IMPLICATIONS OF ADOPTING PROBLEM BASED LEARNING ON CAMPUS CLASSROOM DESIGN
Analysis of Students' Learning Behaviors, Collaboration and Space Use

○Fahed A. Khasawneh *　　　Yoriko Shibayama **　　　Akikazu Kato ***

Keywords: *Problem Based Learning, Campus, Collaboration, Classroom Design, Learning Behaviors*

■ ABSTRACT:

More Japanese universities are adopting problem based learning (PBL). The change of pedagogy was not accompanied by changes in the design of learning spaces. A PBL course in Mie University was studied. The study was based on observation. The focus was on understanding the influences of PBL pedagogy on classroom space use. Students' behaviors during group work were analyzed. The results showed that there was a misfit between PBL that encourages group work and collaboration and outdated classrooms. Effective collaboration behaviors were observed, such behaviors took place when all group members participated equally in learning activities. Communication between group members is essential for healthy collaboration activities. PBL requires creating new learning spaces in university campus optimized for collaboration.

■ INTRODUCTION:

Universities all over the world are adopting Problem Based Learning (PBL). Mie University is trying to cope with this worldwide trend by steadily introducing PBL into its courses. PBL is learning initiated by a posed problem to be solved by the learner; the problem here becomes the focus of the student's activities (Boud & Feletti, 1997). Students usually start with a problem, and then they move to acquire knowledge and skills in a sequence of real world problems presented in context with associated learning materials and support from a teacher.

Complex real world problems motivate students to identify and research the concepts and principles they need to know to solve these problems (Duch, Groh & Allen, 2001). Students centered learning pedagogies increase engagement by encouraging student-faculty contact, collaboration behaviors and active learning (Smith, Sheppard, Johnson & Johonson, 2005). Students work in small learning teams, bringing together collective skills at acquiring, communicating and integrating information. PBL prepares students to become independent inquirers, and to work collaboratively in groups to engage the problem successfully (Saven-Baden, 2003). Collaboration is the work done by two or more students, who work together and share the work load equitably as they progress toward intended learning (Barkley, Cross & Major, 2005).

Traditional classroom designs derived to satisfy the traditional learning pedagogies still prevail in today's learning environments. In spite of recent developments in learning pedagogies, learners continue to use outdated spaces optimized for the two-thirds rule; two-thirds of the time the lecturer is talking and the students are passively listening (Sommer, 2007). There is a growing need to create new classroom designs with inspiring furniture configurations to free students of traditional barriers and enable them to embrace innovative thinking, problem solving skills and healthy collaborative behaviors (Bell, Greene, Fisher & Baum, 2001). As PBL shifts the focus of learning as a process from teachers to learners, the learning space should be reconfigured to reflect such a change. New PBL classrooms need to cater for group work and collaboration (Kolmos, Graaf & Du, 2009). A classroom design can have profound effects on students, learning outcomes and social or collaborative behaviors (Augustin, 2009). PBL optimized learning spaces need to be open environments to facilitate creating and transforming knowledge by means of group work and collaboration (Kiib, 2004).

■ RESEARCH PURPOSE AND METHODOLOGY:

This paper focuses on the university learning space; it aims to investigate the effects of applying nontraditional pedagogies on classroom spatial use, collaborative behaviors, and obstacles to learning posed by the currently available classroom layouts. Understanding how users would adapt their learning environment to cope with PBL, observing their actual collaborative behaviors, and grasping the process of problem solving would provide valuable feedback, which would lead to better designs of learning space so that it would create an ideal environment to promote the emergence of independent inquirers.

As a methodology, this study was based on qualitative methods. The classroom observations were held by video recording as a tool to capture the behaviors of students and

*三重大学大学院工学研究科 博士後期課程・工修
**三重大学大学院工学研究科 博士前期課程
***三重大学大学院工学研究科 教授・工博

*Doctoral Student, Graduate School of Engineering, Mie University, M. Eng.
** Master Student, Graduate School of Engineering, Mie University
*** Professor, Graduate School of Engineering, Mie University, Dr. Eng

faculty. The observation was conducted during the 90 minute class sessions on four separate days, over two terms. In addition, an observer attended the observed class sessions and used a digital camera to record important events, besides taking notes and recording own impressions. The fourth observation included more time devoted to group work, and the use of DV cams enabled covering 100% of tables, therefore it was chosen for further detailed analysis. The collected data was analyzed on two levels; first trying to grasp a general understanding of the events and issues seen to be important to apply PBL smoothly. Secondly, a more detailed analysis was conducted by tracking individuals within each group to understand each individual's activity profile and group dynamics. The frequency and duration of activities were measured per individual for the entire period of group work.

■ A CASE STUDY FROM MIE UNIVERSITY:

A course named "4-Skills startup seminar"; which is a class based on PBL and is dedicated to the undergraduate students (freshmen) was chosen as a case study. This course aims to introduce the students to university life by equipping them with necessary skills and providing them opportunities to learn how to learn. It includes a combination of activities to develop IT application skills, effective communication, group work and problem solving.

The selected course was held in a special classroom dedicated to courses applying PBL, yet its layout followed the traditional classroom configuration; a rectangular classroom, with rows of tables, movable chairs and five whiteboards, and the main projection screen at the center of the front wall. The observed classes consisted of two parts in terms of activity duration: a lecture that explained some general ideas about the posed problem and gave some instructions, and then group work where students tackled the problem under concern.

■ TRANSITION FROM LECTURE TO GROUP WORK AND GROUP COMBINATIONS:

The current configuration of class provides for traditional lecture based courses. This was clear at the transition moments from lecture to group work. Some students needed to move from their places, move tables and chairs to sit in more interaction-promoting configurations. The average transition time was 1.37 minutes. This transition can be seen as an interruption of the learning process, because students required some time to settle down and go back to learning activities. Students tried to position themselves in a configuration that helps them to maintain eye contact with group members (Fig.1).

Two-student groups -the third member of these groups was absent on the survey day- managed to achieve that by tilting chairs toward each others; students either sat beside each other

or faced each other over the table. The first configuration was seen to be more effective, because sitting beside each other facilitates sharing materials, conversation and collaboration. In addition, as PCs were introduced, students could still talk and work on a PC simultaneously. For
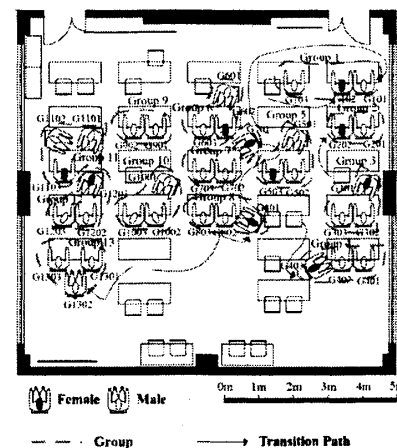
Fig. 1. Student Adaptation of the Classroom Environment for Group Work

the three-student groups, students tried to either tilt their chairs so that all three students could have continuous eye lines to enable them to have sustained conversations, or sat beside each others. While the first configuration was successful before introducing PCs, after which many students tried to sit beside each other to ensure better contribution to PC work. In the four-student groups, students managed by tilting their chairs to face other members, but using the PC effectively was difficult. Many students hesitated to move their chairs or to tilt tables unless they were encouraged to do so by either the faculty or the TA; which indicates the strong authoritive image students hold for a the faculty. There is a need to stress freedom of action and movement of students in order to encourage them to take control of their own learning.

■ MOVEMENT LINES:

The classroom was stacked with tables, leaving narrow spines for movement; those spines seemed to be congested and when the transition was made to group work, many students moved their seats or tilted some tables. The new configurations, in addition to the students' belongings and electrical plugs on the floor, blocked some spines, which limited the freedom of movement for both the students and the lecturer who frequently moved around the groups. Students moved to bring the PC and take it back to the closet; this kind of movement was prominent at the beginning of group work and the end of class. Many students moved almost at the same time, moving through the unblocked vertical spines and then through the longitudinal spine at the front of class and accumulated around the PC closet. It was also noticed that some students moved to talk with faculty and TA. In addition, several students moved to see what other groups are doing. The faculty moved constantly between all groups. All groups were in contact with the faculty at least once. The average interaction time between the faculty and members of a group was 2.33 minutes. The TA started by moving between
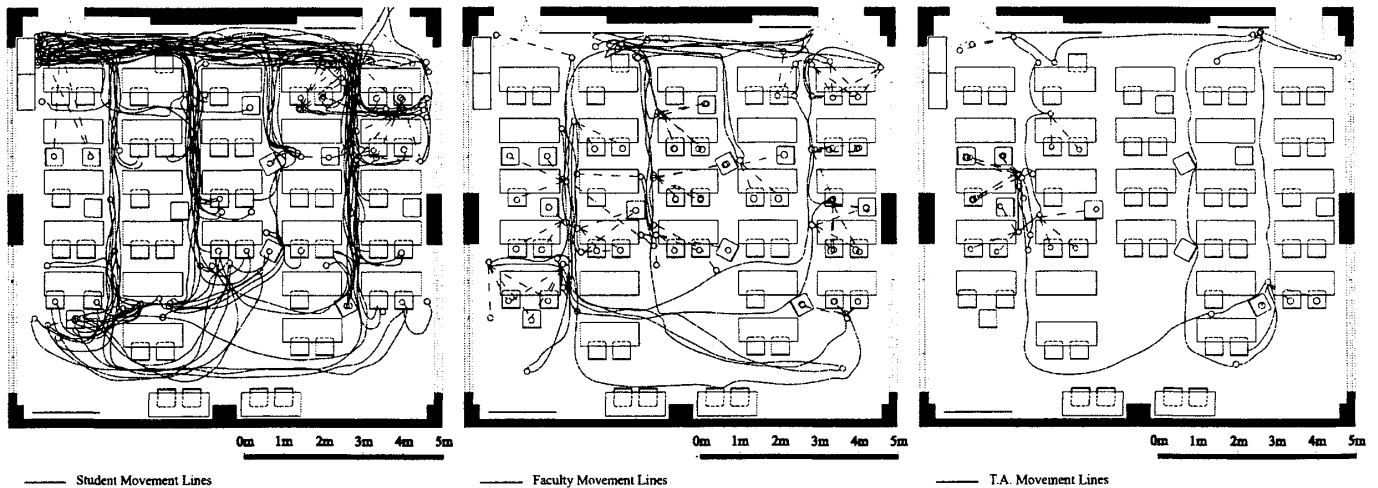
Fig. 2. Users Movement Lines

several groups but eventually ended up staying for a long time at Group 11. The average interaction time between the TA and members of a group was 2.54 minutes (Fig. 2). The users of space were seen in many occasions to cooperate by waiting for others to clear a movement spine before using it to move to their destination.

■ PC USAGE, ENGAGEMENT AND POSSESSIONS:

The task of bringing the laptop PC from the classroom closet and when to use it was left for each group, this made students feel and practice more control on their learning. Five groups brought the PC at the start of class, five other groups brought it at the start of group work, two groups brought it after a while of group discussions and only one group - Group 11 - did not use a PC at all. Also, it was noticed that Group 2 used two PCs and its work was based on computer assisted collaboration. The use of such PCs in unsuitable configurations led to ineffectiveness; only one student could clearly see the PC screen, which created an uncomfortable atmosphere for collaboration and lowered the level of group engagement. As a consequence, some isolation effects were observed in some groups, where one member would seem to be detached from the group, which hinders constructive collaboration. Some students changed their seating locations in the group when the PC was introduced, to be able to see the screen and participate more effectively in the group activities; which led many students to sit beside each other, a configuration that does not help in maintaining eye contact and negatively affects interaction.

Generally speaking the PBL class had a high level of student engagement. Most of the students arrived to the classroom at least 10 minutes before the start of class. The two modes of the class were noticeably different in terms of students' engagement. The lecture was observed to be less engaging to students; 47% of students were noticed to fall asleep at least once. The group work mode was more engaging to students; almost all group members participated enthusiastically in group work and

discussions. The higher levels of engagement in group work are due to the social facilitation effect which causes all group members to try to work harder and put more effort in the presence of other group members. Lower levels of engagement among few students were seen occasionally, when such students were sitting in an uncomfortable organization. Students with lower levels of engagement, showed social loafing behaviors; they depended on other group's members to do their work.

Students required more table surface work area to spread their belongings, because many students used papers, books and the provided PCs. In many cases, students were seen to make use of two tables; they would interact with group members and then tilt their bodies towards the other table to write down notes or read and then go back to interact with group members again, which seemed to make collaboration a cumbersome task.

■ STUDENTS ACTIVITIES AND COLLABORATION:

All collaborations consisted of a combination of activities including talking, PC use, observation, reading, writing and moving. The most important activity was talking among group; as such interaction would create a link between group members, facilitate sharing relevant tasks and guarantee smooth collaboration. Talking with the teacher was noticed to be marginal, except for the case of a female member of Group 11 (G1103).

Limited talking with teacher helps to enforce independent learning and the teacher would be seen more as a facilitator rather than the source of knowledge. The frequency of activities differed among individuals; within each group, PC use was conducted more frequently by one of the group members (G101, G302, G401), and this may be attributed to the layout that enabled one user to easily handle the PC while others participated every once in a while. The observation activity, which is a combination of thinking, watching and listening to instructions, seemed to occur within all group members (Fig. 3).
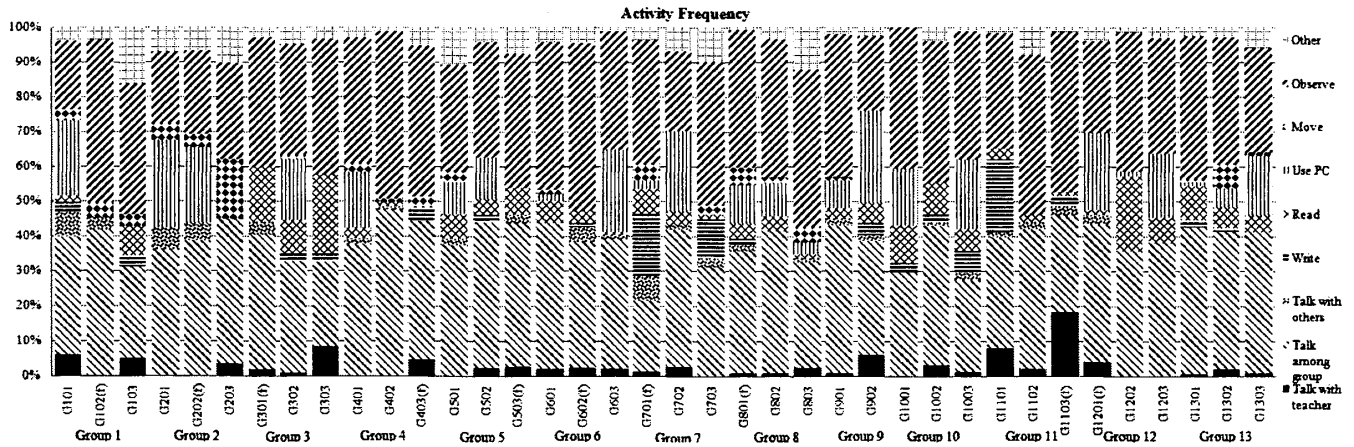
Fig. 3. Activity Frequency

■ ACTIVITY PROFILES OF STUDENTS:

Studying Students activity profiles, showed that a student with effective collaboration and high engagement would show a highly repetitive pattern of learning activities, less interruption, talking with group members would be dominant and mostly related to other activities either by following them or preceding them as in Group 3 (G303) (Fig. 4-A). While, a student of less effective collaboration and lower engagement would exhibit less repetitive patterns as in Group 10 (G1001) (Fig. 4-B).
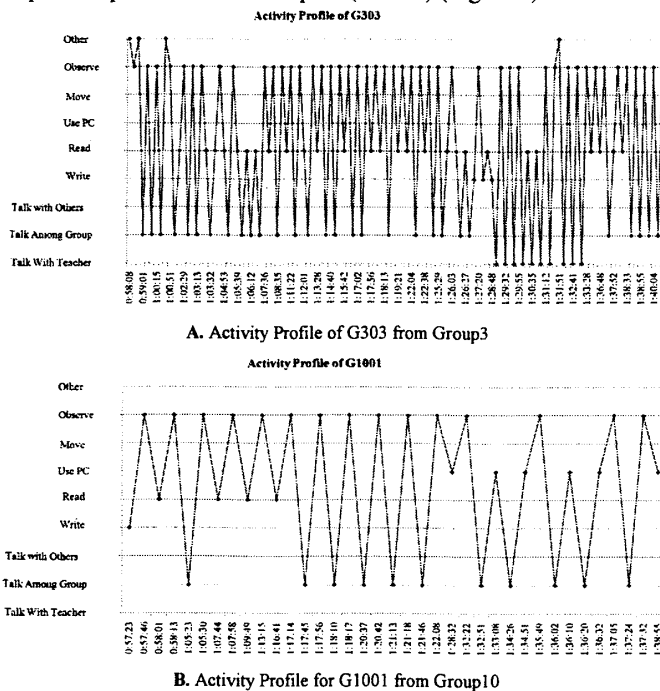

A. Activity Profile of G303 from Group3

B. Activity Profile for G1001 from Group10

Fig.4. Differences in Activity Profile between G303 and G1001

■ CONCLUSION:

A PBL classroom design should meet the needs of PBL, which places focus on students rather than on the lecturer. Traditional class room layouts based on rows of tables hinder the effective application of PBL courses. Classrooms need to stress flexibility to facilitate transition between different learning modes with minimum interruption to the learning process. Table configurations that are optimized for group work and collaboration are an indispensable part of a PBL classroom; such table configurations would guarantee continuous sight lines between students and provide sufficient table work areas to collaborate and use different necessary tools. In addition, the class should be equipped with tools and IT resources to facilitate sharing knowledge.

Effective collaboration can be achieved by promoting group work skills that stress the need for equal participation in learning activities, as well as providing appropriate configurations that induce communication. The group work dynamics and collaboration skills should be emphasized and monitored by the faculty or TAs. Finally, a PBL classroom needs to enable students to have more control of their learning environment, which would provide more comfort and consequently less distractions and more engagement in the learning process leading to innovation.

■ REFERENCES:

Augustin, S. (2009). Place Advantage: Applied Psychology for Interior Architecture. New Jersey, USA: John Wiley & Sons.

Barkley, E., Cross, K. & Major, C. (2005). Collaborative Learning Techniques: A Handbook for College Faculty. California, USA: Jossey-Bass.

Bell, P., Greene, T., Fisher, J., & Baum, A. (2001). Environmental Psychology, Fifth Edition. Florida, USA: Harcourt College Publishers.

Boud, D. & Feletti, G. (1997). The Challenge of Problem Based Learning. New York, USA: Routledge.

Duch, B., Groh, S. & Allen, D. (Eds.). (2001). The Power of Problem Based Learning: A Practical How to For Teaching Undergraduate Courses in Any Discipline. Virginia, USA: Stylus Publishing.

Kiib, H. (2004). PpBL in Architecture and Design. In Kolmos, A., Fink, F. & Krogh, L. (Eds.) (2004). The Aalborg PBL Model: Progress, Diversity and Challenges. Aalborg, Denmark: Aalborg University Press.

Kolmos, A., Graaf, E. & Du, X. (2009). Diversity of PBL: PBL Learning Principles and Models. In Du, X., Graaf, E. & Kolmos, A. (Eds.) (2009). Research on PBL Practice in Engineering Education. Rotterdam, Netherlands: Sense Publishers.

Savin-Baden, M. (2003). Facilitating Problem Based Learning: Illuminating Perspectives. New York, USA: Open University Press.

Smith, K., Sheppard, S., Johnson, D. & Johnson, R. (2005). Pedagogies of Engagement: Classroom-Based Practices. Journal of Engineering Education, vol.94, No.1, January 2005, PP.87-101, http://www.jee.org/2005/January/244.pdf [2011-09-16]

Sommer, R. (2007). The Personal Space, Updated: The behavioral Basis of Design. Bristol, UK: Bosko Books.