation	Task estimation due to students' lack of technical skills	Created research tasks before estimating development tasks for features with lack of knowledge.	✓	
C105	Estimation	Task estimation	Reflecting to the previous sprint.		✓
C106	Requirement	Freedom to decide scope of requirement	No noticeable solution. Restricted their scope and ambitions.	✓	✓
C107	Requirement	Requirement changes	Changed plan. Discussed new ideas and requirement changes in the next sprint.	✓	✓
C108	Requirement	Task management: requirement breakdown	Prioritized tasks.	✓	✓
C109	Group dynamic	People turnover	Changed plan. Cut down features.	✓	✓
C110	Group dynamic	Motivation	No noticeable solution.	✓	✓
C111	Group dynamic	Time optimization	No noticeable solution.	✓	✓
C112	Technology	Applying supporting technology	Chose method that suited the groups, by using or not using the technology.	✓	✓

Until the end of the project, GP12 succeeded using their approach, while GP11 experienced another change of approach that was influenced by other emerging challenges. Approaching the end of the project, GP11 changed their approach to use only Kanban, as they wanted to focus on their game features (see challenge in scope of requirement: C106). GP11's new approach resulted in an improper project management.

“We have so limited time. So, we did not have any room for proper planning. So, we did basically all the things that needed to be done, and then tried to work through them. [...] We thought it was going to be easy because we just had the agile course, and then it was good (but only) in the beginning. [...] We also had problem with roles. Everyone was programmer. This was the requirement that everyone should program 100% of the time. So, we did not have any person that was doing administrative, who could take care of those tasks.”

– GP11

C103: Task distribution. Both groups divided their members into subgroups, to ensure every group member had tasks to carry out. One of the purposes of dividing groups into subgroups was to reduce work dependencies. However, if planned poorly, a subgroup might have finished its tasks ahead the others.

“I am doing all the server and multiplayer programming, and it was basically finished now. I do not have that much to do anymore.”

– GP11

GP11 had to change their plan so that the member who was belong to subgroup which tasks have been completed could be allocated to other subgroups and/or given other tasks. GP12 consisted of students from different majors, thus they divided their subgroups based on the majors. However, during their project, members could not be allocated to tasks that did not correspond to their skills, as it would affect the quality of the final product. In the case where a subgroup's tasks associated with other subgroup's tasks, there would be a waiting period emerged.

“Some programmers will not have anything to do with other parts of the project. It almost feels like kind of a waste of time.”

– GP12

Another drawback of task distribution was that it might occur that the students feel responsible for their own assigned tasks only. They became indifferent to the duties of another member, when it came to the time that this other member might need a help to be able to complete his/her tasks. Furthermore, approaching the end of the project, GP11's task distribution approach created a problem in combining work from each subgroup.

C104: Challenge in task estimation due to students' lack of technical skills. Students might not certainly have the knowledge they needed to develop some features that they wanted to be included in the game. GP11 had members who only had skills in game programming as all of the members came from the same major. Thus, they did not have members with skills to provide other game elements that they needed.

“We don't have any modular, animators and so on, which create some problems.”

– GP11

Tasks for such elements were given to members who had limited or no knowledge at all. Therefore, the lack of skills affected their ability to estimate

the effort needed to complete the tasks, since what they could do was only guessing, which led to under-estimated or over-estimated effort. GP11's solution was to create research tasks before creating the development tasks for such elements. When the research task was completed, they could estimate the development tasks better. However, GP11 stated that this solution still resulted in several changes of plan.

C105: Task estimation. Time estimation of a task depended on: (1) students' knowledge base in order to determine the difficulty of the task, and (2) the definition of done (DOD) of a task in order to understand a level of completeness of the task. Tasks that wrongly estimated affected project planning.

"That was kind of hard at the beginning, because we always underestimated the time that things would take."

– GP12

GP12 stated that their estimation skill became better as the project went on, because then they could estimate the tasks based on their experience from the previous sprints. Both student groups conducted their planning with every group member, in order for everyone to gain experience and learn from the project. However, this approach led to estimation challenge for GP11.

"It felt like we should have smaller groups that decided on specific tasks rather than just having the whole group to estimate."

– GP11

C106: Challenge due to the freedom to decide scope of requirement. The course gave students the freedom to determine their own game. Both groups stated that the course arrangement motivated them, as they were allowed to be creative. Nonetheless, some of them might have high expectation for their final product. Thus, it was challenging to limit the scope of the game, in order to accommodate all the features that they wanted to provide in the game. Furthermore, their own ideas or feedback from teachers' or other groups' members might affect their direction, that resulted in some changes on the requirements or tasks, which then affecting their planning.

"Sometimes we plan too much, but we have to be realistic. That's a bit too ambitious maybe."

– GP11

C107: Requirement Changes. Both groups stated that they would accommodate feedback that was necessary to be implemented. Nonetheless, they might also try to implement feedback that they thought would make their final product to be more impressive. The latter was challenging for GP11, which then affected their planning. GP12 stated that they might change tasks if things were not going as expected, however, they did not want to interrupt the sprint. GP12's approach was to limit requirement changes by writing down and reserved a place for new ideas and suggestions. Then, they would discuss the new ideas and suggestions in the next sprint meeting, in addition to the evaluation of the unfinished tasks from the previous sprint. GP12's then prioritized the tasks, which might result in addition or elimination of tasks. Thus, the approach was working for GP12 to restrict the

addition of new tasks during a sprint, thus reduced the changes of plan in their group.

In addition, GP11's understanding at the beginning of the project that the requirement of the course was to provide a working demo of a game. However, in the middle of the project, they received feedback from the teachers, which made them realized that they needed to produce more than what they had planned. Thus, the realization resulted in the changes of plan and disturbed their agile practice. At the end of the project, GP11 did not produce a complete game in accordance to their new expectation of the final product, because they did not have enough time to finish all the tasks. Although, in their defense, they did not plan to be 100% complete, in forethought to their understanding of the course requirement at the start of the project.

C108: Challenge in task management due to requirements breakdown. It was challenging for the students to breakdown their requirements to smaller user stories, especially for GP11. When user stories had been selected for a sprint, the next challenge was to create all necessary tasks needed for the user stories, in order to limit unexpected works.

“The most important thing is that there is a task for thing that we remember that we need to do, so we do not forget them again.”

– GP12

Both groups experienced challenges when new unexpected tasks emerged in order to complete some user stories. Both groups stated that they prioritized the unexpected task immediately. If the tasks were important in order to complete other tasks, then it had to be done in advanced. For both groups, these unexpected tasks affected their production in the current sprint, as some tasks might not be finished in accordance to the planning. GP12 however added that if they could solve the issues immediately, they would not officially create new tasks, thus it would not change their sprint planning.

Furthermore, tasks that wrongly prioritized might create changes of plan throughout the project, which affected the completeness of the final product. GP11 stated that they could not specifically prioritize their tasks, due to their challenge in requirement breakdown. GP11's prioritization was divided into (1) things that they must have, (2) things that they wanted, and (3) things that they would provide if they had time. At the end of the project, even though they managed to provide features that they must have in the game, they thought that it was not complete enough to satisfy their self-actualization, because they could not finish all the features that they wanted to be included in the game. GP12 was using an approach in which they prioritized tasks in every sprint meeting. They separated the tasks into (1) Tasks to do, (2) Tasks that in progress, (3) Tasks that had completed. Tasks that were not finished in the previous sprint might have to be eliminated or allocated to the next sprint, depending on the importance of the tasks. Task might also be eliminated in accordance to the capability and availability of the group members to work on the tasks (see challenges for lack of skills: C104 and people turnover: C109). GP12's final product was not as expected due to some eliminations of tasks, however, it was still in an acceptable margin in accordance to their original plan. Furthermore, GP12 managed to finish all the tasks on time.

C109: People turnover. GP11 was planned to consist of nine members. However, one member was unqualified to further join the course. This caused

a problem later on in the project that related to the challenge in the lack of knowledge (C104) and task distribution (C103). GP12 experienced challenge from people turnover as well. A member was taking a leave for a period of time during the project. However, GP12 did not change their planning in order to allocate the missing member's tasks to another member. GP12 followed the approach for task prioritization, which was to cut down some features.

C110: Member motivation. GP11 said that because of the freedom to define their own game, the group members had high motivation to build the game that they desired. Meanwhile, GP12 experienced the lack of member motivation earlier in the project that came from the obscurity of their game. However, once GP12 had direction of the work and the game had visible shape, members gained more motivation. Motivation challenge might also affected members' commitment in working on the assigned tasks.

“We did have some problem with people not owning up to positions they were assigned to. Growing into these positions or commitments is part of every project, though.”

– GP12

C111: Schedule and time optimization. Each group had a project room and a fixed daily schedule to work on the project. This environment reflected the situation of working in a company. However, even with a fixed schedule, challenges occurred due to students' commitment to follow that schedule accordingly. If a student was not available at the working hours, while another student needed him/her to be able to continue working, the other student's work became ineffective due to waiting time. Thus, it might affect the planning for the associated tasks, which might affect the whole project as well.

“People were late and someone overslept, and so on, and we didn't maintain our rules. We needed stricter rules.”

– GP11

There was also an occasion where members from other groups visited each other in order to give feedback. Development time then spent inefficiently as their discussion might wander to topics other than the game. Nevertheless, these kinds of visit might boost the group's motivation if they received good feedback from their peer colleagues.

GP12's challenge in time optimization came from their planning approach, which was with all the group members. Planning meeting would cost the development time, as they wanted to accommodate every member's ideas.

“If the project was for commercial with a real client, then the planning would be better assigned to specific people, for example, the lead programmer, lead artist, and project manager.”

– GP12

C112: Challenge in applying supporting technology. Both groups experienced challenge in applying technology that best suited their work in order to support their development tasks and project management tasks. GP11 used Git (<https://git-scm.com>) in order to manage their coding. However,

at the beginning of the project, they claimed that there were more comments made than the coding itself. Thus, it lowered their motivation to continue using Git. GP12 decided to use only Scrum Board [13] instead of project management software to manage their project progress. They stated that the decision was beneficial as Scrum Board made it easier for all the group members to view and evaluate project progress in a glance.

4.1.1.2 Students' challenges prioritization

Table 3 shows students' prioritization of their challenges.

Table 3. Students' prioritization of challenges in project without a real client

<i>Rank</i>	<i>GP11</i>	<i>GP12</i>
1	Planning	Estimation
2	Estimation	Group Dynamic

4.1.1.3 Lessons learned

Table 4 shows the list of lessons learned derived from the students.

Table 4. Lessons learned on project without a real client

<i>Description</i>	<i>GP11</i>	<i>GP12</i>
Improving technical skills	✓	✓
The importance of planning	✓	✓
How to not to depend on a technique entirely	✓	
The importance of breaking down the user stories	✓	
The importance of an availability of dedicated people for project planning and project management	✓	✓
Improving skills in Scrum and Agile Method in general	✓	✓
Improving social skills	✓	✓
Learning about their own skills and competencies		✓

4.1.1.4 Students' perception on real client

The students were asked about the advantages and the disadvantages if they given a real client in their project, as well as the risks of having a real client in a student project. Table 5 shows the result.

Table 5. Students perception on having a real client from project without a real client

<i>Category</i>	<i>Description</i>	<i>GP11</i>	<i>GP12</i>
Advantage	New perspective to improve the game	✓	
	Networking to industry		✓
	Increasing motivation due to real expectation and requirement		✓
Disadvantage	Limitation of creativity	✓	✓
	Students have lack of control on requirement changes		✓
Risk	Limitation of creativity due to client's requirements	✓	
	Lack of resource and people to accommodate client's needs and requirement changes	✓	

<i>Category</i>	<i>Description</i>	<i>GP11</i>	<i>GP12</i>
	More requirement changes if client came with unclear requirements	✓	
	Client's unprofessional behavior		✓
	When doing project with in a large group as in their project, networking might delegated to one or two persons only, leaving others without contact and experience.		✓

4.1.2 Student Projects with a Real Client

4.1.2.1 Challenges and Solutions

The challenges in the student project with a real client are identified into 6 categories, which are challenges in project management, estimation, requirement engineering, client relation, group dynamic and supporting technology. There are 9 challenges in total, with 11 solutions. There were no common challenges with common solutions between the two student groups. The challenges and solutions are summarized in Table 6, and then detailed description is provided.

C201: Task management. GP22 was using 2 weeks sprint earlier in the project. However, some members were not able to finish their task on time. They said that this was due to the different schedule of each member, as some of the members had other course and thesis in parallel with the project. They changed their sprint duration into 3 weeks time to accommodate members' availability.

C202: Applying proper agile practice. GP21 claimed that they experience challenge earlier in the project in order to apply proper agile practice in their team, especially in handling meeting. GP21 project management was unstructured and they experienced many changes of plan.

C203: Challenge in task estimation due to lack of technical skills. GP21 was demanded by their client to develop mobile application. Their challenge occurred because they had no knowledge of the programming languages to be used. At the start of the project, they allocated time for research phase in parallel to fixing administrative tasks for the project with their client. Furthermore, as they were demanded to provide application with different technology, they divided members into two subgroups, in order to optimizing time in their research phase. However, the time for research phase was limited as they had to start their development phase. With little knowledge on what they should do, they had problem in estimating the tasks. A subgroup experienced more difficulties than the other subgroup. The subgroup with the difficulties underestimated their effort, while the other subgroup overestimated their effort. GP21's estimation skill became better as the project went on, because then they could estimate the tasks based on their result on the previous sprints. GP21 added an approach to reserve some extra time in the end of the project, as a buffer if they did not manage to finish their tasks as planned. Moreover, they consulted with developer from the client's company whenever they needed assistant due to their knowledge limitation. However, both approaches were not efficient enough for them to be able to finish all their tasks by the end of the project.

Table 6. Challenges and solutions in student project with a real client

<i>ID</i>	<i>Category</i>	<i>Challenges</i>	<i>Solution</i>	<i>GP 21</i>	<i>GP 22</i>
C201	Project Management	Task management	Changed sprint duration.		✓
C202	Project Management	Applying proper agile practices	Changes of plan.	✓	
C203	Estimation	Task estimation due to students' lack of technical skills	<ul style="list-style-type: none"> • Created research tasks. • Divided members into subgroups. • Consult with client's technician. 	✓	
C204	Estimation	Task estimation	Breaking down user stories	✓	
C205	Requirement	Unclear requirement	Conduct meetings and negotiate with client		✓
C206	Client	Client response	Continuous contact and communication with the client		✓
C207	Group dynamic	Schedule	Prioritized work		✓
C208	Group dynamic	Time optimization	No noticeable solution.		✓
C209	Technology	Supporting technology	Changes of choice and technique.	✓	

Both groups also implied that they did not meet their clients' expectations due to the lack of knowledge, also because of the project was the first experience they were working together in a group. GP21's client thought that the members could manage to learn the new programming languages that they needed by the end of the project. GP22's client was complaining about the members' ability in handling requirements.

“One thing that the customer expected from us, which we haven't study or learn, was the requirement management. Like, how do you analyze and work with the requirement list.”

– GP22

C204: Challenge in task estimation due to user stories breakdown. Students of GP21 emphasized the importance of breaking down the user stories into more details, in order to produce better task estimation. An incomplete details of user stories led to wrong task estimation, thus resulted in changes of plan.

“The smaller you can get the activities, the better. That was one of the reasons why we had fairly inaccurate time estimation. After each sprint, we had to break down almost half the activities again and again.”

– GP21

C205: Challenges due to client's unclear requirements. When given unclear requirements, students experienced a challenge to analyze the requirement and maintain the same understanding level with the client. GP22 conducted meeting with their client at least twice a week in order to have mutual

understanding with each other. It was important for GP22 to be able to negotiate requirements with their client, to be able to motivate their argument, and to ensure that what they produce was in accordance to the client's purpose. As for GP21, they did not experience this challenge. GP21's client had clear requirements and the client's feedback was not triggering requirement changes.

C206: Client response. GP21's members did not have any problem with their client in communication and relation. Their client was easy to contact, helpful, and understood their ability and scope as students that doing student project. Earlier in the project, GP22's members experienced the challenge in gaining correct information from their client. Their contact in the client's company was a not the user of their demanded final product. At the beginning of the project, there were unclear requirements and the user responded slowly to the students' contact. Thus, the students' contact was also responding slowly to the students. There was also unproductive time occurred as GP22's members had to wait for the client's to give them the company's coding standard that they needed for developing the product. GP22's members then communicated with their client about the importance of continuous interaction, and the client was supporting them and giving them better response thereafter. However, GP22's members implied that the slow progress/communication was due to their client's main job, thus the client might not prioritize the student project. Later on, both student groups maintain their relation with their clients fairly well until the end of the project.

C207: Schedule. GP22 experienced challenge in accommodating the different schedule of each member, as some of the group's members had other course and thesis in parallel with the project. GP21 did not experience this challenge as they all came from the same major with the same schedule. GP22 members were prioritizing their schedule for the project work, on top of their other responsibilities outside the project. In addition, they stated that they preferred to focus on the project, as project with external customer might give opportunity of working. GP21 members had other course that was in parallel with the project as well. However, the course topic was in-line with the project thus it was actually beneficial for their development tasks.

C208: Time optimization. GP22 experienced challenge in optimizing time when they were planning their tasks at the beginning of the project. They might directed to topics that were not related to their planning tasks, thus reducing their productivity.

"We could talk about other stuffs, and other things, so our mind just wander off, instead of just focusing on the tasks."

– GP22

C209: Challenge due to supporting technology. The course required students to documenting their projects. GP21 experienced challenge in deciding project management method that well suited them. Wrong choice of project management method led to time inefficiency, when the valuable time would instead spend to apply the correct technique and dealing with technical problem, rather than to focus on development tasks. Even though the choice decided based on the previous experience of a member, it did not guarantee that the choice would be convenient. GP21 had to change their decisions and

technique of their project management method. GP22 stated that they did not have problem related to project management method.

4.1.2.2 Students' challenges prioritization

Table 7 shows students' prioritization of their challenges.

Table 7. Students' prioritization of challenges

<i>Rank</i>	<i>GP21</i>	<i>GP22</i>
1	Estimation	Requirement engineering
2	Lack of knowledge	Client relation

4.1.2.3 Lessons learned

Table 8 shows the list of lessons learned derived from the students.

Table 8. Lessons learned in project with a real client

<i>Description</i>	<i>GP21</i>	<i>GP22</i>
Learning about their own skills and competence	✓	
The risk of taking project which the developers do not have the base knowledge for the implementation	✓	
The importance of good communication with client towards mutual understanding of requirements	✓	✓
The importance of the background of developers in a group	✓	✓
The importance of breaking down the user stories	✓	
The importance of good relation with client towards work networking	✓	✓
Improving social skills	✓	✓
The importance of the feedback from client		✓
The importance of group dynamic towards work efficiency		✓

4.1.2.4 Students' perception on real client

Table 9 shows the perception of students in having a real client in their project.

Table 9. Students' perception of having a real client in a student project

<i>Category</i>	<i>Description</i>	<i>GP21</i>	<i>GP22</i>
Advantage	Experience implementing real problem in industry	✓	✓
	Expand people networking	✓	✓
	More chance in job opportunity in client's company	✓	✓
	Increasing motivation towards remarkable final product		✓
Disadvantage	If product failed, might affecting the result for the course and decrease job opportunity		✓
Risk	Unclear requirement affect planning	✓	✓
	Less focus to the purpose of the course (for example, project management), as students became more focus to finishing the product.	✓	
	Limitation to creativity due to client's requirements.	✓	

<i>Category</i>	<i>Description</i>	<i>GP21</i>	<i>GP22</i>
	Created pressure due to expectation to deliver successful final products without less noticeable mistakes.	✓	

4.2 Project comparison

4.2.1 Comparison on Challenges

Table 10 summarizes the comparison on the challenges between project without a real client and project with a real client.

The result shows 12 challenges in student project without a real client and 9 challenges in student project with a real client. The challenges are mapped into 6 categories, which are project management, estimation, requirement engineering, client relation, group dynamic and supporting technology. The comparison between the two project types compresses the students' experience into 8 challenges, which are challenges in compliance to agile practice, students' lack of knowledge/skills, task management, estimation, requirement engineering, group dynamic, supporting technology, and client response.

Table 10. Comparison of challenges

<i>Challenges</i>	<i>Without Client</i>		<i>With Client</i>	
	<i>GP11</i>	<i>GP12</i>	<i>GP21</i>	<i>GP22</i>
Compliance to agile practice	✓	✓	✓	
Student's lack of knowledge/skills	✓	✓	✓	
Task management	✓	✓	✓	✓
Estimation	✓	✓	✓	
Requirement	✓	✓	✓	✓
Group dynamic	✓	✓		✓
Supporting technology	✓	✓	✓	
Client response				✓

Three out of the four groups experienced challenges in the compliance to agile practice. These groups stated that the members needed some time in order to get familiar with the agile development method and to apply it in accordance to what they need.

Three out of the four groups experienced challenges due to the lack of technical skills because of lack of people with the desired skills or lack of knowledge needed to satisfy client's demand. This challenge influenced the challenges in supporting technology and estimation that the same groups experienced as well.

All student groups experienced the challenges in task management, which influenced by students' lack of knowledge/skills and group dynamic. Tasks had to be planned and estimated in consideration to members' capability, knowledge, and schedule.

All the student groups experienced challenges in requirement engineering. Three of the four groups expressed the challenge in user stories breakdown. Three groups expressed challenges in requirement changes, which came from (1) the client on project with a real client and (2) ideas and expectations of the students/teachers on project without a real client.

One of the groups with project with a real client experienced challenges due to client response. However, members of this group stated that the challenge only occurred at the beginning of the project. Once the group improved their communication with their client, the problem did not longer influencing their project.

4.2.2 Comparison on Lessons Learned

Table 11 summarizes the comparison on lessons learned between project without a real client and project with a real client.

From the comparison of the lessons learned, students in project without a real client emphasized their experience on project planning and agile development method, while students from project with a real client emphasized the importance of communication with client. All the student groups expressed that from the projects, they improved their technical, requirement engineering and social skills. One group from each project expressed that they were able to evaluate their own competency after the project and to reflect based on it for the next projects.

Table 11. Comparison of lessons learned

<i>Lessons learned</i>	<i>Without Client</i>		<i>With Client</i>	
	<i>GP11</i>	<i>GP12</i>	<i>GP21</i>	<i>GP22</i>
Technical skills	✓	✓	✓	✓
Project planning	✓	✓		
Agile method	✓	✓		
Requirement engineering	✓	✓	✓	✓
Social skill	✓	✓	✓	✓
Competency evaluation		✓	✓	
Communication with client			✓	✓

4.2.3 Comparison on Perception of Having a Real Client

4.2.3.1 The Advantages

Table 12 summarizes the comparison on the advantages of having a real client between project without a real client and project with a real client.

Table 12. Comparison of the advantage of having a real client

<i>Advantage of having real client</i>	<i>Without Client</i>		<i>With Client</i>	
	<i>GP11</i>	<i>GP12</i>	<i>GP21</i>	<i>GP22</i>
Feedback for improvement	✓			
Networking		✓	✓	✓
Increasing motivation		✓	✓	✓
Experience implementing real problem			✓	✓
Job opportunity			✓	✓

From the comparison of having a real client in student project, one of the groups in project without a real client had assumption that meet the experience of the groups with a real client, which were the advantages of networking and work motivation. One of the groups in project without a real client added the advantage would be to gain feedback to improve their

product. Groups from project with a real client expressed the benefit of having the experience of implementing real problem and to feel a real world situation, as well as opportunity to working in the clients' company.

4.2.3.2 The Disadvantages and the Risks

Table 13 summarizes the comparison on the disadvantages of having a real client between project without a real client and project with a real client. Table 14 summarizes the comparison on the risk of having a real client between the two student project types. The students' perception of the disadvantage of having a real client has relevancy with the risk of having a real client.

Table 13. Comparison of the disadvantages of having a real client

<i>Disadvantage of having a real client</i>	<i>Without Client</i>		<i>With Client</i>	
	<i>GP11</i>	<i>GP12</i>	<i>GP21</i>	<i>GP22</i>
Limitation on creativity	✓	✓		
Students have lack of control on requirement changes		✓		
Failed product affected course result and job opportunity				✓

Table 14. Comparison of the risk of having a real client.

<i>Risk of having a real client</i>	<i>Without Client</i>		<i>With Client</i>	
	<i>GP11</i>	<i>GP12</i>	<i>GP21</i>	<i>GP22</i>
Limitation on creativity	✓		✓	
Lack of resource	✓		✓	
Unclear requirements	✓		✓	✓
Client's unprofessional behavior		✓		
Networking is limited for specific people only for students with large group		✓		
Less focus to the purpose of the course			✓	
Pressure			✓	

Three out of the student groups stated that one of the advantages/risks would be the limitation to their creativity. One group of each project type expressed the risk of the lack of resource and knowledge of the members, which might affect the client's expectation. All of the student groups expressed the risk that caused by unclear requirements from the clients. Other risks that was not commonly said by the student groups are: the risk that caused by client's behavior, limited chance of networking when conducting project in a large group, the focus on the purpose of the course, and the pressure that the students feel because they do not want to make mistakes in front of the client.

5 DISCUSSION

This section discusses the implications of a real client involvement in student project and implications of the research for future works.

5.1 Implications of client based on challenges in the student project

Looking at the comparison in the challenges that the students experienced during the project, the result shows that students in project without a real client and project with a real client experienced similar challenges. However, the result shows that students in project without a real client experienced all the similar challenges, while the students in project with a real client might not experienced a same challenges.

All student groups experienced the challenges in task management and requirement engineering, which were affecting each other. Tasks were coming from requirements. Whether the requirements were clear or unclear, task management was challenging as it was affected by students' capability in distributing the tasks to the group members effectively.

Studies [2][7] motivate that the presence of a real client is important to reflect the real world, where some real problems like requirement changes would be hard to replicate in a classroom. However, based on the result, requirement changes were not happening in project with a real client only, but also with project without a real client as the students determined their own requirements. Students from each project types were using different approach in solving the challenges related to requirement. One group in each project type was insistent in providing the requirements that they or the client wanted, despite their knowledge limitation, in order to achieve self/client satisfaction. On the other hand, the other group in each project type tried to limit their requirements by evaluating the necessities of requirements at each iteration or by negotiating the requirements with their client.

The challenges in estimation affected by students' lack of knowledge/skill. One group in each project type experienced this challenge. One of the student groups in project without a real client was only consisting of students from the same major while they needed skills from members from other major. On the other project type, a client demanded a project to create an application that the student groups had no knowledge in advance on how to develop the application. Both groups stated that the problem was affecting their estimation, which resulted in an incomplete final product. Students on both project type had to allocate more time to study the missing knowledge, which then consumed the development time.

Student groups from both project types experienced the challenge due to group dynamic. Student groups from project without a real client expressed more challenges related to students' commitment on the project, and related to the size of the groups which influenced members' social skills. Only one student group in project with a real client experienced this challenge, and it was due to the different schedules of the students, which related to their responsibilities for the other course that was running in parallel with the project. For challenges that could be solved in systematic ways, such as setting a schedule, student groups might come up with an acceptable solution

for their groups. However, related to social behavior, student groups might come up with poor solutions or no solution at all. They would keep the progress of their work and adjust to the behavior challenges as the project went on.

Student groups from both project types also experienced challenges that related to the supporting technology, which all of the student groups came up with the solution to leave or change their approach in using the technologies.

The result shows that the only difference between the two project types is the challenge due to client response. However, only one student group in project with a real client experienced this challenge, and it was only at the beginning of the project. The other group in the same project type had no problem in communicating with their client since the beginning of the project, as their client was a mild client.

The result indicates that the students' approach in solving challenges is influenced by the students' state-of-mind and motivation to get to the direction that they wanted. The students might take the direction to give maximum effort to satisfy themselves/client in producing a remarkable product, or to manage the project so that it resulted in an optimized final product that delivered in timely manner.

Thus, the students' approaches were not necessarily affected by the involvement of a client in a student project. However, when given a complicated client in a project, some students might gain additional skills, such as negotiation skill, which is reflected by the experience in one of the student groups in a project with a real client in this study.

5.2 Implications of client based on lessons learned in the student project

Students from both project types stated that they were expected to use agile development method in their project. Scrum was mostly chosen as it has been taught previously. However, the previous experience of some members did not guarantee the success of applying agile concept, especially at the beginning of the project. The result shows that the larger student groups were experiencing more difficulties in applying proper agile method, thus project management became one of the important lessons learned during the project. While the smaller student groups did not express a learning outcome related to project planning and agile development method. The larger groups were in project without a real client and the smaller groups were in project with a real client. The difference might happen due to two factors. The first, agile development method in general is more suitable for a small team than for a large team [11]. Hence, the larger groups had more difficulties in handling the group dynamic that affecting their project management. The second, the student groups in project with a real client was focusing more on how they could satisfy their clients by focusing on the product, than focusing on their project management. This factor is stated in one of the students' perception of having a real client. The students said that one of the disadvantages and risks of having a real client is that they might have less focus on the purpose of the project, which was the project management itself. Thus, when asked about what they learned during their project, they did not include project management as one of the learning outcome. This becomes one of the implications of having a real client in the student project.

Even though, only one student group in a project with a real client that facing a challenge due to client's behavior, communication with client is found to be necessary by the students in such project type, which then they stated it as one of the lessons learned. This result supports the result from studies [2][3][5][6][7][9], which also discuss the importance of communication with client as one of the lessons learned in a student project.

5.3 Implications of client based on students' perception of having a real client

Looking at the comparison on students' perception of having a real client, students in project with a real client clearly expressed more advantages than what expressed by the students in project without a real client. Networking and job opportunity was expressed by one student groups. However, some students in project with a real client might not have the same access to the networking and job opportunity. This was also expressed as one of the risks of having a real client by one of the students from group in project without a real client, who said that especially in large group, networking and job opportunity might be limited only for the members who actually interact with the client. Nevertheless, the students in project with a real client did not actually express this risk of networking as one of the risks in their project. Again, this could be due to the fact that they are smaller size in groups compare to the students in project without a real client, thus the same fear was not appearing in both project types.

Students in project without a real client express more disadvantages of having a real client in comparison to students in project with a real client. One of the disadvantages is the limitation of creativity that expressed as well as the risks of having a real client by one of the student groups in project with a real client.

The result shows that the students in project without a real client might have fear of having a real client in a project in accordance to client's behavior. Based on the result, one of the student groups in project with a real client was actually having a complicated client at the beginning of their project. However, because they managed to solve the problem between them and their client, in the end they did not see the problem as the risk of having a real client. Thus, indicates that having a real client in the project might remove the fear of clients' behavior when students faced the actual environment.

Another implication of having a real client in student project is the pressure that the students in project with a real client expressed as one of the risk of having a real client. Students feel obligated to the final product that they should deliver to their client, thus they felt the pressure to only giving what the client wanted and they were afraid to make mistakes as it could affect their image as a professional which led to job opportunity that might come after the end of the project.

5.4 Implications of client to students' motivation

Studies [2][7] had a belief that the presence of a real client could increase students' motivation. One of the students in project without a real client also expressed that if they have had a real client, it might increase their motivation, as they would have a real problem and a real expectation. On the contrary, the students in project with a real client expressed that due to the

limitation of creativity in student project with a real client, it might also risk students' motivation in the project. Hence, the result indicates that the presence of a real client does not necessarily influence the level of motivation of the students'. All groups from both project types were motivated due to different reasons. Moreover, students from project without a real client were actually expressing more motivation statements, than the students from project with a real client, because of the project without a real client allowed the students to express their creativity and innovative interests.

5.5 Summary of implications of client in the student project

Therefore, the thesis result indicates that having a real client in student project is not necessarily important in order for the students to gain broader experience in software development process and project management that is influenced by students' state-of-mind and behavior. The indication has also stated in the study from Fitch [12] that discusses the students' professional development in a real-client project. Based on Fitch's and this research's result, it is actually the team factor that has important effect in the success of a project, whether the project has a real client or not.

However, interaction with a real client, especially a complicated client, gave the students additional soft skills in the way to solve their challenges with their clients.

5.6 Implications of the research

One of the implications of this study is for the university to consider in deciding of having a real client in a student project. Few factors have to be considered.

Current perception of student projects with a real client is much more relevant in order to reflect a real industry in which a software company is working for a client from a non-software company. However, nowadays software industries are not necessarily developing software based on the demand of a client only. Many games and start-up companies are starting their business without having an exact client. What these kinds of company do is to gather and analyze what the market needs, and then they create applications based on the analysis, and test the product to the market. Market's feedback gives them the ideas and requirement changes to enhance their applications. Thus, the experience of the students of project without a real client in this study might also be considered to reflect a real world industry.

Furthermore, there are other software development situations that might not have been revealed yet in order to be implemented in student projects, for example, software development in an information technology (IT) department that develops a software to address the needs of other department in the same company or the needs of the IT department itself.

The decision to have a real client in a student project must be considered regarding to the learning outcome that the university wanted for their students to have by the end of the project. Based on the result, a real client might not necessarily needed in the student project, if the university wants to focus on the learning outcomes such as to provide student with a good project management skill, to improve students' behavior, to extend students'

creativity. However, if the university wants to provide students with professional skills related to external relation and help students to have job opportunity after project or graduation, then having a real client in a student project gives a lot more advantages for the students.

From this study, the advantages of having a real client have its trade-off to potential problems that should be address by the teachers, which are: (1) the focus of the course in project management, (2) the pressure for the students, (3) limitation to creativity, (4) the impact of job opportunity. Perceptions within the students, teachers and client when giving a real client, should be synchronize to ensure that the final product should not affect the grade to minimize pressure to the students. There is also the need to deliver to the students that having a real client or not in a project will not necessarily have any effect on their technical and project management skills.

Mahnic presented in the study of introducing Scrum in student project that a well-designed study could provide the students a realistic simulation of professional experience [9]. Hence, an addition to the result of this study.

Another result from this study is general issues that should be consider in conducting student project in software engineering, which are:

- (1) The proper setting of students group when doing project that combined students from different majors.
- (2) The proper setting of students group when doing project with agile development method, in order for the students to be successful in learning and applying agile development method.
- (3) The suitability of students' background knowledge/skills to the clients' demand.

5.7 Suggestion for future works

In future work, more qualitative or quantitative studies are needed to compare both student project types in order to enhance the findings of each project type, for example, with exploring the experience of the teachers and the clients. The limitation of this study might come to the amount of the student groups included. Furthermore, students in different country with different cultural background might face different challenges when facing a real client in a student project. Thus became a suggestion for future work to extend the numbers of student groups and diversity.

6 CONCLUSION

This thesis presents the comparison on students' experience between student project without a real client and student project with a real client. The study aim is to find out the implications of client involvement in a student project. The study shows that students from both project types experienced similar challenges during their project, except for a challenge in communication with a client that only happened in the project with a real client.

Based on the result, client involvement in student project does not necessarily affect students' activities and behavior in doing the project and solving internal problem within themselves. However, when given a complicated client might give the students additional skills in certain way, for example, the skills on negotiation and external communication. Furthermore, the benefit of having a real client in a student project has a trade-off to some potential problem that might occur that should be address by the teachers.

The research result can be used for the university in deciding to have a real client or not having a real client in student project.

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