Acquiring Software Project Specifications in a Virtual World

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Abstract: In teaching software engineering, it is often interesting to introduce real life scenarios for students to experience and to learn how to collect information from respective clients. The ideal arrangement is to have some real clients willing to spend time to provide their ideas of a target system through interviews. However, this arrangement cannot be scaled up as it demands too much resource. Starting from 2008, we have used Second Life (SL) to create a virtual company, named SVG Corporation, which has multiple departments so as to simulate the real-world business environment. The development of this fictitious company not only provides a new experience in requirement collection to students, but also lowers the working effort of our colleagues in acting as external business clients. Students can practice their communication and fact finding skills during visits in the departments and interviews with the virtual "staff". The company has been used to support 2 subjects, Human Computer Interface and Foundations of Database Systems. The presence of SL acts as an online platform for students to access and acquire user requirements from staff (AI robots) of a virtual company, through a series of interviews, for system development. The roles of SL are twofold: to reduce the operational overheads in the project administration and to allow students to gain more hands-on experiences through working on a simulated real-life business cases. Hence, student could learn how to apply their knowledge and understand the software development process in the real business world. In this paper, we would like to report our experience and results of using SL in the software engineering student projects. Furthermore, the problems and the difficulties encountered during project period will be discussed for future enhancement.

Keywords: second life, software development project, AI robots, simulation, eLearning

1. Introduction and motivation

Compared with the educational environment in the past several decades, it is undoubted that the development of technologies, especially the advancement of the Internet, applies revolutions on traditional teaching and learning tools. Face-to-face lectures are no longer regarded as the solely productive means for education. Instead, there are different media for facilitating effective teaching and learning, including animations, videos, involvement of multimedia games and etc. Educators, however, are not merely contented with these auxiliaries. Hence, some of them have brought about the application of online virtual worlds for education due to the practicality as well as usability of virtual immersive environments (Warbuton 2009). It is obvious that virtual worlds are often used as a social communication source without geographical restriction. Its simulative nature also allows students to easily get familiarized from their physical world experience. With the help of avatars, the visual representation and interactive tools of users in virtual worlds, students are able to experience everything provided as if they are acting in reality (Hew et al. 2010). Amongst a number of 3D virtual worlds available on Internet, Second Life (SL) has been identified as the most popular and commonly used in education by the regular Eduserv virtual worlds survey (Warbuton 2009). SimTeach, an online resource about multi-user virtual environments (MSVEs), says there are over 100 institutes of higher education having active projects in SL. Also, the Linden Lab, the developer of SL, often receives enquiries from different educators worldwide about either starting a SL class or working an educational project using SL platform (Joly, 2007). Zhang suggested that the building and scripting functions allow SL to be ideally applied for Computer Science education and it could be proven from the research works done on diverse disciplines (Zhang, 2007), including programming (Esteves et al. 2010), aesthetic computing (University of Florida, 2007) and software engineering (Ye et al., 2007).

Apart from different teaching methods, assessment tools, such as assignments and projects, are also significant in education so that student learning progress could be reviewed through their works. Hadjerrouit emphasized that a more realistic environment is required for software engineering education in order to nurture skillful engineers (Hadjerrouit, 2005). In Fall 2006, a simulated environment with business cases of a company has been introduced to a class of software engineering students and departmental colleagues were acted as external clients for giving requirements during interviews. Students gave very positive feedback because they considered, through the arrangement, they have learned communication skill and business knowledge, which were quite difficult to acquire in regular lectures and tutorials. However, the project arrangement

cannot be scaled up. When there are increasingly more students involved, resources of physical presence of company managers are very difficult.

This paper reports our work on providing students term projects for software engineering education using SL as a platform and discusses the observations done within these 3 years. After the introduction, section 2 presents the roles of SL in the term project. It is followed by the feedbacks from students and teaching staff for analysis in section 3. Finally, in Section 5, we will conclude the paper and discuss problems encountered and future enhancement.

2. Background work

In this project, students were working in teams and required to solve business problems and facilitate operational processes of a virtual company named “SVG Corporation” (SVG) using their professional IT knowledge. In order to develop useful computerized systems for “staff” in SVG, students have to acquire the specification of the to-be-developed system and hence interviews are required. This arrangement could not be scaled up because of the demanding resources while the introduction of SL overcomes the problem of the shortage of manpower. AI robots have been set up “physically” in the virtual company to act as SVG staff in SL. The presence of AI robots allows students to interact with and get the user requirements for system development through avatar-robot conversation. Figure 1 shows a snapshot SVG Corporation in SL.

Other than hands-on technical skills, it is anticipated that students could be trained with soft skills such as communication skill and collaboration skill in this term project since students are allowed to work in an excellent learning space which mimics the real-life professional context provided by a 3D virtual world, SL (Sancho et al. 2009). It is believed the training of important soft and social techniques could be achieved during the interviews. Therefore, logging of interview conversations has been done possible so as to allow lecturers to analyze and provide comments based on the student performances reflecting in their interview records.

Figure 1: SVG in Second Life

3. Methodology

For Fall terms of the past 3 years, students were guided progressively to work on the Multi-Subject Student Project (MMSP) with just in time releases of information from the SVG Corporation, a fictitious company. The flowchart of the project schedule is shown in Figure 2. In addition to conducting interviews, SL also acts as an interactive platform for students to receive progressive supervision from teaching staff on their works. Students would obtain feedbacks from lecturers during the second project meeting held in SL. The purposes of this meeting are to guide students in doing a software development project properly, and to further imitates the progress meetings in reality so that students would have an idea that progress meetings are the normal practice of the real-life business environment.

In order to streamline the logistics of the multi-subject student project, our team has developed a set of support tools inside and outside SL. They are described next.

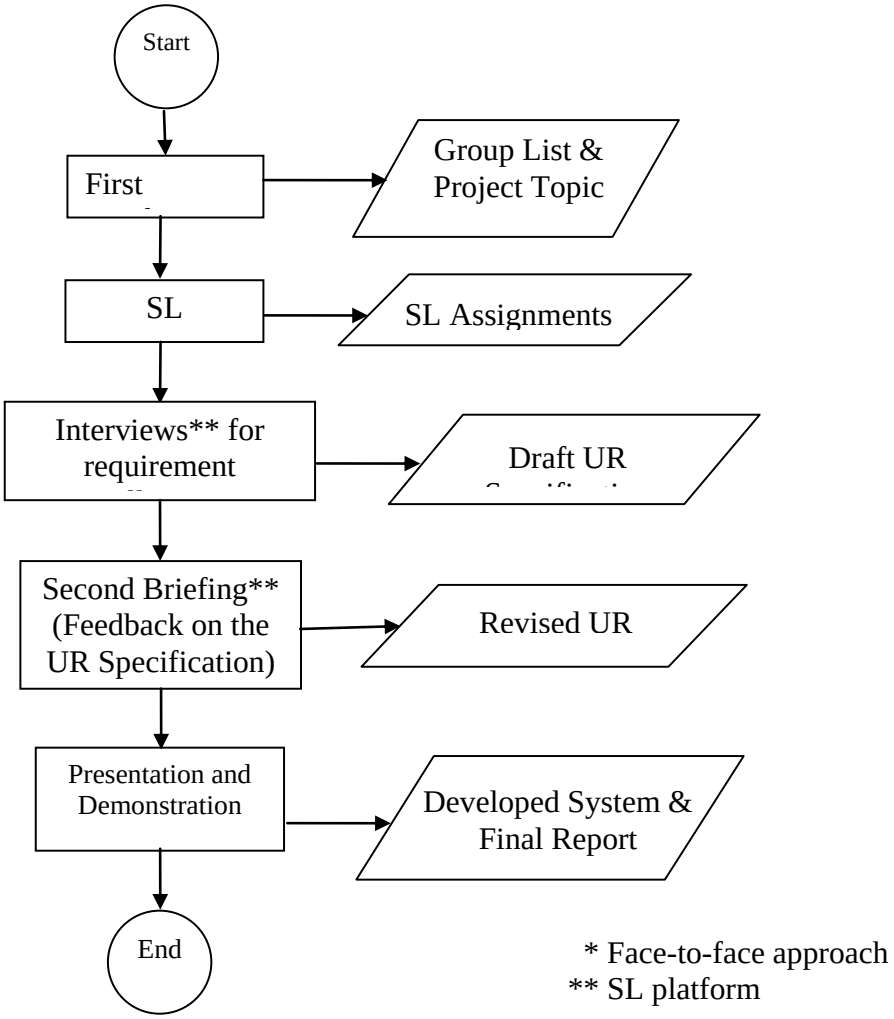

Figure 2: Flowchart of multi-subjects term project

3.1 SVG – the virtual company

A virtual company with several departments named as the SVG Corporation was built inside SL. The following is a description of the SVG, which was provided to students as a handout on the project website.

> *"SVG Corporation mimics an international company which earns revenue as a franchiser and an operator of restaurants. Apart from restaurants, SVG also funds SVG Charity House (SCH) and SVG Burger University. Although the SCH is an independent non-profit organization, SVG Corporation pays the general and administrative costs of the SCH global office. Therefore, a majority of the money donated by individuals and organizations go to the SCH and support the SCH programs. SVG Burger University has provided trainings which emphasize consistent restaurant operation procedures, service, quality and cleanliness. It is the marvelous global center for SVG's operations training and leadership development. Furthermore, SVG Privilege Club has been set up as the membership program for the customers. It also links with SCH because points can be gained through any kind of donations to the SCH. The SVG is a subsidiary of the SVG Corporation."*

Some snapshots of SVG in SL are shown in Figure 3 and Figure 4.

Figure 3: The SVG Corporation (top view)

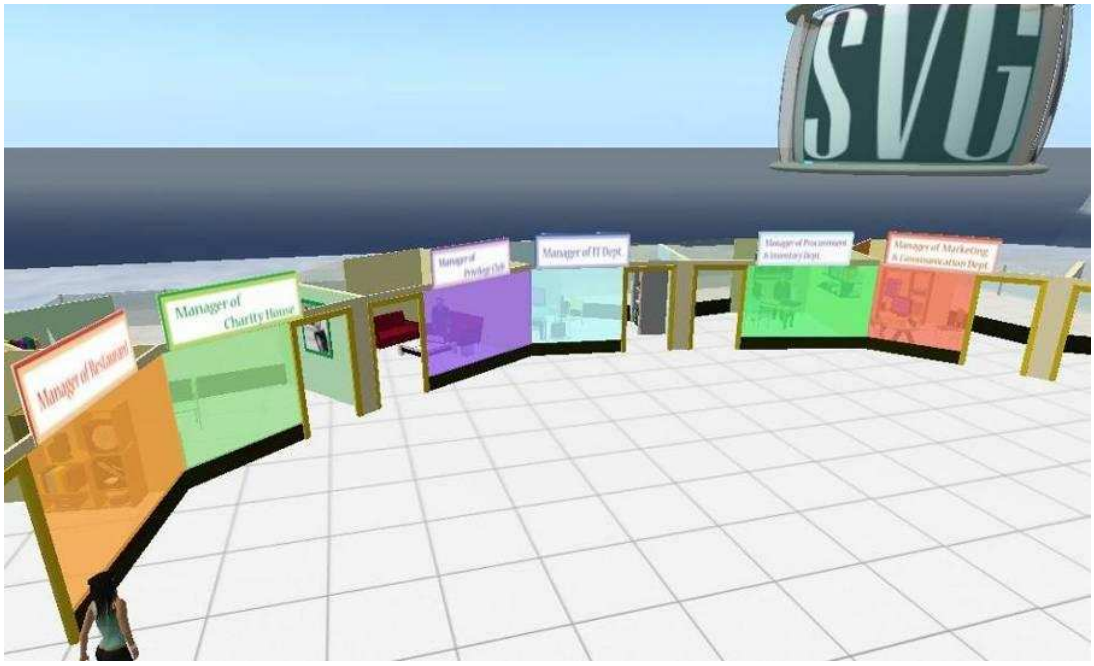

Figure 4: Different departments in SVG

3.2 Project website

A project website for the multi-subject student project (MMSP) provided a centralized information hub to provide group formation, submission deadline, sample templates tutorials and other materials related to the MMSP. It also acted as a channel to notify students about the progress of their projects and collect feedbacks from the lecturers.

3.3 Avatar registration page

The registration webpage enabled students to establish the correspondence between their avatar IDs and student numbers. After matching, recording of student activities or conversations in the SVG was possible. Lecturers could use the logs to analyze student activities and provide individual guidance. They could advise on the communication skill of students. Also, the registration page supported the appointment arrangements for interviewing with SVG staff.

3.4 SVG Staff – AI Robots

One objective of introducing SL is to reduce the workload of colleagues to act as external clients while at the same time, to enrich students to acquire some real world experience in communicating with people outside campus. After investigating a number of techniques and the approach of utilizing AI robots have been adopted. The building of AI robots was based on Panaorabots, which provided the robot hosting service (http://www.pandorabots.com/botmaster/en/home). The dialog control of the interviews between students and SVG staff were based on the Artificial Intelligence Markup Language (AIML). Through matching pre-defined keywords and question structures, SVG staff could offer appropriate responses to students. Through the support of Pandorabots, the processes for both robotic creation and robotic training became simpler and easier and the AIML scripts could be generated automatically by using a few user-friendly interfaces without computer programming. Figure 5 illustrates the first step for building an AI robot.

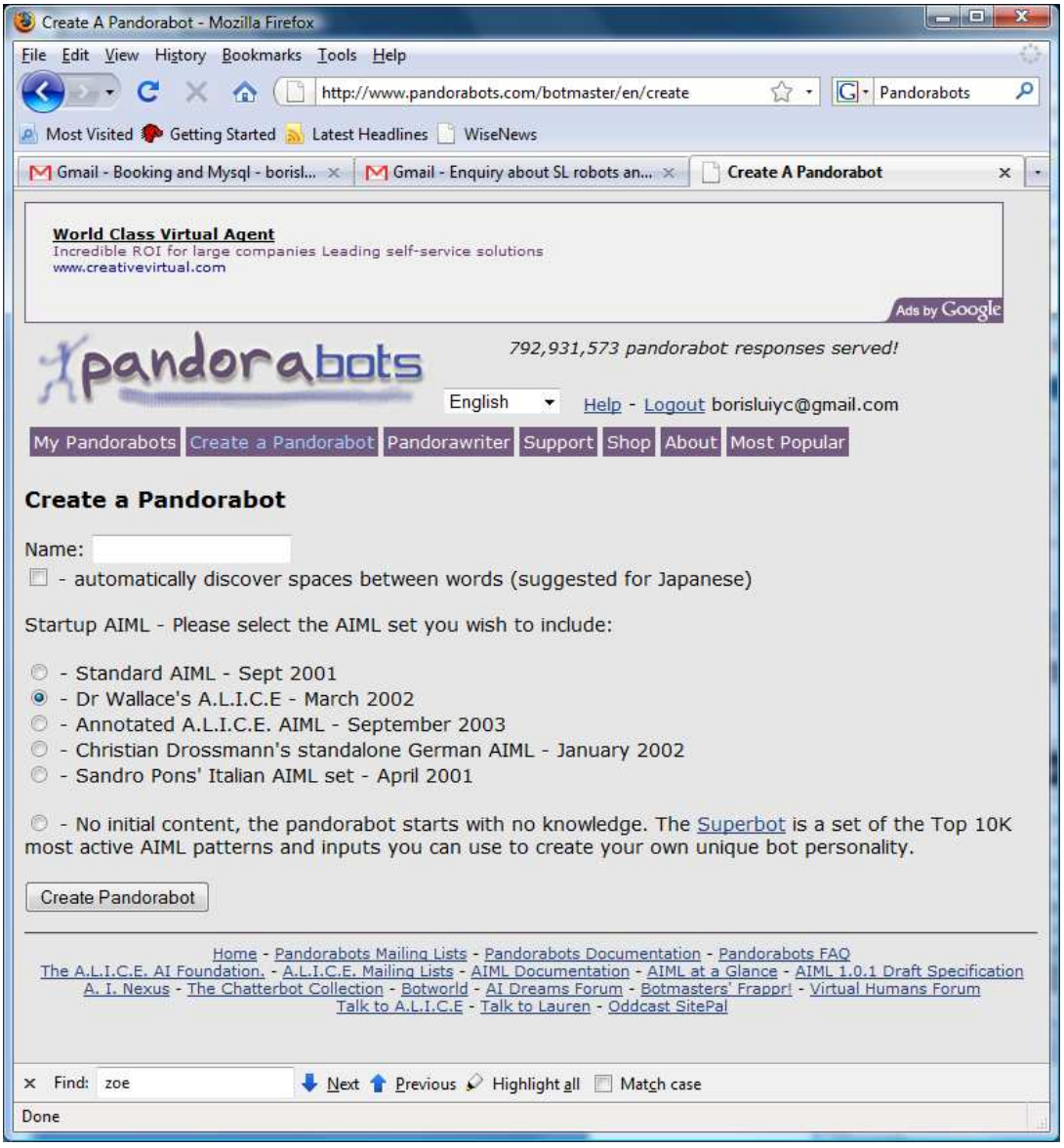

Figure 5: Robot initialization in Pandorabots

Besides the development of the AIML scripts, PHP coding was used for logging the conversations during staff-student interviews. A database was constructed to store the student information, including student ID and the corresponding avatar names as well as the questions and answers acquired during interviews. It acted as a source for lecturers to investigate the interview skill of an individual student. Figure 6 includes some snapshots of the staff (AI robots) during interviews.

Figure 6: Managers as Pandorabots in SecondLife

4. Evaluation

The multi-subject term project, with the involvement of SL, has been run for 3 times and a set of student surveys has been conducted during each project period in order to evaluate the student learning experience. In 2008, a survey was conducted for the students. It mainly focused on the usage of SL but the data collected was not sufficient enough to reflect the student needs. Thus, a set of 3 surveys, which are Pre-project survey, Mid-project survey and Final Project Survey, have been designed and used in the Fall semesters of 2009 and 2010, respectively. In addition to student feedbacks, we have received comments from teaching staff concerning the effectiveness of the application of SL towards student studies in this term project.

4.1 Student survey in 2008

The survey was divided into three parts. The first part allowed students to indicate the subjects taken. In the second part, students were required to give general evaluation of SL into different aspects. For instance, it was necessary for students to evaluate the user-friendliness of the interface of SL; the usefulness of the orientation package provided; the attractiveness of facilities and buildings in virtual PolyU campus for more exploration; the benefits to teaching with the help of SL; the interestingness of this project; the adequacy of the use of SL; their understanding of this project and the operations in the real business world. In the last part, students were expected to write down some comments about SL and the difficulties encountered when using SL. The overall result of the second part is shown in Figure 7.

As shown in Figure 7, students were mostly satisfied with the application of SL in the term project, particular in the usefulness of the orientation package provided and their understanding of the role of Second Life in this project.

In general, students who have much experience on online games, especially in 3D MUVEs, can adapt to the new mode of requirement collection process easily but the SL orientation package provided also allows students with little online game experience to get familiarized with this new platform and tried to gather system requirements in a smooth and efficient way. Hence, over 60% of the students knew what they were supposed to work with the SL. In addition, around 60% of them also satisfied with the simulated business environment for improving their practical skills such as communication skills and problem-solving skills.

Nevertheless, there was a noticeable dissatisfaction on the “benefits to teaching” category. As this project focused on the practical trainings for students without much active teaching involved, students were less likely to receive much knowledge using SL. In addition, it was the first year to involve SL as teaching and learning tool and hence it could be difficult for students, who have been taught in a traditional way for decades, accept this innovative approach.

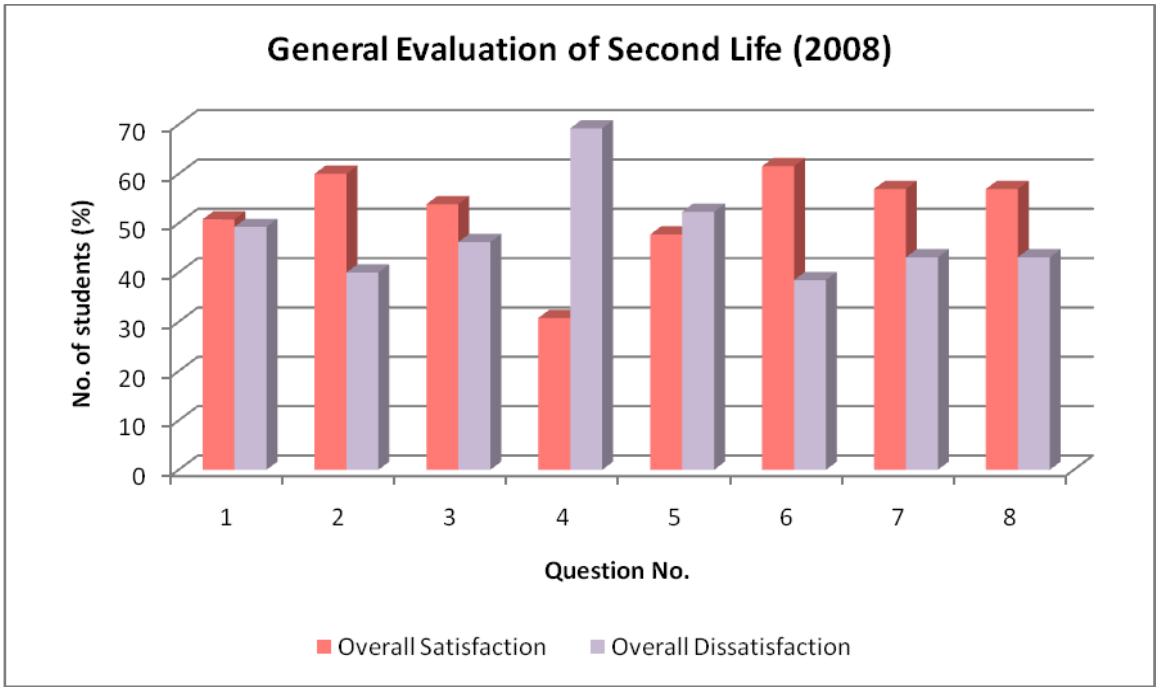

Figure 7: General evaluation of SL (2008)

Table 1: Survey questions (2008)

Question	Content
1	The interface of Second Life is easy to use.
2	The orientation package provided is useful.
3	The facilities and buildings in virtual PolyU campus attract me to explore more in Second Life.
4	The use of Second Life benefits to teachings.
5	Second Life makes this project more interesting than other traditional projects.
6	I know what I am supposed do in this project with the use of Second Life.
7	The use of Second Life is adequate to this project.
8	The virtual company (SVG) helps to understand the operations in the real business world better.

4.2 Student surveys in 2009 and 2010

In 2009, a set of 3 surveys has been provided for students in order to evaluate the application of SL as well as the practicability of term project in promoting software engineering education. It is believed that the surveys could help in collecting meaningful data for analysis. Sine the same set of surveys has been conducted in the Fall semester of 2010, results got from these 2 years would be presented below, with the exclusion of the data collected from the Final Project Survey because it focused on the feasibility of the entire multi-subjects term project.

4.2.1 Pre-project surveys

The Pre-project survey was conducted before the commencement of the multi-subject term project and it acted as a preliminary statistics of student cognition on virtual worlds as well as SL. Hence, questions are usually related to student experience on virtual worlds and SL. It is discovered that most of the students, either from 2009 or from 2010, felt strange to SL platform and less than 10% of them had tried it before the first project briefing. These results explained the necessity of the SL tutorials so as to enable students to get familiarized with this new platform soon. However, a slight increase in the amounts of student trying out SL when comparing the two years (5.3% vs 9.3%). This increase indirectly reflects that the SL began attracting students to try it out as a game and estimates its possibility as a learning tool.

4.2.2 Mid-project surveys

The Mid-project survey was conducted after the first submission, the User Requirement Specification (UR Spec.) on the ninth week of the semester. Students had just finished the UR Spec. with information collected from the interviews using SL. This survey was mainly focus on the user experience of SL. Students were asked to judge the user-friendliness and effectiveness of SL in the requirement collection process. The results of the self-evaluation of the learning progress in the mid-project period and the general evaluation of SL are shown in Figure 8 and Figure 9 for 2009 and 2010, respectively.

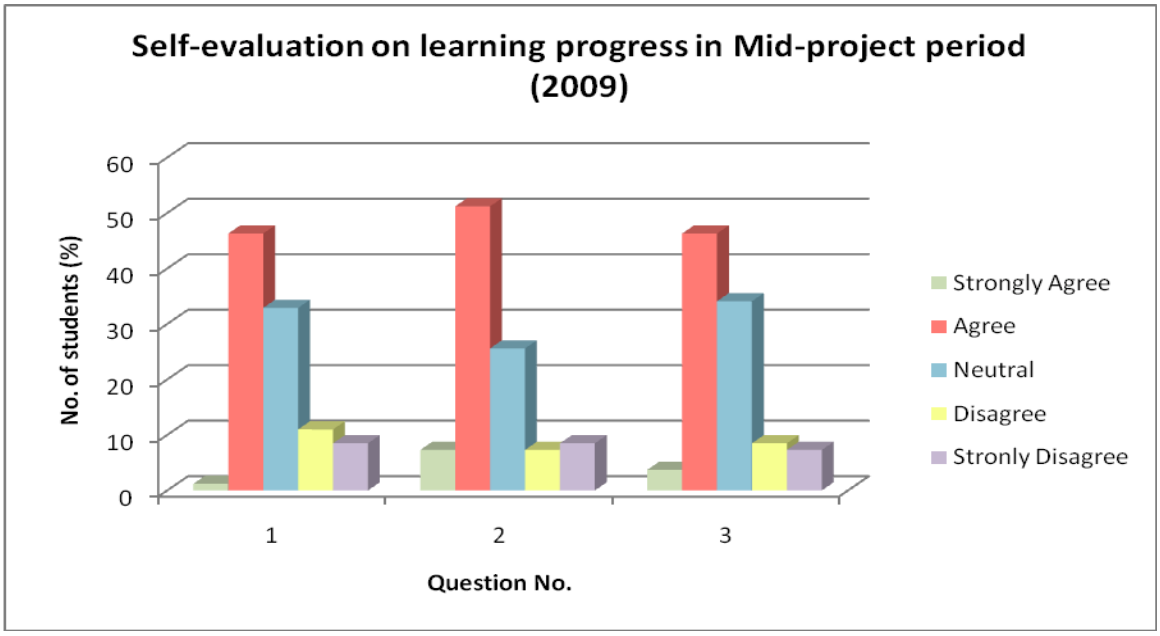

Figure 8: Self-evaluation on learning progress in mid-project period (2009)

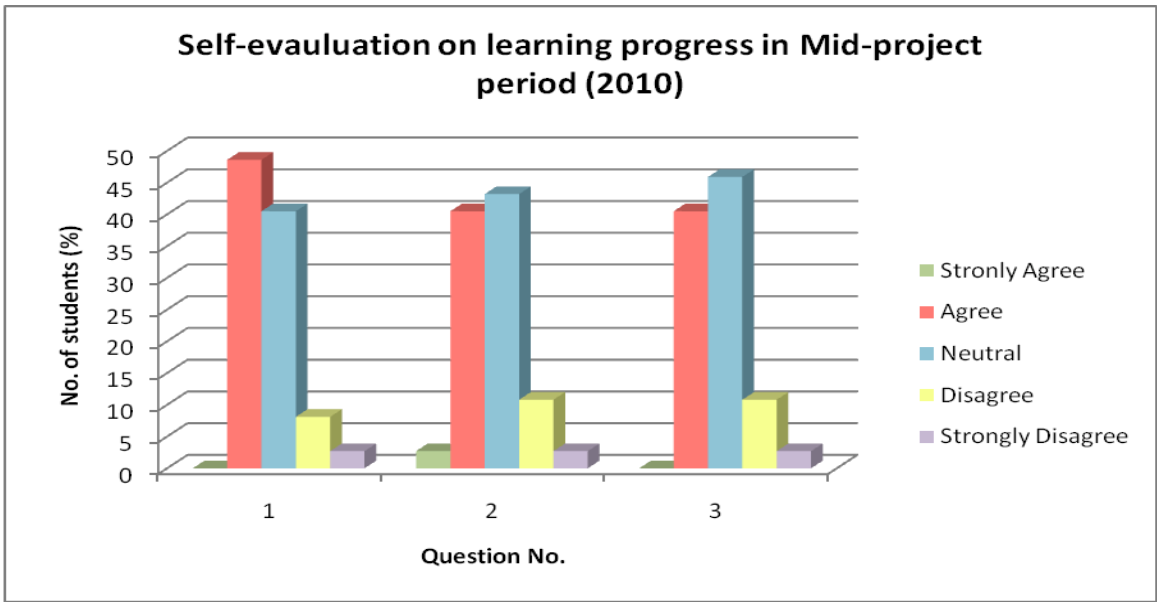

Figure 9: Self-evaluation on learning progress in mid-project period (2010)

Table 2: Questions of mid-project survey (Self-evaluation on learning progress)

Question	Content
1	My understanding on how to apply IT to business cases has been raised.
2	My team spirit can be developed and trained when working on this Term Project.
3	My knowledge on how to develop an informative system progressively has been advanced.

4.2.3 Post-project surveys

Figure 10 and Figure 11 illustrated that less than 20% of students thought that they cannot gain much knowledge from this multi-subject term project. Only around 16% and 14% of students, in 2009 and 2010 respectively, disagreed that their team spirit can be developed through the project works. These statistics are quite encouraging that majority of students was contented with our proposed learning approaches. Hence, it fulfills the learning objectives of developing soft techniques as well as technical knowledge.

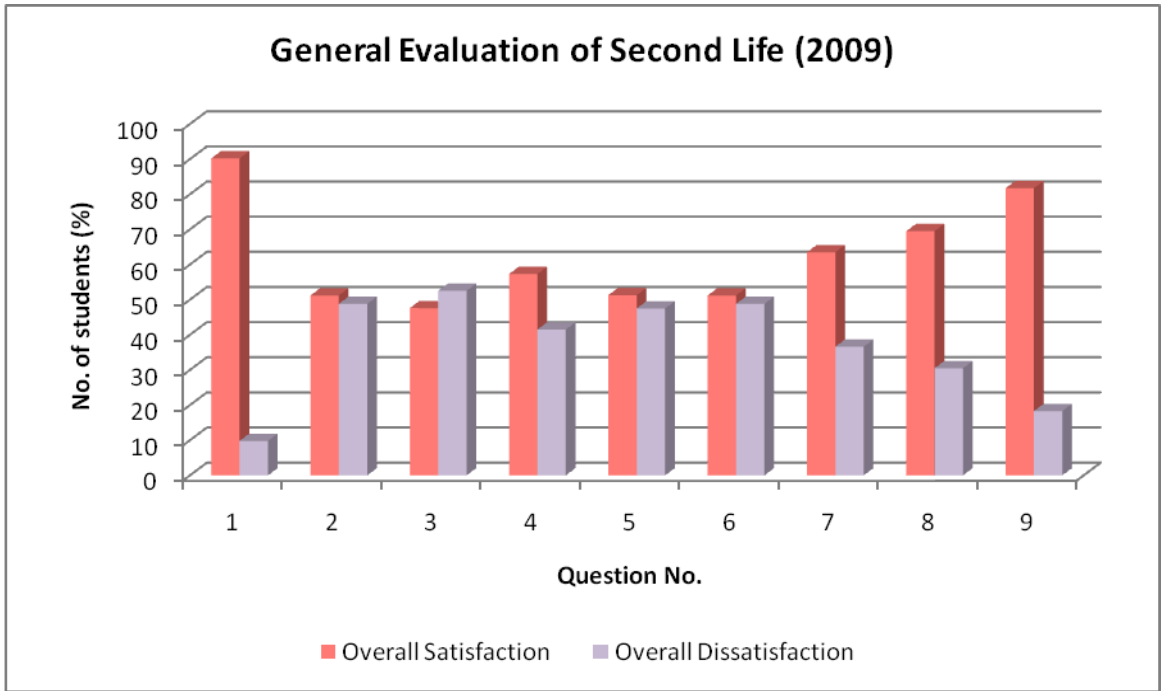

Figure 10: General evaluation of Second Life (2009)

From Figure 10, it is found that most students were satisfied with the application of Second Life in the term project, particularly in the following 3 areas.

- SL tutorials and assignment
- Flexibility interviews
- Experience on the software development process in real business world

Around 90% of students agreed that SL tutorials allowed them to familiarize with the new platform. This indicates that SL tutorials were essential to students before commencing the interview process for requirement collection. With this arrangement, students were motivated to explore more about SL in a relaxing environment and hence the promotion of student active learning could be achieved indirectly. Approximately 70% and over 80% of students were contented with flexibility interviews as well as experiences on the software development process in real business world, using SL, respectively. These results revealed that the presence of SL may complement the deficiencies in limited resources.

However, the situation has been altered to a certain extent in 2010 and which are illustrated in Figure 11. Students generally suggested improvement would be needed of the application of SL in the interviews. Similar to the results got from 2009, students satisfied with the SL tutorials and the experience on the software development process in real business world but not the interview arrangement. Although students were provided with reasonable periods for interviews, from 9am to 7pm, daily within 2 consecutive weeks, some of the students expressed that they were often occupied by lectures and tutorials which hindered them from conducting interviews during the assigned period. It revealed that the project team should check up student needs at intervals.

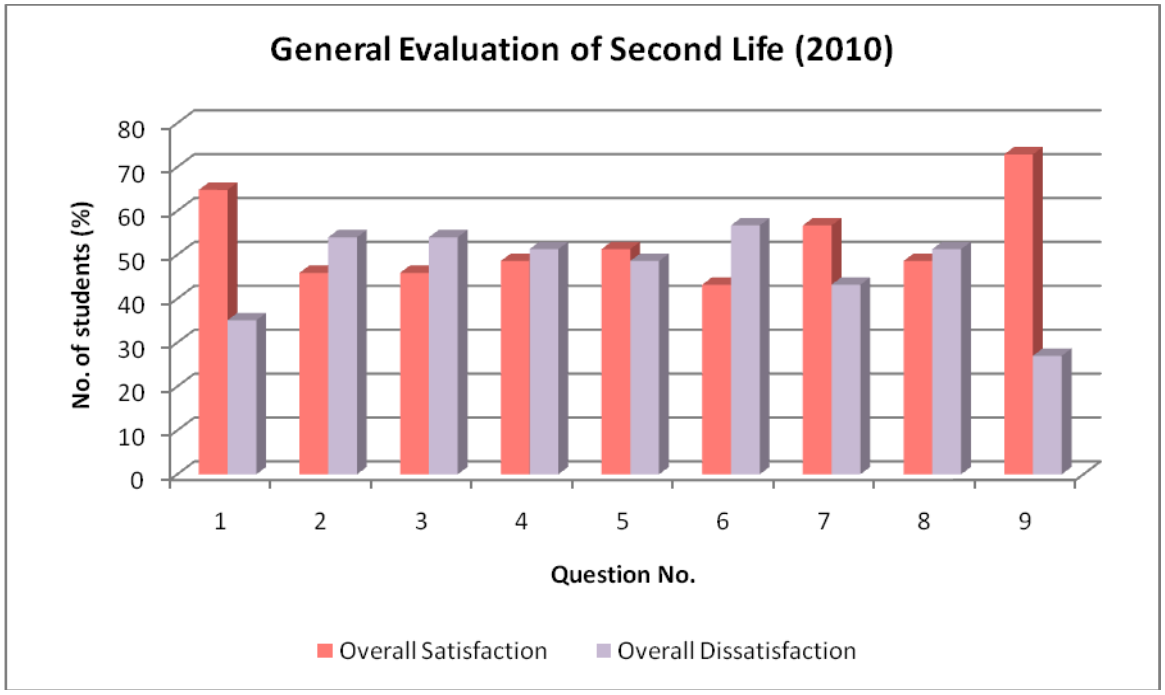

Figure 11: General evaluation of Second Life (2010)

Table 3: Questions of mid-project survey (General evaluation of SL)

Question	Content
1	The tutorial and SL assignment allows me to get familiarized with Second Life environment soon.
2	The facilities and buildings in virtual PolyU campus attract me to explore more in Second Life.
3	Second Life makes this project more interesting than other traditional projects.
4	The virtual company (SVG) helps to understand the operations in the real business world better.
5	The arrangement for interview is adequate to this project.
6	My communication skill and interview skill has been increased.
7	It is an innovative approach to do interviews within Second Life.
8	The involvement of SL allows greater flexibility in the time of interviews.
9	I gain more understanding on software development process in real business world through interview process and preparing UR Specification.

Despite both groups of students agreed that it is an innovative approach to have interviews within SL, a significant portion of them did not think that SL makes the project become more interesting. In terms of the student comments, the application of SL in the term project distracted them because students claimed that the set-ups of SL tasks were occasionally out of order and which leads to somewhat time-consuming task completion.

4.3 SL teaching staff

Apart from feedback received from students, the opinions collected from SL teaching staff were also significant in determining the feasibility of the application of SL in this software development project. SL, in the perspective of teaching staff, acts as a very useful means to support an innovative user requirement collection process. Nevertheless, there are still some drawbacks in applying SL in a software development project which are outlined below.

4.3.1 Insufficient feedbacks during student interviews

For the sake of examining the student activities during interviews, we have logged the conversation between students and AI robots. Students would be provided with comments about their performance so that their social and interview skills would be improved. Owing to the number of students available in each subject, it is less likely for students to receive immediate comment during their interviews. Hence, it makes students feel frustrated by repeating failure in acquiring the required information.

4.3.2 Inadequacy of SL workshops

Some teaching staff assumed that students from Computing (CS) are not necessarily provided with extra SL workshops or tutorials because they believed that CS students are keen towards any computing-related technologies, including RFID, online games, 3D virtual worlds and etc. Students can learn and master new software platforms independently. On the contrary, SL trainings are required for students since it provides an opportunity for students to learn the basic operation of SL and enable to have a chance to seek help when facing difficulties. It is obvious that a decrease in the number of SL tutorials held for 2010 students resulted in general drop of student satisfaction in the Mid-project survey.

5. Conclusion and recommendation

Our work is the first full scale operation of student joint projects across multiple subjects in the Department of Computing, The Hong Kong Polytechnic University. During the project period, several surveys have been conducted in order to gather student feedbacks in order to help us to understand the feasibility of using SL to empower students learning the process of software development. Also, comments from teaching staff have been collected so as to provide different perspectives. After reviewing the results and comments, it is obvious the multi-module term project arrangement does serve its purpose and improve on student learning. Students are in favor of the joint project arrangement. Yet, some students were not content with some of the support in the developed SL environment. Their dissatisfaction is generally based on 3 areas, including technical set-ups of AI robots, unfamiliarity with SL platform and insufficient SL training.

5.1 Unfamiliarity with SL platform

Although SL is a well-known 3D virtual world, it is not popular in Hong Kong. As discussed in Section 3.2.1, most of our students have not heard of SL before. According to Frailey, familiarization is fundamental human characteristic that people always seek for (Frailey, 1999). Hence, changes often become unfavourable even though a comfortable condition has been provided. Therefore, it is expected that plenty of time is required for adaption if innovation has been included in teaching and learning means. For instance, SL could be introduced during the summer time so that students could be provided with a longer period to know this new platform well.

5.2 Incomplete dialogue database of AI robots

Students considered the question and answer sets of the robots are not exhaustive. Since everyone has his/her own style in conversation, it could be quite hard to enhance the “brain” of each robot with only a limited number of robotic dialogic trainers. Hence, only limited sets of question could be prepared for each AI robot. Apart from keyword matching, sentence structure is another criterion for our robots to determine if any relevant and useful answer could be replied. However, it is discovered that, sometimes, students just typed in keywords when checking the interview logs. This would increase the difficulties for students in acquiring user requirements. In order to solve this problem, people from different academic fields should be invited as system trainers so that the robots could be “smarter” with comprehensive question sets. Also, a new mechanism, in addition to keyword matching, should be included in the AI robots to interact with students. Furthermore, students should be encouraged to raise questions instead of keyword presumption.

5.3 Inadequacy of SL training

In our practice, SL would be first introduced to students at the very beginning of the semester. Therefore, students have to be familiar with SL at most within 1-month period. Some students may find it difficult to begin and lose interest towards SL rapidly if no further SL trainings is available. Therefore, continual trainings should be offered before the commencement of the term project so that students can have more hands-on experiences on using SL.

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