

Using Real Industry Projects for an Assignment of a Master Level Course

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Abstract—This Research to Practice Full Paper presents an experience of using real projects for an assignment of a master level computer science course. Research showed that employing real customers in the coursework leads to a deep learning via motivation. However, not many examples can be found that using the real world projects as a part of normal coursework. The assignment design was justified and refined by applying the existing experiential learning guidelines and other methods. Students' opinions had been solicited through a panel study with two waves. The results showed that the most challenging issue was the time management and that was followed by understanding client requirements. Above 90% of the students preferred to have real clients in their assignment. Regarding the skills that they had learned from the clients, professional skill was the most, it was followed by communication skills. This confirmed that experiential approaches appear to be more effective in developing skills that employers seek. More than 70% of the students believed that they had learned a lot from the assignment. A number of improvements have been introduced to the same assignment for the current semester. Further improvements will be sought in the future.

Keywords—*real world project; assignment; student centred learning; experiential learning.*

I. INTRODUCTION

Research showed that employing real customers in the coursework leads to a strategy of deep learning via motivation. Real projects entail many challenging problems and together with the student-centered approach enables and enhances the motivation, it is also a chance for the students to increase their occupational identity [1]. Many positive experiences can be found from the literature, where real world projects have been used as the capstone projects in the last year of the undergraduate studies [1, 2]. The capstone project encourages the students to experiment with advanced software engineering practices and tools, and to analyze the gathered experiences [2].

However, not many examples can be found that using the real world projects as a part of a normal coursework. In higher education, experiential learning exercises often are not integral to course goals and thus are not evaluated. Further, students' incidental learning, which can be significant, is often not recognized or valued in formal classroom settings [3]. The main reason for this could be the time limitation of a normal course, which limited the students to communicate with the

real world clients sufficiently and work on the project deeply to produce a high quality product.

In this paper, we present an experience of using real industry projects for an assignment of a master level computer science course. The assignment was implemented in the first semester of 2017. This did give us many challenges and benefits. In reviewing this special teaching practice, we are trying to understand the lessons we have learned and to identify the possible improvements in the future.

This type of teaching practice is considered as experiential learning. Experiential learning means learning from experience or learning by doing. Experiential education first immerses learners in an experience and then encourages reflection about the experience to develop new skills, new attitudes, or new ways of thinking [3, 4]. In experiential learning, the student manages their own learning, rather than being told what to do and when to do it [4]. Experiential learning guidelines have been applied in the assignment design to justify and refine the assignment.

Experiential learning can be divided into two major categories: field-based experiences and classroom-based learning. Field-based learning includes internships, practicums, cooperative education, and service learning [3, p.7]. Our assignment should be field-based experiential learning where student project groups provide web based system development service to their clients. As graduate students, they are looking forward to and will join the real world soon. They are not only need to be equipped with the necessary technique skills, but also need to be equipped with the workspace related skills. Experiential approaches appear to be more effective in developing skills that employers seek, such as communication skills, the ability to work in teams, and workplace literacy. By stretching the learner's ability to deal with moral complexity, experiential learning becomes a vehicle for adult development by helping learners reach new levels of cognitive, perceptual, behavioral, and symbolic complexity [3].

A panel study was used as a data collection instrument in this study. A panel study collects data at various time points with the same sample of respondents. The various data collections are often called waves. A panel study is therefore a longitudinal study; it differs from other studies that collect information over time, such as time series and cohort studies, in that it studies the same samples longitudinally [5]. Panel

study is an investigation of attitude changes using a constant set of people and comparing each individual's opinions at different times. Students' opinions, attitudes and reflections at different time points can help to understand students' learning. To analyze how the assignment facilitates students' learning, a two waves panel study was used. Students' opinions had been solicited by two surveys at different stages of the assignment. In the both of the surveys, nine identical questions were included. The first (Wave 1) was conducted two and half weeks before the deadline of the assignment and the second (Wave 2) was conducted two weeks after the submission of the assignment. In panel study, data on the results of the intervention are collected and analyzed, and the findings are interpreted in light of how successful the action has been. At this point, the problem is re-assessed and the process begins another cycle. This process continues until the problem is resolved [6]. The survey results were analyzed, issues in the assignment implementation were identified and possible improvements were outlined for the revision of the assignment in the new semester.

Client feedbacks were obtained via a client feedback form and informal conversation. While the two waves revealed the consistent opinions regarding the assignment in general, there were a few important differences worthy of note. Based on the data collected, we tried to identify the improvements and work out guidelines for future teaching practice. We also tried to identify a suitable methodology for this type of projects.

The rest of the paper is organized as follows: Section II explains the assignment design. Section III covers data collection, analysis and discussion. Section IV covers the summary and the future work.

II. ASSIGNMENT DESIGN & IMPLEMENTATION

Our course is a master level web based system course. The course is run in the first semester of each year. There is an assignment in the course which is a group project on developing, evaluating and presenting an enterprise web based system by integrating selected technologies and selected software. The learning outcome associated with this assignment is to plan, develop and evaluate enterprise web based systems. The purpose of this assignment is to assess the knowledge and skills the students learned from the course on web based system plan, analysis, design, development and evaluation by demonstrating these in the creating of an actual web based system.

In the past, the students were asked to create a fictional enterprise and then develop a web based system for it. However, a real world enterprise should be more effective in helping the students to achieve the expected learning outcome. This can be achieved by turning the project into a real world experience. By employing the real world projects, the students not only be able to test their knowledge learned from the course, but also be able to develop the workspace related skills through the project.

Reference [4] reviewed important literature in the experiential learning area, summarized and provided guidelines for the different stages and different cases of experiential learning design.

When planning to incorporate an experiential component into a course, there are several steps to take [4]:

1. Analyzing your learner population and determining their needs. This includes student's level, students' prior knowledge and experience, students' culture background and etc.
2. Identify appropriate activities for your learner population and course content.
3. Identify potential issues when integrating experiential learning. There are quite a few issues and challenges in such experiential learning exercise.

Our students were graduate students. Most of the students in this course had software or website related prior knowledge. Many of them had work experience. They should be mature enough to manage themselves and to take the real world challenge. Most of them are international students, so there were culture diversities, but they should be capable to deal with the people with different culture background.

To meet the learning outcome of our assignment, we need to find projects from a real world enterprise for student groups. The enterprise would be the client for the project and they should have contact person to communicate with the project team regarding the project requirements, testing, delivery and etc. They also should provide client feedbacks at the end of the project. A client sheet had been introduced to the assignment to define the project scope, project timeline, client responsibility, project delivery and etc. The clients were explained about the client sheet and they needed to agree with the content of the client sheet to proceed.

The candidate projects were solicited through the lecturer and their colleagues' professional network and their industry liaisons. Students were also encouraged to find the candidate projects. As an assessment, consistency and fairness are the main challenges. We need to find the projects with similar difficulty level, similar complexity and similar size from different enterprises. This was controlled by the lecturer, who filtered all the candidate projects and selected the suitable projects. It is possible to assign two groups to the same project with the consent of the client. In the first semester of 2017, we had 16 student groups and 12 projects, four projects were assigned two groups. One of the projects was recommended by one of the students. The client sheet also can help to standardize the projects to improve the consistency and fairness of the assignment.

For the evaluation, we need to include clients' input. However, high weighted client input would introduce inconsistency. So the client input for the evaluation was limited to a small percentage. Another important issue is the time limitation. The course is 15 credits, which means each student should spend 150 hours; the assignment was worth 40% course weight, so each student should spend $150 * 40\% = 60$ hours. This time is much less than the hours spent by a capstone student in our department, which is 600 hours. We assigned 4 members for each project group, so the total hours spent on a project should be 240 hours. The client was encouraged to prioritize their requirements in case there is no sufficient time to complete all the requirements before the deadline. The third

challenge is the skill issue. The learning outcome of the assignment is about website development, not about project management, however, to complete the project successfully, the students do need some project management skills.

As it is common to use a real world project for a capstone project, it is reasonable to refine and justify our master assignment design by comparing the master assignment to the undergraduate capstone projects. The main common item was the stakeholders. A few differences had been identified.

In a capstone project, the stakeholders could be the project team, the customer and the mentor. The customer offers the project topic. There are one or more representatives from the customer organization, who actively participate in the requirements definition work, as well as monitor project progress and give input in several milestones during the project [2]. This is similar to our assignment, where we have client, client contact person they have the similar responsibilities as the customer and their representative. The lecturer acts as the mentor of the assignment.

The first difference is the time frame. Our undergraduate capstone project is equivalent to four course papers. Usually there are 3-4 team members in a capstone projects, each will take 600 hours, the average total should be 2100 hours. Another capstone project example can be found in [2], where about 120 students who conduct different projects in 7-10 person teams. The projects last about five months, and each student spends 150-200 hours of effort on the project. Take an average of the team member number, which is 8.5, take an average of the hours spent, which is 175 hours, the total averaged hours for the project is 1487.5 hours. This means a group of students will take 1400 - 2400 hours in a capstone project, but they only take 240 hours in our assignment. With this time limitation, our assignment project scope should be much smaller than a capstone project and normal capstone project methodology will not be suitable for the assignment.

The second difference is students' difference, capstone projects are for undergraduate students only, the students of the master assignment are graduate students. And they are more mature, more experienced, more skilled and got better analysis ability and possibly better technique skills. It is possible for our graduate students to complete a high quality small scope real world project within the time constraint. To ensure that the project is at master level technically, a few compulsory technique components had been added to the assignment, these were outlined in the client sheet, only those clients who accepted these technique requirements were employed for the assignment.

The third difference is the software scope as mentioned previously. The software scope for the assignment is smaller due to the time limit, this resulted in the limitation of the methodology could be employed in the project. For the capstone projects, there are more options; for the assignment, it seemed that a water fall approach is more practical, of course, the students were required to interact with the clients at all the stages of the project.

The fourth difference, a capstone project allows the students integrate the skills they got from the different courses,

the assessment of a capstone project would not focus on a specific technique, rather, they are more about the finally quality of the whole project and the general procedure have been followed. On the other hand, our assignment mainly assesses the knowledge and the skills the students have learned from the course. So the compulsory technique components mentioned previously is necessary.

According to [7], experiential learning model is conceived as a four stage cycle, 1. Immediate concrete experience. 2. Observations and reflections. 3. Formation of abstract concepts and generalizations. 4. Testing implications of concepts in new situations. Concrete experience to validate and test abstract concepts. Two aspects of the experiential learning model are particularly noteworthy. First is its emphasis on concrete experience to validate and test abstract concepts. When human beings share experience, they can share it fully, concretely and abstractly. Second, action research and laboratory training are based on feedback process.

Testing our master assignment against the above model could further justify and refine the assignment. We test the two main aspects of the model. In the abstract conceptualization stage, the students learned the various web based system related knowledge such as visual design principles, the merits of different software systems and etc. In the assignment, the students would get the chance to apply the design principles they have learned to a real world web based system to tests the results. The students would also get the chance to test the merits of the different types of web based systems. Generally, the model stresses the continuous nature of learning and the appropriate feedback which provides the basis for a continuous process.

Reflection and feedback opportunities were provided in the assignment for the students to improve their performance during the assignment and to improve their future learning after the assignment and the course. These opportunities also allow the lecturer to reflect on the assignment design and implementation for improvements in the next semester for the new students. The students were encouraged to share their ideas and their work with the lecturer to get lecturer's feedback throughout the project. The students were also encouraged to consult the lecturer with the issues they encountered throughout the project. There was a work in progress presentation component in the assignment, where the students would get a chance to reflect what they have done so far and get lecturer's feedback formally. The students were also encouraged to seek client's feedbacks. The final report was the most important chance for the students to reflect on the whole assignment.

Two surveys had been conducted before and after the completion of the assignment. By taking these surveys, the students got a chance to reflect on what they have done with the assignment. The last question in the second survey, "If you do this assignment again, what would you do better?", was a particularly good opportunity for the students to reflect on their practice. By analyzing the results of the surveys, the lecturer would have a chance to reflect on the assignment design and identify the issues and the possible improvements.

III. DATA COLLECTION AND ANALYSIS

Students' opinions had been solicited and analyzed through a panel study with two waves. Nine identical questions were included in both waves, however, there was an extra question in Wave 2.

A. Data Collection

The survey for the first wave was an in-class survey, which was conducted two weeks before the submission of the assignment. Out of 57 students, 53 responded and 51 was valid. The survey for the second wave was conducted online via an online survey system in two weeks after the submission of the assignment, to which, 21 students responded. Therefore, the data analysis was based on the 51 responses from Wave 1 and 21 responses from Wave 2. The huge dropping of the responses could be due to a few reasons. The main reason could be that when the second survey was conducted, the semester already ended. Many international students went back home and enjoyed their holidays. Another reason could be that after completed the course for a little while, they were not as passionate as when they worked on the assignment. The third reason could be that the second survey was conducted online, not in the classroom where the all the students were doing the same survey at the same time.

Nine identical questions were included in both waves, however, there was an extra question in Wave 2. Table I shows all the questions, Q1-Q9 were included in both of the surveys, Q10 was only included in the second survey.

Altogether there were four single answer questions, where only one answer was allowed to be selected from the given options. There were five multiple answer questions, where multiple answers could be selected from the given options. There was one open question, where there was no option provided.

TABLE I. SURVEY QUESTIONS

| No | Questions |
|------|--|
| Q1. | If you have choice for this Assignment, you prefer to have? (single answer) |
| Q2. | If you have choice, which type of client do you prefer? (multiple choice) |
| Q3. | How many people from your client side you have contacted so far? (single answer) |
| Q4. | How did you communicate with your client so far? (multiple choice) |
| Q5. | What have you learned from your client so far? (multiple choice) |
| Q6. | In your view, how would your client treat the website you created? (single answer) |
| Q7. | Do you have any issues so far with the assignment? (multiple choice) |
| Q8. | How much have you learned so far from this Assignment? (single answer) |
| Q9. | Any other suggestions? (open question) |
| Q10. | If you do this assignment again, what would you do better? (multiple choice, only for the second wave) |

B. Data Analysis

The answer option distributions for each question were calculated. As the response size had been changed in the survey of Wave 2, to compare the results from the two waves, response percentages were calculated. The question, the options and the results for Question 1, 2, 5-8 and 10 are shown in the following figures.

The question 3 was about how many people from the client side the students had interacted with in the process, which can help us understand the workload involved and how deep the students engaged with the industry. Most of the groups interacted with one or two people from the client side. This could be due to the small scope of the project and the limited time of the project. The question 4 was about the communication tools used in the process, which can help us to understand the role of the electronic tools in the process. The results showed that email was the mostly used tool; face to face communication was the second; and telephone communication was the third. Above 92% responses from Wave 1 and 76% from Wave 2 indicated that they used email for the communication. Above 74% responses from Wave 1 and 76% from Wave 2 indicated that they used face to face meetings for the communication. It's interesting to see that the face to face meetings had been increased in Wave 2. This could be interpreted as that in the initial stage of the project, the students were more like to understand the requirements, email communication was effective. When project nearly completed, the students were more likely to discuss their outcome with the client, the face to face meetings would be more effective for this purpose. In the future online communication should be promoted, so the communication could be more efficient.

The question 1 was about whether the students preferred the real world project or a fictional project. Fig. 1 depicts the results. Above 90% of the students from both of the waves preferred to have real clients for their assignment. The pattern of the answers from both of the waves are extremely close. The only difference is in Wave 2, one student preferred not to have the real client. This could be due to that there had issues in collaborating with the client. Instead of solving the problem, the students preferred to give up.

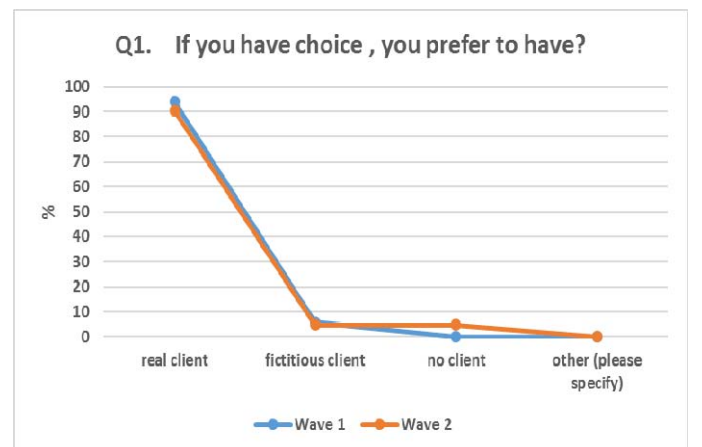


Fig. 1. The results of Question 1

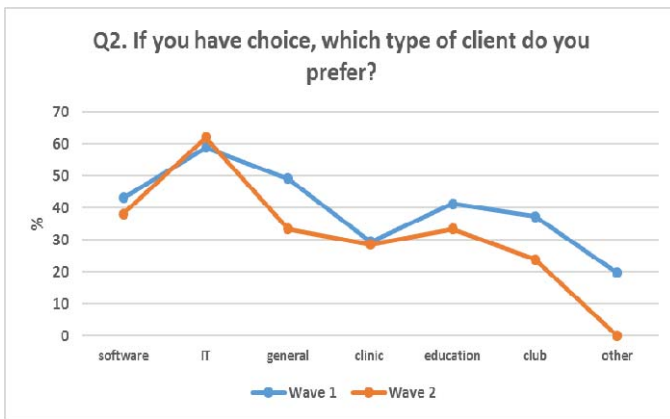


Fig. 2. The results of Question 2

The question 2 was about the type of the clients the students preferred. Fig. 2 depicts the results. The answers to this question could reflect the students' expectation of the clients in certain sense. The most preferred client organization was an IT company, but many other business organizations were also acceptable. This suggested that the students were aware of that what they would learn from the clients were more about workspace skills, not web based systems technology. In Wave 2, the IT company stood out a little, this suggested that after completing the whole project, they realized that IT companies were still more helpful.

The question 5 was about the skills they had learned from the clients. Fig. 3 depicts the results. The software skills they had learned from the clients was the least. This confirmed the statements of [3] that experiential approaches appear to be more effective in developing skills that employers seek, such as communication skills, the ability to work in teams and etc. It was noted that the communication skills and professional skills had been increased significantly in Wave 2. This could be due to that at the final stage of the project, the students had intensive interactions with their client, which highlighted the communication skills and professional skills. For the other skills they have learned from their client, the students identified *time arrange*, *precise requirement specification*, *about the business*, *real time project*, *how to think outside the box*, *working as per client requirement*, *client requirement understanding*, and *the client requirement always changes*. Most of these were related to the requirements. This highlighted that understanding the client requirements and meet the requirements was a challenging component of the assignment. This helped the students realized that many challenges in software projects are not related to technical questions [2].

The question 6 was about how client will treat the students' work after the delivery in students' view. Fig. 4 depicts the results. Most of the students believed that their client will use their work. However, "like it, but will not use it" increased a little in Wave 2. In general, the students were confident on their work, their work could be valuable and their client could appreciate it very much. Due to the time limitation and the small scope, the projects might not be able to be used immediately.

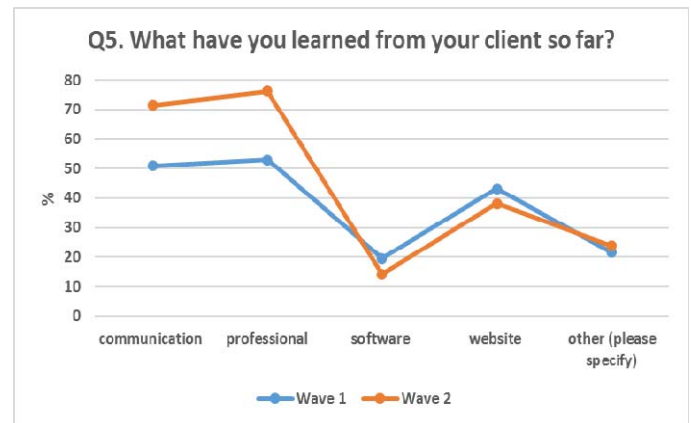


Fig. 3. The results of Question 5.

The client might be able to use the project after some minor modification; or use it as a section of their current website; use it as an instrument to refine their requirements of their real website. This was taken into the consideration in the current assignment implementation. Now we advise the potential clients of the possible usage of the project before the project commences. A statement, "The project might end up as a prototype which can help you to clarify and refine your requirements", had been added to the current client sheet.

The question 7 was about the issues the students had encountered throughout the assignment. Fig. 5 depicts the results. The most challenging issue they had during the project was the time management and that was followed by understanding client requirements and collaborating with the team members. The time management and collaborating with the team members were particularly highlighted in Wave 2. Other issues identified by the students included *designing an appropriate architecture*, *bugs in software*, *report should be simple*, *report could have been just a simple document* *designing the system*.

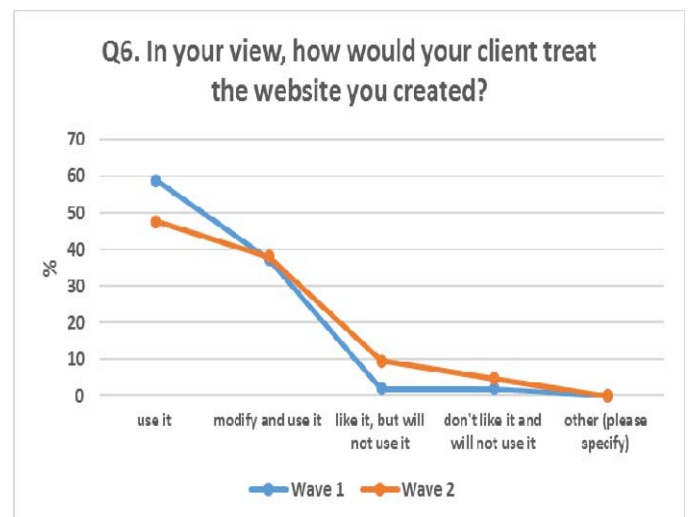


Fig. 4. The results of Question 6.

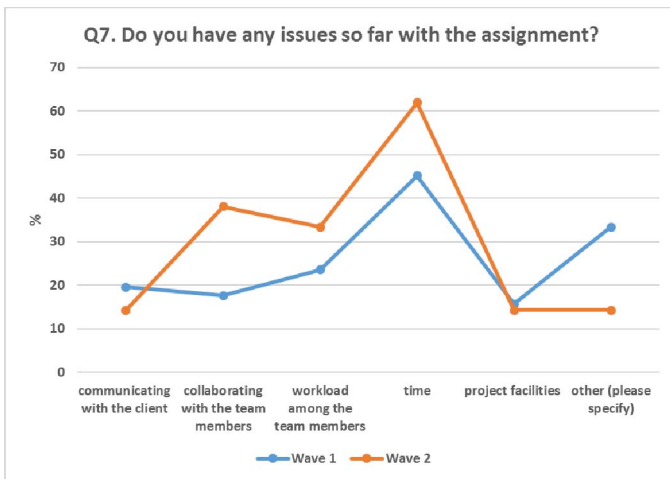


Fig. 5. The results of Question 7.

The technique related issues identified were used to improve the course content in the current semester. The report required the students to reflect on the assignment, which was the important learning step and should not be waived.

The question 8 was about how much the student have learned from the assignment. Fig. 6 depicts the results. More than 70% of the students believed that they had learned a lot from the assignment. It's interesting to see that the peak of the answers had been shifted from significant in Wave 1 to a lot in Wave 2. The more they had done and the more they realized they need to learn.

The question 9 was about general suggestions. The answers were pretty general as well, including expressing their appreciation of the assignment, the *Assignment group work is a very good experience for me, a real client helps to gain the practical knowledge dealing with the real world*; possible improvement from the client side, *the clients can provide more materials about their company otherwise we can only google*; the improvements of the course content, *introduce CMS earlier so students will have concept earlier for the Assignment*. In the current semester, CMS has been introduced earlier in the current semester aiming to help the students to achieve better results in their assignment.

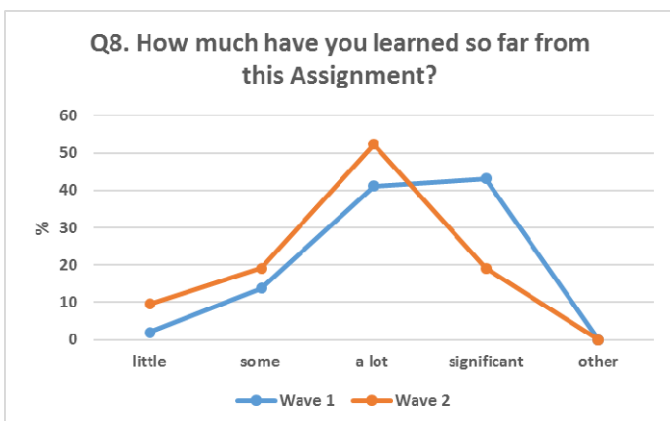


Fig. 6. The results of Question 8.

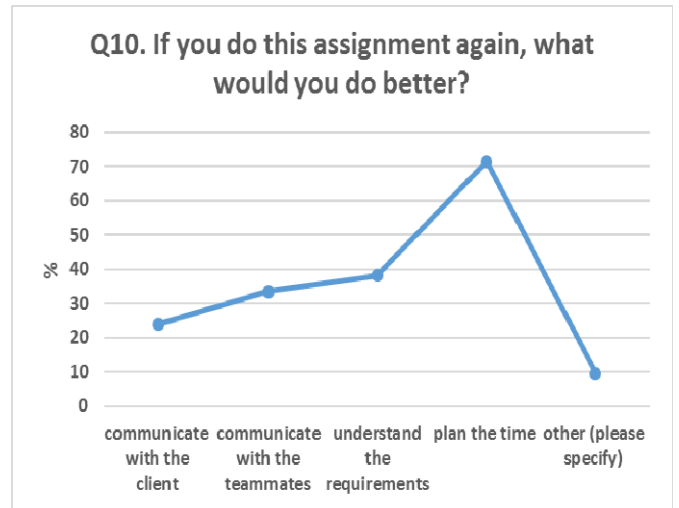


Fig. 7. The results of Question 10.

The question 10 was about how could the students do better if they do the assignment again. Fig. 7 depicts the results. This question was only asked in Wave 2 to give the students an opportunity to reflect on the whole assignment. The peak was to plan time better. This is consistent with the answers for question 6, where time management was the biggest issue.

The clients' feedbacks were solicited via a feedback form. Totally we have 16 groups. Each client was asked to provide an overall mark for the project team out of 5. If the client failed to provide a feedback, the client mark was counted as 0. Three groups formed up late and were assigned a project within the department with a staff of the department acted as a client. Some clients commented that the students didn't communicate enough for their projects. On the assignment document, it was emphasized that the group must keep a log regarding the communications with the client, including emails, phone conversations, online meetings and face to face meetings. In the current semester, an informal check point is introduced to check the students' communication log. Table II shows the average marks for the client feedback, where the average mark from the internal was much lower than the average mark from the external clients. This could be due to that the internal groups were the weak groups. Another possibility could be that the internal projects did introduce inconsistency.

C. Discussions

In summary, the number one issue of the assignment was the time frame. This issue is addressed from different aspects in the current semester. The assignment weight has been increased to 50% and the group size has been extended to 5-6 members. So the average hours each group can spend on the assignment is 412.5 hours. The clients are also advised the suitable scope for this project. Another important issue was the project requirements. Good understanding of the requirements should be from sufficient communications. To make the communication more effective and efficient, the project team is required to assign different roles to the team members.

TABLE II. CLIENT FEEDBACKS

| <i>Client Group Type & Number</i> | <i>Client Mark</i> |
|---------------------------------------|--------------------|
| Internal average (3) | 1.00 |
| External average (13) | 4.01 |
| Overall average | 3.45 |

The following requirements are introduced in the current assignment requirements:

Team Member Roles and Responsibilities

- *Project coordinator will liaise with all the stakeholders of the project to gather and clarify the requirements; organize team meetings; balance team workload; and write necessary emails, project log and other team management documents.*
- *Developers (3-4) will design, develop and test the application including codes, documents, unit test and integration test.*
- *Tester will write user test plan; conduct workflow test and system test; and organize user test.*
- *The roles can be performed in turn by the team members in the process of the project.*

This is consistent with other capstone project examples, where three roles: project manager, quality assurance (QA) manager and architect were defined. The QA manager also took the main responsibility for requirements elicitation and customer communication [2]

The course content has been improved to respond to the students' comment. The following are two more possible improvements to the assignment:

- Introduce a formal check point for the assignment to check the project progress, in particularly, to check the communication with the client.
- Ask the students to provide a plan for their project at the beginning of the project.

Moon has listed the areas of potential learning that "should be included in learning outcomes and assessment criteria" for external activities [8, p.164]. When planning an external activity, instructors should consider this list and select the most appropriate items to expand upon.

In the future, the following list should be reviewed for further improvements of the assignment.

- about work and workplace practices,
- how organizations work,
- communication skills and about working with people,
- about personal work behavior patterns,
- to evaluate their own performance,
- to work with feedback from others,

- about their own career aspirations,
- to plan and complete projects,
- to learn from experience,
- about self-management,
- to use reflection and reflective practice,
- key employability (or other) skills "not easily gained elsewhere in the curriculum,"
- self-confidence and a willingness to take initiatives, and
- to enhance their orientation toward lifelong learning [8, p. 164].

IV. SUMMARY AND FUTURE WORK

In this paper, an experience of using real industry projects for an assignment of a master level computer science course was presented. The assignment design was justified and refined by applying the experiential learning guidelines [4]; by testing the assignment design against the experiential learning model [7]; and by comparing the assignment to the undergraduate capstone projects.

Students' opinions had been solicited and analyzed through a panel study with two waves. The results showed that the most challenging issue they had during the project was the time management and that was followed by understanding client requirements and collaborating with the team members. Despite that, above 90% of the students from both of the waves preferred to have real clients in their assignment. The most preferred client organization was an IT company, but many other business organizations were also acceptable. Regarding the skills that they had learned from the clients, professional skill was what they learned the most, it was followed by communication skills. This confirmed the statements of [3] that experiential approaches appear to be more effective in developing skills that employers seek, such as communication skills, the ability to work in teams and etc. More than 70% of the students believed that they had learned a lot from the assignment. This highlighted that understanding the client requirements and meet the requirements was a challenging component of the assignment. This could help the students realized that many challenges in software projects are not related to technical questions [2].

A client sheet had been introduced to the assignment to define the project scope, project timeline, client responsibility, project delivery and etc. The clients were explained about the client sheet and they need to agree with the content of the client sheet to proceed. The client sheet also can help to standardize the projects to improve the consistency and fairness of the assignment. To address the issues identified from the presented teaching practice, a number of improvements have been introduced to the same assignment for the current semester. These include increasing the assignment weight to 50%, extending the group size to 5-6 members and introducing team member roles and responsibilities.

To maintain the current clients and attract new clients, a website is under the development currently. This website will interact with the current or previous clients, showcase the results of the student projects, and allow potential clients to submit their candidate projects to be employed in the future.

In the future, we will evaluate the outcomes of the improvements introduced in the current semester. Review the assignment against more education models for further improvements. The similar exercise will be conducted at the end of each semester to improve the quality of the assignment and to refine the proposed approach. More survey questions regarding the students' learning on web development can be used to get better understanding on how effective this teaching practice is. Other qualitative methods such as focus groups can be employed to dig the strengths and weaknesses of this teaching practice deeper.

One technique that can assist in ensuring that the students are equipped with relevant discipline knowledge and skills as well as generic, transferable skills is work-integrated learning (WIL) [9]. The teaching practice presented in this paper is a type of WIL, however, the recent papers on WIL are more related to WIL program development and evaluation [9 – 11]. A WIL curricula evaluation framework was presented by [10], which can be used to evaluate our teaching practice in the future for further improvements and refinements.

REFERENCES

- [1] V. Isomöttönen and T. Kärkkäinen, "The value of a real customer in a capstone project," in *Software Engineering Education and Training*, 2008. CSEET'08. IEEE 21st Conference on, pp.85-92, IEEE, 2008
- [2] J. Vanhanen, T. O. Lehtinen and C. Lassenius, "Teaching real-world software engineering through a capstone project course with industrial customers," in *Proceedings of the First International Workshop on Software Engineering Education Based on Real-World Experiences*, pp.29-32, 2012 Jun 9. IEEE Press.
- [3] L. H. Lewis and C. J. Williams, "Experiential learning: Past and present," *New directions for adult and continuing education*, pp.5-16, 1994(62).
- [4] M. Schwartz, "Best practices in experiential learning," *The Learning and Teaching Office*, Ryerson University, 2012.
- [5] Medicine Encyclopedia, "Panel Studies," [Online]. Available: <http://medicine.jrank.org/pages/1285/Panel-Studies.html>. Accessed 8 February 2018.
- [6] R. O'Brien, "An Overview of the Methodological Approach of Action Research," 2001. [Online]. Available: <http://www.web.ca/~robrien/papers/arfinal.html>. Accessed 8 February 2018.
- [7] D. A. Kolb, *Experiential learning: Experience as the source of learning and development*, FT press, 2014.
- [8] J. A. Moon, *A Handbook of Reflective and Experiential Learning: Theory and Practice*, RoutledgeFalmer, 2004
- [9] B. Freudenberg, M. Brimble and C. Cameron, "WIL and generic skill development: The development of business students' generic skills through work-integrated learning," *Asia-Pacific Journal of Cooperative Education* 12, no. 2: pp.79–93, 2011.
- [10] C. Smith, "Evaluating the quality of work-integrated learning curricula: A comprehensive framework," *Higher Education Research & Development* 31.2, pp.247-262, 2012.
- [11] D. Jackson, "Employability skill development in work-integrated learning: Barriers and best practice," *Studies in Higher Education* 40.2, pp.350-367, 2015.