

A Collaborative E-learning Environment in a Tablet Computer Classroom

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Abstract

The paper presents an E-learning environment based on a tablet computer classroom, equipped with 53 tablets, established in Minghsin University of Science and Technology. During lecture hours, each student owns a tablet computer and conforms to classroom rules that execute the Five Must learning disciplines. In our experiment, 27 students in a discrete mathematics course went through half semester in an ordinary classroom and another half in the tablet classroom. Questionnaires are conducted before and after the students use tablets to measure the effectiveness of our design. Results strongly recommend our environment and processes for college learning.

Keywords: collaborative learning, e-learning.

1. Introduction

Computers with Internet access has become an important platform for contemporary college learning activities. Recent developments of accessible computing devices made knowledge acquisition and management more efficient and more competitive. The development trends are stronger computation, lower prices, mobility, and functionalities.

In this paper, we explore the possibility of better learning effectiveness in college classrooms with manual writing functionality of tablets computers. We designed a tablet PC classroom in Minghsin University of Science and Technology, MUST, in Taiwan. The classroom contains 53 HP tc4400 tablets computers and uses campus Ethernet to access Internet. The class in our experiment is a senior grade discrete mathematics course in a two-year college of Information Management Department. We use electronic data to present course contents and set up

standard procedures to strengthen students' mind-focusing and learning habits.

We will survey some important collaborative learning pioneering researches in this section. In the following section, a few common learning issues in today's college classrooms are raised. Section three will elaborate our design to enforce Chinese learning disciplines, the Five Musts, in the classroom processes. The goal is to make students learn collaboratively and effectively. The fourth section is a measuring of our first semester's efforts. The final section presents a discussion and some future work goals.

In 2001, Lou, Abrami, and d'Apollonia showed that small groups surpass individuals in learning with technologies [5]. In 2004, Scott Adams studied the cooperative e-learning key aspects such as gender, training, ability, group size, and ethnicity [7] and identified training and cooperative learning regarding computers in schools. In addition to memorizing and recognition, Slavin showed a learning process goes through knowledge, comprehension, application, analysis, synthesis, evaluation stages [8]. Slavin also showed several collaborative learning practices, Student Teams-Achievement Divisions, Teams-Games-Tournament, Team Assisted Individualization, and Jigsaw [9]. Each suggests specific processes for collaborative learning.

Johnson & Johnson defined cooperation to be a form of collaboration [3, 4]. Cooperation is working together to accomplish shared goals. Whereas collaboration happens in both small and large groups, cooperation refers primarily to small groups of students working together. A learning group can be formal, informal, fixed, or argumentative, and creates various learning effects.

Interaction is a major benefit realized by computers and Internets. The impact to effective learning is a real asset in the action, reaction, and feedback processes. By obtaining reactions and feedbacks, students tend to involve into learning team. In 1989, Scardamalia,

Bereiter, Mclean, Swallow and Woodruff proposed CSIL (Computer Supported Intentional Learning Environments) concept. Students gain higher-order executive control in building their recognition of theories through their contribution is preparing their class assignments [6]. While some IT specialists pursue better system for e-learning [1], our interests are the collaborative processes and how to motivate students.

Webb and Adams observed that the industry developments also contributed positive effects in computer-aided-learning [11, 7]. Johnson & Johnson identified that group learning causes healthy interdependency, equalized participation, consensus reaching, offering and gaining assists, increased interactions, task coordination, and confliction and argumentations.

2. Common Learning Issues

The commonly deployed computer classrooms that allow groups of students concurrently take a course exist in every college. But, many have not seen the ideal collaborative learning effects.

Mostly, our students only watch and listen to the class, and may be absent minded. We investigated the common practices in Taiwan's colleges and observed following issues.

(1) Few interactions besides watching and listening inside classrooms,

Many students look at the blackboard but do not see course contents, listening but not understanding. Having classroom interactive activities, such as raising hands, on-line quizzes or voting may draw students' attentions. But, these processes may be mutual interfering and cannot be extensively repeated. Students are often absent-minded even if they sit in front of podium.

Taking course notes is a good practice for learning. We noticed students rarely take enough notes. Many students seek for Xerox copies or use Internet searches to find related notes and materials. Some students just live without course notes. Lacking for enough study time and without comprehensive notes, many students have low achievements for mathematics courses.

(2) Few activities after class hours,

Learning is a continuing process. But, often, when students walk out the classroom, their learning processes pause until next class hour. The learning becomes a segmented process that only activated inside classroom. In between class hours, the efforts for many are merely web searches, copies, and pastes to compile assignments.

(3) Lack of learning companionship,

Many students rarely interact with any other classmates. Even within a group project, some members are still very inactive. The silent roles in a group often contribute less and cannot experience the thorough group learning process. Relatively active partners in a group will often take over other members' duties and produce unbalanced team cooperation.

(4) Copying or downloading homework results.

The Internet's got rich collections of data. The Internet search engines often find many related, but not accurate documents. The documents are not originated nor digested by the students. Some portal web sits even provide a "knowledge exchange" platform which allows visitors to ask for solutions of specific questions. Some paid services help compiling assignments or even project papers or dissertations have distorted knowledge sharing into selling. If homework or project reports can be easily obtained by downloading an electronic document, learning can be ineffective.

3. Mind Focusing E-learning Design

Two common faults of the above mentioned issues are that students fail to focus their minds to the course, and electronic data copies may not be originated from the specific student. We discovered the digital inking of tablet computers have the potential to eliminate these faults.

The traditional Chinese learning disciplines, Five Musts, are the presence of one's Eyes, Ears, Hands, Mouth and Mind. Our students not only will watch and listen to a course, but also will continuously use hand-writing, and speak to discuss in the course, ubiquitously. We anticipate this make students concentrate their minds and achieve greater successes.

With the tablet computer and Internet technologies, we redesign the discrete mathematics course to enforce the Five Musts at the departments of Information Management. Our courses demand students use hand-writing (drawing) and speaking (discussion) ubiquitously, in addition to possibly absent minded watching and listening in the classrooms. Participating students should experience the effective learning technology and rebuild their learning behaviors.

To attack issue 1, we make students submit their hand-written notes to our Internet file server for every class. Their notes are version controlled. Thus, students can hardly afford to miss one class or lose their focus for a few minutes. Interaction inside classroom increases.

For issue 2, we allocate lab hours to have students discuss and enjoy the tablet computers for homework. The notes compiling is a continuous process. Students

need to check out the notes and do homework before next class in their own unique handwriting.

The group activities, lab hours, and group meetings, telephone talks, and VoIP connection will bring classmates together to resolve issue 3. We also designed a “companion recorder” that uses Internet to log distant group meetings, telephone talks, and VoIP connection time. The “companion recorder” reasonably assumes each member in a group can access Internet. During meetings, the web system randomly generates group synchronization instructions to ask one group member use vocal command to instruct others conform to instructions and log discussion records. Members earn group credits by stay vocally connected and increased learning companionship.

The desirable feature of tablet computers that records instant, unique, continuously accumulated personalized hand-writing and drawing notes and homework will prevent issue 4. Pirating assignments no longer works in our classroom.

Figure 1 shows a traditional PC classroom that mostly relies on lecturers to send out data toward students during class hours. Although a lecturer may freeze students’ screens or dynamically suspend network access to keep students mind-focusing, it will lose the benefit of Internet and constrain freedom of using computers. Individual student cannot follow the class movement quite often.

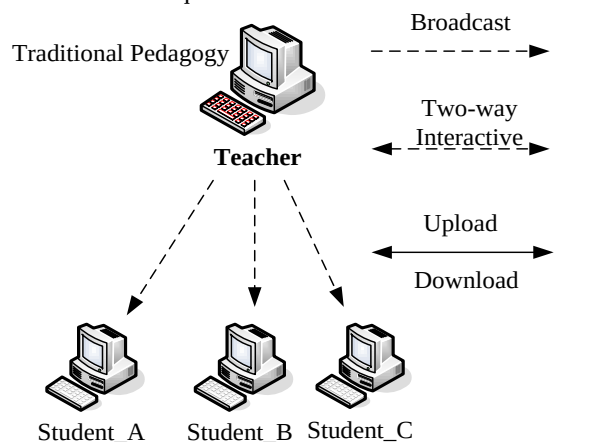


Figure 1. The traditional computer classroom pedagogy.

Figure 2 is the new approach in our classroom that involves a file/web server, named giveMe5 to signify Five Musts collaborative e-learning. Every student owns a tablet PC and need to digitally-ink onto electronic class document. The documents need to be uploaded to server and version-controlled right after class. Since the hand-writing cannot be duplicated for others, every student needs to follow the rhythm of class. The document also contains homework sessions

that the students need to fill out after class hours then submit and get version-controlled. These version-controlled documents can be checked by the teachers to monitor students’ learning progresses. Students have to manually take notes and write homework. The class processes thus become a learning habit for active class participants.

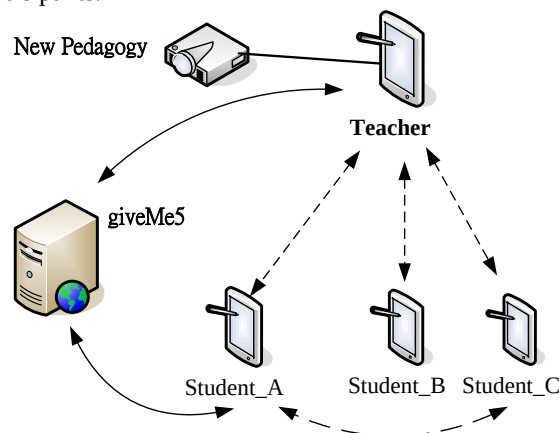


Figure 2. The table PC classroom pedagogy.

The “companion recorder” is a web function that records group credits when group member continuously have oral conversation. Figure 3 shows collaborative learners access giveMe5 server through the Internet. Learners communicate with computers or vocally through VoIP or PSTN phones.

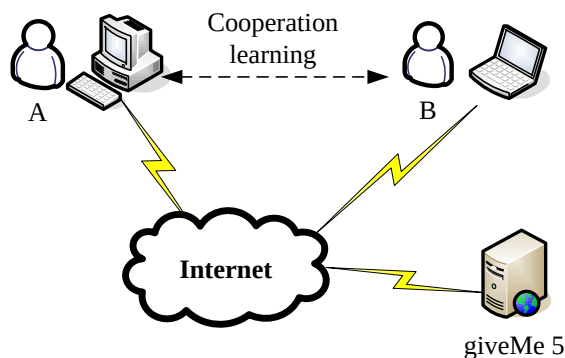


Figure 3. The companion recorder.

Every one to three minutes, randomly generated instructions on giveMe5 server show on a single site for learners. The learner needs to orally notify other partners to follow instructions and earn credits for the group, similar to playing Internet games. This guarantees oral communication continues. Total group credits earned for the group is the indication of

collaboration. While earning credits, learners communicate and execute collaborative learning.

4. Project Observations

27 students in a discrete mathematics course went through half semester in an ordinary classroom and another half in the tablet classroom. Questionnaires before and after students using tablets classroom are conducted [10]. We got 17 valid responses for the before tablet classroom questionnaire of 20 items that need to be agreed or disagreed. Some of the agreed items are:

- (1) Taking course notes helps learning,
- (2) Satisfied for the current pedagogy,
- (3) Feel positive about group interaction and cooperative learning.

The important disagreed items are:

- (4) Not comfortable with the course contents due to the high complexities,
- (5) 29.4% disagreed that tablet computers may benefit taking notes in class.

In summary, the 17 students anticipated a digital learning environment to improve learning effectiveness and were willing to contribute in a cooperative learning group.

After six weeks using the tablet classroom, the students responded the second questionnaire of 32 items rated on a seven-point Likert scale ranging from “strongly disagree” (point 1) to “strongly agree” (point 7). Among the 32 items Q1 to Q32, Q31 is a validation check that screens out invalid responses. Only 16 are valid after the strict validation check. The reliability analysis concluded the Cronbach’s *alpha* value for the effective 31 items is 0.770. This indicates our analysis is quite reliable.

Item	Q1	Q2	Q3	Q4	Q5	Q6	Q7
Rating	2.19	5.75	4.88	4.75	4.56	5	2.06
Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15
5.06	5.19	4.81	4.94	5.31	5	3.25	3.19
Q16	Q17	Q18	Q19	Q20	Q21	Q22	Q23
5.13	3.88	5.06	5	5.19	4.31	5.38	5.38
Q24	Q25	Q26	Q27	Q28	Q29	Q30	Q32
5.19	5.56	5.19	5.31	5.25	4.88	1.81	6.31

Table 1. “After using tablet” questionnaire results.

The items are grouped by 4 categories: Self skill assessment Q1~Q10, Course content assessment Q11~Q18, Group learning motivation Q19~Q26, and Technology utilization attitudes Q27~Q30, Q32. Table 1 lists the average ratings of the 31 items. Please refer

to [10] for the questionnaire definition of Q1 through Q32 in Chinese. We interpret the result and conclude the following.

- (1) Students’ computer skills are good. They would not be reluctant to use computers and Internet. (Q1 and Q30 are correlated.)
- (2) Those who can operate computers effortlessly tend to agree networked computer classroom has positive impact on learning. (Q2, Q3, Q4, Q6, Q8 correlated.)
- (3) Most students do not need assistance when they use the computer classroom and operate tablet computers. (Q5)
- (4) Students accepting computers agree that learning materials are easy to acquire and it is advantageous to use networked computers inside classrooms. (Q7, Q9, Q10)
- (5) Students are satisfied with course contents. (Q11~Q18)
- (6) Students feel comfortable with the collaborative learning scenario. They agree that group learning is superior to individualized study in building their communication and presentation capabilities. (Q19, Q20, Q25)
- (7) Collaborative learning would not occupy more time from the students than traditional learning do. (Q21)
- (8) Collaborative learning would help students to get higher grades in learning. (Q22, Q23, Q24, Q26)
- (9) Computers and Internet would efficiently help students’ learning and assist their careers in the future. (Q27, Q28, Q30, Q32)

Randomly selected students were interviewed at the end of semester. Noteworthy comments and facts are:

- (1) If affordable, most tend to purchase a tablet PC,
- (2) The most favored distant communication tool over phone-call is the Instant Messenger for its multi-session capability. We presume multi-session communication defocuses students attention and disfavor this fact for learning purposes.
- (3) The digitizer pen is unfavorable for grasp disabled persons while a mouse works fairly.
- (4) Tablets are more useful than they expected especially when with innovative software like Microsoft Office oneNote, or Windows Journal.
- (5) High intention to take future courses that use this classroom.

5. Discussion and Future Work

We observed some drawbacks of this classroom. First, the cost is 150% to notebook PC and twice to desktop PCs. Classroom user training takes one week. Due to user habits, some students prefer mouse than digitizer pen at the first three weeks. The expected hardware failure rate may be higher than notebook PCs due to delicate mechanism of tablets.

The learning companionship is not a pure information technology issue. It is mostly a mentality issue. Individual personality may be reluctant or shy to have close companion with others. Although some students enjoy “companion recorder” as a group gamming, we still need to improve the look and feel of “companion recorder” to attract collaborative groups to earn credits and learn.

Yet, the classroom looks clean and neat due to the packaging of the tablets. Only minimum space even without a mouse pad is required. We are encouraged by the positive feedback from participating students. In the following semester, we expand our experiment to have eight seeding teachers using tablet PCs in their classes across Engineering School and Management School. One Multimedia Practice course professor will conduct one class in a desktop PC classroom and another in the tablet classroom for comparison. The following five goals will be assessed for our future success.

Goal 1: Increased interaction in the classroom. This can be verified by students’ appraisal questionnaires. Students adhere to the activities in classroom because they need to concentrate on the lecture and hand-write notes that need to submit to server for every continual class.

Goal 2: Adherence to the course activities. This is achieved by allocating lab hours for students to use our equipments for studying, discussing, doing homework or preparing presentations. A bookkeeping of the lab attendance rate will assess this goal.

Goal 3: Increased learning companionship. Group activities are planned. Wifi campus and VoIP/PSTN phones will facilitate discussion and team buildup. The group project “companion recorder” results are the indications of this goal.

Goal 4: Consistent homework and class attendance performance.

We require hand-written/hand-drawn class notes and homework. Students need to submit consistent manuscripts for every lecture and exercise on to our e-learning server. We will use the e-learning system to gather submission, attendance, and achievement data to measure the successfulness of this goal.

Goal 5: Confident students are willing to use innovative system in learning.

We will monitor students’ behavior change and observe how they use the IT to aid their course. This can be measured by students’ appraisal and questionnaires.

The key to these goals are a convenient learning environment, course design, motivated students, and enthusiastic teachers. We strongly recommend this teaching environment that elaborates collaborative learning with Five Must disciplines.

Acknowledgements

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