You are my Clients: A Multi-disciplinary Software Development Project

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Abstract

Recently, there are many good examples of how multi-disciplinary learning can support students to learn collaboratively and not solely focus on a single professional sector. In past years, we have arranged students taking different subjects within the Department of Computing to work in groups for joint projects. One observation is the lack of application domain knowledge amongst many of the completed projects. There is a need to bring in business elements while not introducing much demand in resources. In Fall 2011, we have attempted to gather students studying different professional domains together. Three groups of students from the Department of Computing (COMP) and the School of Hotel and Tourism Management (SHTM) are involved. The first group of SHTM students is planning a conference event in 2012 with over 300 guests. These students act as the customers who require a banquet management system as well as a delegates managing application. The role of the second group of SHTM students is to manage the development projects with the support of IT consultants who are in fact the COMP students. During the semester, different communication channels have been set up to facilitate the inter-group and intra-group communications with the support offered by an e-learning system, Blackboard. In addition, there are classroom presentations given by the SHTM students and prototype demonstrations prepared by the COMP students. Pre-project and post-project questionnaires have been given to all participating students in order to assess their gain in professional and business knowledge in 2 different areas, namely database application development and conference management. In this paper, we would like to report our experience, problems and the difficulties encountered in this multi-disciplinary pilot project.

Keywords: Multi-disciplinary Learning, Teamwork, Software Engineering

1. Introduction

In designing software engineering course materials, teacher would like to relate the “hard” facts back to the real world situation especially for senior year students preparing for their job hunting. What kind of skills companies want? For many companies, IT students are expected not only having technical skill but also other “soft” techniques like communication skill, creativity and entrepreneurship so as to cope with the rapidly-changing business environment (Žagar, Bosnić & Orlić, 2008). A product-based learning approach was taken on a Java course to the computer-science and software engineering students in United State (Ragan et al, 2009). For database application developments, one of the main issues to learn is focusing on the ‘client-centredness’. Domínguez and Jaime (2010) from Spain had launched a database design course following the ideas of PBL and applied an enterprising way of working during the whole process including deadlines, limited resources, penalization for delays, role-playing, documentation production and checking, etc. There is a need to find appropriate clients for students to appreciate and acquire the real world requirements of a development project. After realizing the issue, a multi-module software engineering term project involving different subjects has been set up for year 2 students studying in the Department of Computing. In Fall 2006, a simulated environment with business cases of a company had been introduced and colleagues were asked to act 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 traditional lectures and tutorials. Because of the intensive resource demand, during 2008-2010, a virtual company was built inside an online world (Second Life) to cope with the large number of student projects. However, for these 3 years, student feedbacks were mixed due to the issues of robotic support in Second Life.

2. Motivation

In 2010, the new Hong Kong Polytechnic University training hotel, Hotel Icon, had open for authentic student learning. One of its objectives is to support a series of integrated student learning activities that will be built through collaboration between School of Hotel and Tourism Management (SHTM), Department of Computing (COMP), Institute of Textile and Clothing (ITC) and Department of Applied Biology and Chemistry Technology. Students will be able to work towards specific subject learning outcomes while not limited by traditional departmental bounds and allow to have a shared teaching and learning context that will be both challenging and innovative. For example, student projects in the School of Hotel and Tourism Management (SHTM) designing hotel facilities may find the results of the testing, experiment and material collection of Institute of Textile and Clothing (ITC) student projects acting as inputs for the projects of SHTM students. The purpose is to enable students not only benefit from getting new experiences but also new ideas through interactions with peers in other disciplines.

Interest in multi-disciplinary team working has been existed for many years (Mathias & Thompson 1997, Barr et al. 1999 & Riebe et al. 2010). Multi-disciplinary learning brings different groups of people with complementary backgrounds to work together (Wicklein & Schell 1995). We have found example in Statistics course collaborated with other subjects (Ojeda & Sahai 2003) and another example of inter-disciplinary/cross faculty collaboration done by Pan et al. (2010) where the Industrial and Manufacturing Systems Engineering Department and the Faculty of Education within the same institute created a joint project to re-purpose an eLearning system to serve the education students' need in relation to teaching practice. This form of learning can break down traditional barriers between students of different disciplines and empower them to appreciate non-familiar professional knowledge (Hoare et al. 2008). It can promote problem solving, with input from a wide variety of view points and different knowledge aspects. For undergraduate education, it has long been known that we need to produce graduates with a strong cross-disciplinary outlook as many significant advances have been resulted from interactions between different fields. Recently, Hayhurst et al. (2011) has discussed how well-established management subjects and appropriately structured group projects can enhance the multi-disciplinary learning of engineering students. We need students having division specific knowledge and skills as well as how to working with others. The development of multi-disciplinary course is essential as the real world is complicated.

A team is a small number of people with complementary skills who are committed to a common purpose, performance goals and approach for which they hold themselves mutually accountable (Katzenbach & Smith 1993). Tjosvold's (1989) model of cooperative dynamics in organizations suggested that cooperative interaction improves productivity. Through team working, people can be more motivated to apply their learned knowledge. In the report from University of Glasgow, it presents four main factors supporting multidisciplinary teamwork – committed individuals who play a key role in team development, staff with a common sense of purpose or vision and who work together to achieve it, clearly negotiated team roles, and explicit support for such developments at the organizational level (Wilson & Pirrie 2000). For different types of multi-disciplinary learning activities, multi-disciplinary team working is well-established in the literature of health and social care. Based on the study of Patrashkova-Volzdoska (2003), in a cross-functional team communication, the communication frequency can have a curvilinear relationship to team performance instead of a straightforward relationship commonly believed.

This paper reports our experiences on providing students term projects for database application with multi-disciplinary team working. We hypothesize:

H1a. COMP students will gain event and convention management knowledge from the SHTM students through the project.
H1b. SHTM students will gain database system development knowledge from the COMP students through the project.
H2. Students will achieve better learning out-comes through the project.
H3a. Students will notify that there are differences when they interact with students from the other disciplinary.
H3b. Students will notify that there are seminaries when they interact with students from the other disciplinary.
H4. Students will achieve better team working and communication skills through the project.

Learning should be a constructive, self-directed, collaborative and contextual process. Section 1, the introduction, presents the background and we elaborate the motivation of our work in Section 2. It is followed by the methodology that we have adopted in section 3. Section 4 discussed our findings and feedbacks from students. Finally, in Section 5, we will conclude the paper and discuss problems encountered and future enhancement. Our studies focus on the collaborative leaning principle and through a better understanding of why and under what circumstances these theories or concepts work or not work, we hope our study could be considered as an example of one which contributes towards the collaboration learning theory building.

3. Methodology

In Fall 2011, the Hotel Icon Project is launched to enable authentic and collaborative multidisciplinary learning experiences for students in The Hong Kong Polytechnic University. The project has a number of sub-projects which are servicing students from different combinations of academic departments and schools. One of the sub-projects is to support the multi-disciplinary team working for students in SHTM and COMP. Here, different students will have different roles (end-users, vendors, developers) in a database application development project.

The SHTM students acted as end-users to present and explain the business needs, and later analyze and critique existing problems in a business application. Another group of SHTM students acted as vendors (or consultants) to evaluate the selection of appropriate technologies for the respective business application. The COMP students were developers to apply the principles of database design to a real life problem and be responsive to know the impact of the database system developments to the industrial. Overall, all students could be benefit from working together as a team, gain better understand of different roles and the nature of group dynamics, develop effective communication and critical thinking skills, and design alternatives solution in a group setting.

A class of SHTM students (Group A, Special Event Project I) were asked to help in organizing the International Convention & Expo Summit 2012 (ICES2012) and the 11th Asia Pacific Forum for Graduate Students' Research in Tourism (APFGS2012). The whole class will become the organizing committee of the 2 conferences and each student has gone through a recruiting process for a duty assignment. In order to help these students to better manage the event by applying information and communication technology (ICT) and enhance departmental collaboration and student exchange, a multi-disciplinary student project is developed which included another group of SHTM students (Group B) who studied 'Special Topics in Convention and Events' and COMP students who studied 'Foundations of Database Systems'.

After several rounds of discussions with participating lecturers, two business applications for the conference have been identified as below.

- The Banquet Managing System should be able to
    - Collect information specific to the event with the ability to accommodate several hundreds of users and thousands of records in an easily scalable manner;
    - Keep track of the meal selection and seating arrangement;

    - Provide information for the catering services.
- The Delegates Monitoring System should be able to
    - Collect information specific to the event with the ability to accommodate several hundreds of users and thousands of records in an easily scalable manner;
    - Manage meeting related information like the session topic, meeting location and attendee response etc.;
    - Allow the organizing committee to know and track on the meeting sessions' "people flow".

Group B students and COMP students would serve as development consultants and developers for the two applications above. Group A students would provide business requirements as a wish list to the COMP students. Figure 1 shows the relationships and the activities of this multi-disciplinary student project for the 3 groups of students.

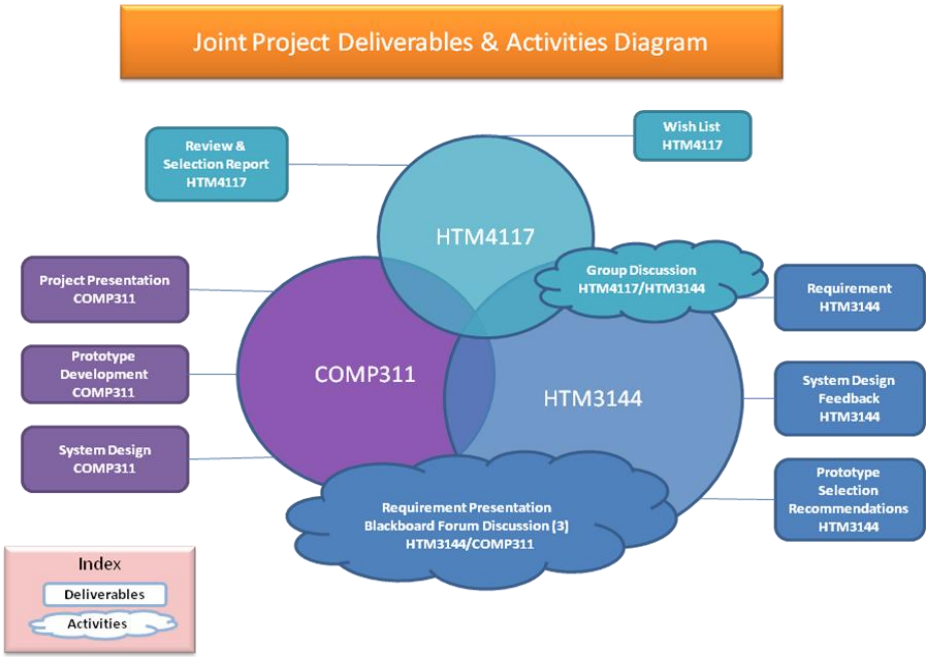


Figure 1. Joint Project Deliverables and Activities Diagram

3.1 Student Participants and Roles

In Fall 2011, for the multi-disciplinary term project, there were 115 COMP students from the Foundations of Database System subject; 25 SHTM students from the Special Event Project I subject (Group A) and 11 SHTM students from the Special Topics in Convention and Events subject (Group B). Group B SHTM students would act as systems' liaisons in the project. They needed to communicate with their customers and collect the business requirements. After their own digestion, they should convert the business needs into the system requirements and then pass them to the COMP students, the developers, who needed to develop a database application as the final product. The breakdown of the student roles is shown in Table 1.

Class	Group B	Group A	COMP	Total
Role	Liaison	Customer	Developer	
Number of Active Students	11(3*)	25	115	148
*Among the 11 students from HTM3114, 3 of them also took HTM4117.				

Table 1. Participants Summary

3.2 Project Arrangement

Group A students were further divided into 5 different teams. During the first week, each team had to come up with a wish list for the two systems: Banquet Managing System (BMS) and Delegates Monitoring System (DMS). The BMS should be able to collect information specific to the event with the ability to accommodate several hundreds of users and thousands of records in an easily scalable manner; keep track of the meal selection and seating arrangement and provide information for the catering services. While, the DMS should be able to collect information specific to the event with the ability to accommodate several hundreds of users and thousands of records in an easily scalable manner; manage meeting related information like the session topic, meeting location and attendee response etc. and allow the organizing committee to know and track on the meeting sessions' 'people flow'.

A wish list presentation was given to the Group B students in week 2 of the semester. The two teams of Group B students who acted as the systems' liaisons needed to consolidate the wish lists from all the teams of Group A and wrote out a business requirement plan for each system. The plans were then passed to the COMP students. In addition, two rounds of business presentations were given to the COMP classes by the Group B BMS team and DMS team, respectively. At the same time, a forum discussion section was opened up in Blackboard (a Learning Management System). The 115 COMP students were divided into 31 teams with 19 teams working on BMS and 12 teams working on DMS. In week 7, the 31 COMP teams had to submit their system design documents which would be reviewed by the Group B BMS and DMS teams. After received the feedback, the COMP teams got around 3 weeks to build a prototype of the application. They had to demonstrate their prototypes to the Group B BMS and DMS teams in week 12 as shown in Figure 2. Based on the demonstrations and screen shots, the two Group B teams would provide suggestions and recommendations to the Group A class through a presentation with all the pros and cons listed and supporting reasons given. Finally, the Group A class would select one application for each system to be adopted afterwards. Figure 3 summaries the flow of the project arrangement.

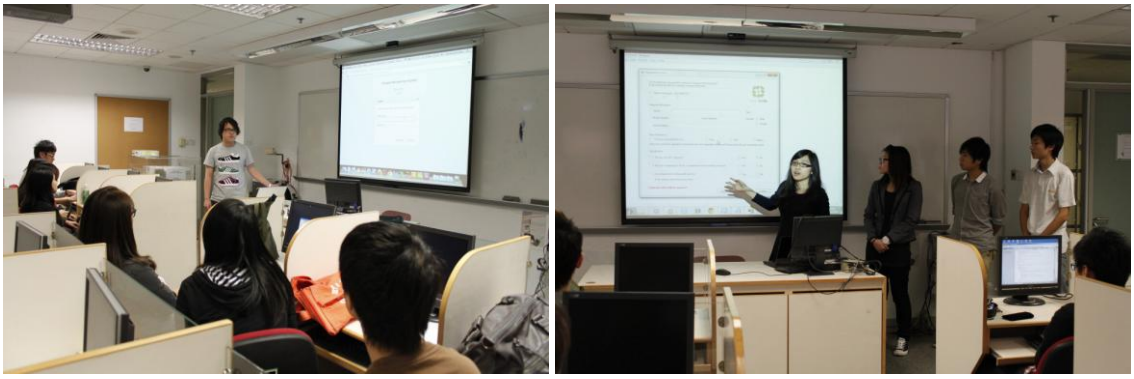


Figure 2. Prototype Demonstration of Group B

3.3 Feedback collection

In order to make the comparisons before and after the multi-disciplinary student project arrangement, a pre-project questionnaire and a post-project questionnaire were given to all the active students in week 2 and week 14 during their lecture classes. The questions are designed with the consideration of the four main factors supporting multidisciplinary teamwork from the report of Wilson et. al. from University of Gasgow (Wilson & Pirrie 2000). There were 10 questions concerning the level of confidence in the knowledge of relational database, hotel and tourism management and their pass experiences on database development and convention organization. Another set of 15 questions were related to the objectives and expectations of the students. Besides, we also wanted to find out what were the student comments on the usage of

different communication methods like the face-to-face meeting, online forum discussion etc.. Most of the questions were in Likert scale (1 is strongly disagree and 5 is strongly agree). 107 pre-course questionnaires were collected and 134 post-course questionnaires were collected. 93 students had done both set of questionnaires.

To enrich our data and gather more feedbacks, we also performed several interviews with a selected group of students in the middle of as well as at the end of the semester. Questions concerning the likeliness, usefulness, communication and planning with other departments were asked during the interviews.

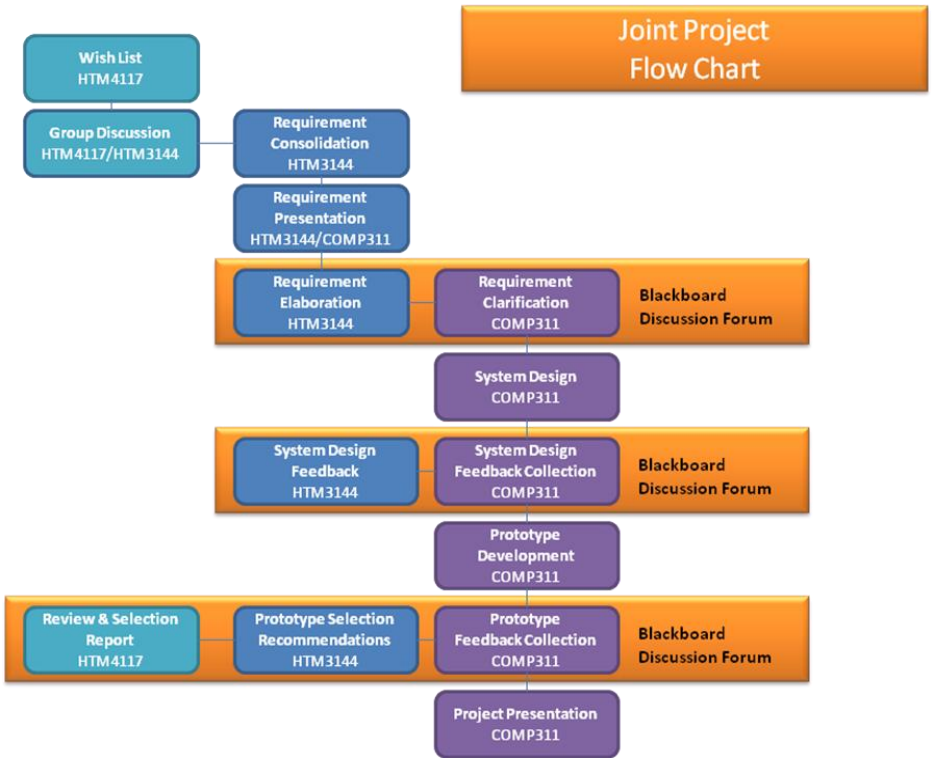


Figure 3. Joint Project Flow Chart

4. Findings and Discussion

4.1. Survey Findings

Each pre- and post-questionnaire contains 63 different questions covering different aspects, including level of confidence of different domain knowledge, learning outcomes of respective subjects, inter-group dynamics among students from different disciplines, and communication channels.

4.1.1. Domain Knowledge

For domain knowledge, we asked 3 questions concerning the relational database and 3 questions concerning the hotel and tourism management. The result was shown in Table 2. Comparing the results, the COMP and SHTM students got a similar pattern. Both of them indicated the improvement in their own area of knowledge (either database or event and convention management) and their counterpart's area knowledge. The result on the knowledge gain from both groups is encouraging. The gain in the domain knowledge supported our hypothesis H1a and H1b.

	Students of COMP		
(Mean)	Pre-course	Post-course	Gain
Knowledge in Relational Database	3.11	3.74	0.63
Knowledge in Hotel & Tourism Management	2.29	3.12	0.83
	Students of SHTM		
(Mean)	Pre-course	Pre-course	Gain
Knowledge in Relational Database	2.59	3.05	0.46
Knowledge in Hotel & Tourism Management	3.71	4.08	0.37

Table 2 Level of Confidence before/ after the project

4.1.2. Expectation and Learning Outcomes

By getting the mean score of questions on learning outcomes (lo) and expectation (ep), both groups marked have lower scores in the post-course questionnaire (COMP lo/ep: 3.7/ 3.7; SHTM lo/ep: 3.9/ 4.1) than those in the pre-course questionnaire (COMP lo/ep:3.9/ 4.0; SHTM lo/ep: 4.3/ 4.4). Thus, further analysis was taken on the 93 set of questionnaires done by the same subjects (the students). The students gave a high expectation in the pre-course questionnaires frequently do not have much gain on satisfactions in the post-course questionnaires (

Figure 4).

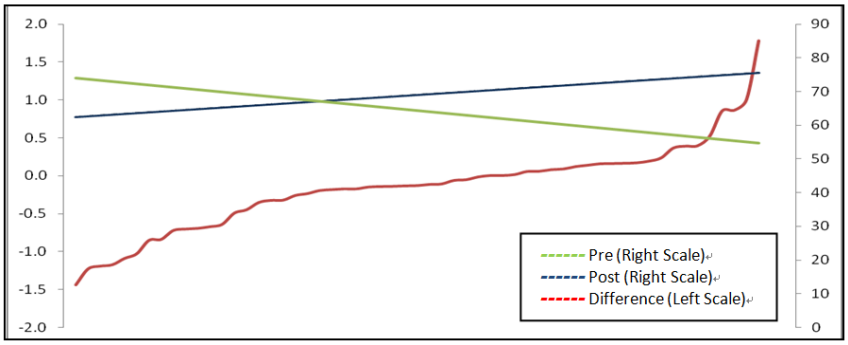


Figure 4. Expectation before / after / difference

With the previous result, we performed further analysis and have divided the 93 students into 5 different groups according to their roles, backgrounds and their degree of involvement in the joint project as shown in Table 3. The group of students taking both the customer and liaison roles had the highest degree of involvement. The next group was the group taking the liaison role. Both groups needed to follow through the whole project from start to end in gathering the business requirement, presenting the requirements, answering the question from the developers, giving comments on the prototype demonstrations and suggesting recommendations to the customer. The group of students taking the customer role only got involved during the beginning of the semester on creating the wish list and at the end on selecting the final applications. For the developer groups, we divided them into one who took more business and management training and the second one who was only keen on the technology. The paired-samples t-tests were done comparing the pre and post results against each group. It was found that each group got the

statistically significant positive feedback on different aspect. More positive feedbacks were given by the groups with higher degree of involvement.

Group (No of students)	Role & Background	Degree of Involvement	Questions with Positive feedback (under Paired Samples t-test significant <.05)
SHTM-B (7)	Liaison	High	– Learnt from students of other disciplines – Strengthen on communication skills – It was a good learning experience – Worked efficiently and effectively
SHTM-AB (8)	Customer and Liaison	Highest	– Given the chance to apply learning to a real problem – Communication with teams using different communication channels – Carrier out a task with well-defined objectives and outcomes – Developed an application which can be use in real business
SHTM-A (16)	Customer	Low	– Developed an application which can be use in real business
COMP-B (27)	Developer Background leaning towards business side	Medium	– Gained new knowledge benefit future jobs – Provide prompt input to the project – Able to plan and management tine to complete task and achieve goals – Developed an application which can be use in real business
COMP-A (35)	Developer Background leaning towards technology side	Medium	– Given the chance to apply learning to a real problem – Carrier out a task with well-defined objectives and outcomes

Table 3. Paired Samples t-test on Expectation and Learning Outcomes

4.1.3. Communication

Different communication means have been used to support the interactions between students, in particular, the Blackboard Learning Management System which the University has been using since Fall 2011. It supports forum, wiki, blog, email and online chatting. Table 4 shows the evaluation results from the students on the different communication channels. Both groups of students prefer to have more face-to-face interactions than communication through the other means.

		Necessary	Helpfulness	Likeness	Recommend to future project
Blackboard	COMP	n/a	n/a	2.7	2.7
	SHTM	n/a	n/a	3.5	3.4
Forum discussion (in Blackboard)	COMP	3.7	3.6	3.4	3.3
	SHTM	4.2	3.9	3.5	3.5
Videos	COMP	n/a	3.4	n/a	3.5
	SHTM	n/a	3.9	n/a	3.9
Classroom face-to-face interaction	COMP	4.0	3.9	3.9	3.9
	SHTM	4.3	4.3	4.2	4.3
Inter-group face-to face interaction	COMP	3.9	3.9	3.8	3.9
	SHTM	4.3	4.5	4.2	4.2

Table 4. Evaluation Results of Students using Different communication channels

4.1.4. Group Dynamics

In the pre-course questionnaire, we asked 8 questions concerning the intra-group dynamics. It was found that most students were familiar with group project or group work and they known their team members in advance (COMP M=3.5, SHTM M=4.1). In the post-course questionnaire, we asked the same 8 questions but concerning the inter-group dynamics this time (COMP M=3.5, SHTM M=3.9). From the results (Table 5), both groups rated the intra- and inter-group dynamics questions without significant difference statistically. Group process is not in a linear sequence. At different phases, a group may engage in different kinds of decision making process and problems to be solved. The communication within groups in each stage of Tuckman's (1965) group development model could be in various forms. In the case of inter-group scenario, the groups shall go through the forming, storming, norming and performing stages as well. However, each stage takes time to process and then carriers on. In a multi-disciplinary student project, the time allowed for interaction is limited. We had encountered students with intra-group conflicts during the semester but it seems there were not many complaints on the other side (students from the other discipline). The post-course questionnaire shows a friendly and peaceful scene. Conflict in groups occurs over task issues as groups begin presenting their ideas (Harris & Sherblom 2008). The group interactions on the intra- and inter-group development process is presented as in Figure 5.

	Diff. on Mean	Diff. on Std. Deviation	t	Sig. (2-tailed)
(1) I like to work with groups from another department.	.020	1.116	.180	.857
(2) I am capable to ensure that both groups' purposes and objectives are clear.	.111	.891	1.241	.218
(3) I am able to nurture a mutual understanding between two groups in order to achieve goals.	-.121	.961	-1.255	.213
(4) I am able to support group(s) from another department to help to achieve the goals.	.091	.834	1.084	.281
(5) I am able to contribute to group(s) from another department by sharing information and expertise.	.081	.911	.882	.380
(6) I found that groups from another department think differently.	-.030	1.199	-.251	.802
(7) I am able to recognize the differences of another department.	.141	.979	1.437	.154
(8) I am able to respect the differences of another department.	.162	1.037	1.550	.124

Table 5. Paired Samples t-test on Group Dynamics

4.2. Interviews Findings

There were 2 rounds of interviews conducted. One was in the middle of the semester with COMP students and the second one is towards the end of the semester with SHTM students. During mid-term interviews with COMP students, they reflected that they were not sure how to tackle the project at the beginning. They needed to repeatedly read the documents and discussed with the tutors before getting a better idea of the work, which may have discouraged them. Some students raised the concern about the assessment. Especially, they were not sure how they should be reacted when there were conflicts between the requirements from the SHTM students and the subject lectures as the requirements were given by the SHTM students while the grading was done by the subject lecturers.

For the semester-end interviews, SHTM students commented on the necessity of the face-to-face discussion rather than in an electronic form. They found interactions with Blackboard and / or forum discussion was not the ideal way of communication because timely responses and diagrams were often needed. Also, the workload of the joint project was much higher than expected though the whole process was very interesting. However, the time and effort being spent on the discussion, evaluation and organization were at least double when compared with other SHTM students working on other projects but in the same class.

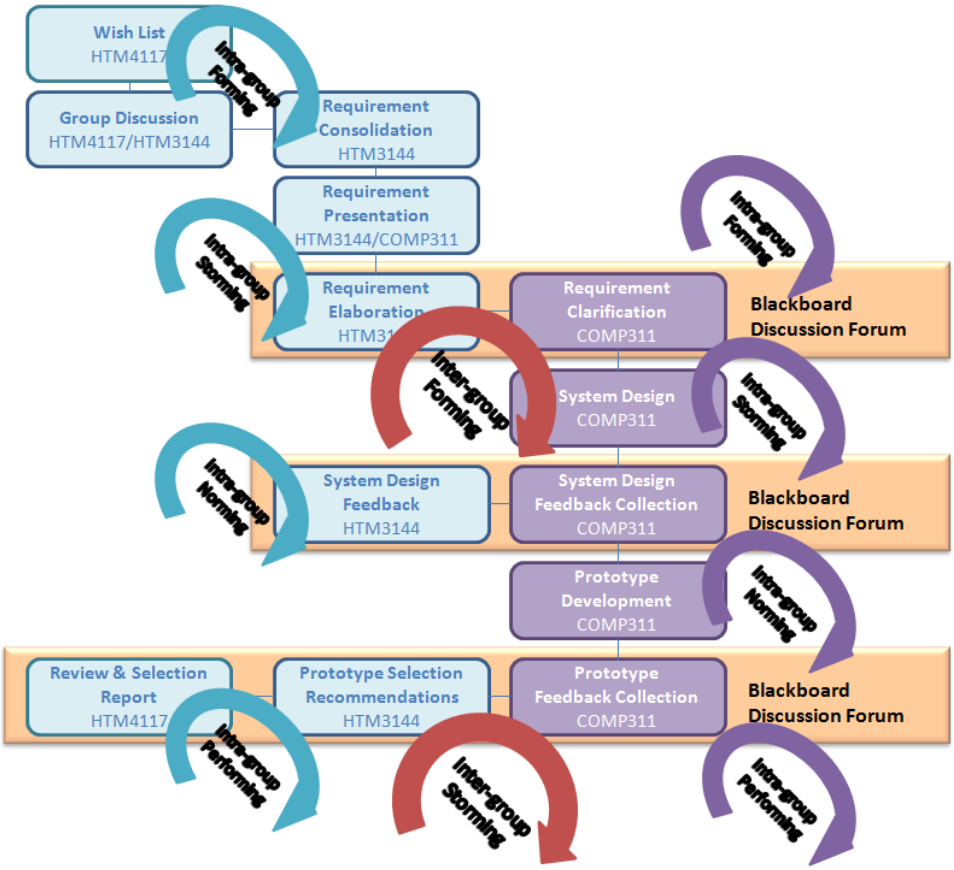
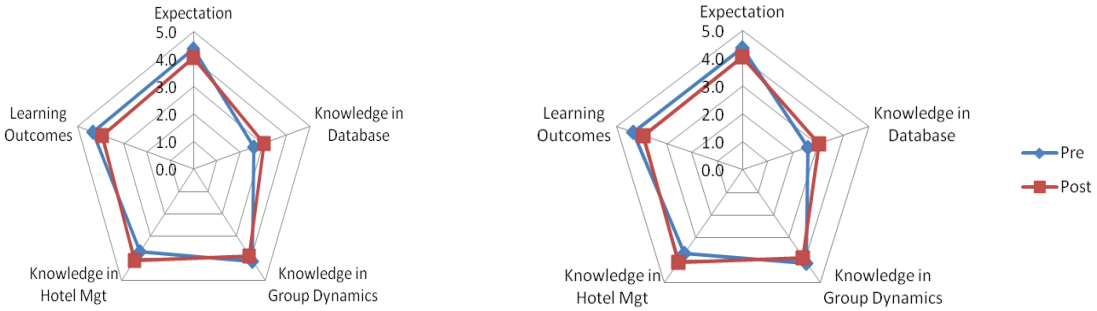


Figure 5 Intra- and Inter-group development model

In both interviews, students have noted that there are differences when they interact with students from the other disciplinary but that there are also seminaries.



COMP Students SHTM Students

Figure 6. Students Pre/Post Questionnaires Summary

5. Conclusions

This paper discussed the motivation and arrangement on a multi-disciplinary team working approach for students coming from different disciplines. In Fall 2011, we have gathered students studying different professional domains together to work on a joint term project. Three groups of

students from the Department of Computing (COMP) and the School of Hotel and Tourism Management (SHTM) are involved. The first group of SHTM students is planning a conference event in 2012 with over 300 guests. These students acted as the customers who required to define the specifications of a banquet management system as well as a delegates managing application. The role of the second group of SHTM students was to manage the development projects with the support of IT consultants who were in fact the COMP students. We have summarized the preliminary findings of the questions in Figure 6 for COMP and SHTM students. Pre-course and post-course questionnaires have been given to all participating students in order to assess their gain in professional and business knowledge in 2 different areas, namely database application development and conference management. In our preliminary findings, it has been observed that the 2 groups of students have improved their knowledge in both domain areas. Yet, the high expectation beforehand has not led to a high rate of satisfaction. It is observed that the higher the degree of involvement to the project, the higher the overall learning outcomes result. That is more work, and more gain. Also, it is interesting that students are in favour of face-to-face interactions when we consider electronic means were their natural choices. Students achieve better team working and communication skills through the project.

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