

ICT and Cooperative Learning: Reinventing the Classroom

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This paper presents a case study on the impact of the use of Information and Communication Technology (ICT) as a tool, and cooperative learning (CL) as a pedagogical approach to the delivery of curricular content. The two-month study was implemented during the second grading period in the two sophomore classes at UP High School in Cebu. These classes served as the control group and experimental group, respectively. Both classes used ICT resources in most of the learning activities of the course. The main difference was in the pedagogical approaches employed to facilitate learning. The control group used individual and group-based learning activities while the experimental group used the Teams-Games-Tournaments (TGT) cooperative learning method (CLM). For purposes of this study, the control group was labeled as NCLM group and the experimental group as the CLM group. The main objective of this study was to show that the use of ICT in the classroom should be coupled with sound pedagogical approaches in order to maximize the positive effects of technology integration in the learning process. A pre-test and a post-test were given to the students to determine their academic performance before and after the study.

Introduction: The Use of Educational Technologies

The new communications and information technologies are contributing to significant changes in how communities function and interrelate at the local, national and global levels. In such an environment, where the nature of work, as well as that of knowledge and communities, is being

radically altered, it has become necessary to rethink the fundamental axioms that determine expectations and behaviours of daily life (Downes et al., 2001).

The rapid influx of ICT has tremendously changed the way people, especially the children, interact and learn. The pervasiveness and vitality of educational technologies have provided ways of making the delivery of educational services more interesting; and absorption of new ideas more engaging for the students. The integration of technology in the school has created opportunities for a better teaching and learning environment. The marriage of content and technology not only provides the teacher with a more effective way to transfer knowledge and information to students, but also enables students to learn in a more productive way (Neo, 2004). The increased level of interactivity and exposure to more modalities of learning demands a need to take a closer look at the nature of the classroom — whether as a “place” or “activity”.

To address the need to modernize the classroom coupled with the belief that acquisition of new technologies improves learning, people are in a rush to outfit the classroom with computers and provide Internet connectivity; thinking that increased student–computer ratio and the availability of a gateway to the so–called Information Superhighway can make the classroom a better teaching–learning place. This is a common misconception among the public elementary and secondary schools of the country.

Given the inherent usefulness of technology, the implementation strategy for using it will affect the realized effect on both the level and distribution of student achievement. Poor implementation will attenuate outcome gains for all students (Noll et al., 2000). What is therefore important is not the technology itself but instead, the learning processes that take place

within the classroom. According to Thornburg (1999), “Learning does not take place better or faster simply by replacing one instructional medium with another. The effective use of technology in education requires thought, experimentation, and a willingness to spend time needed to develop and refine strategies until they are proven to be effective.” Thus, a successful integration of technology in education requires a rethinking of the ways in which learning is being facilitated together with the readiness and patience to explore new ways of teaching. The education process must be based on a model that is appropriate for an information-driven society.

One such pedagogical approach is the use of cooperative learning methods (CLM). Though not a new development in education, only a few teachers are using CLM. A lot of researches in universities abroad have shown that the use of these methods actually increases the achievement levels of students.

Traditional Teaching Vs. Cooperative Learning

Traditional teaching is a method of learning that views the classroom environment as one where the role of the teacher is to simply give information to students (Chafe, 1998). In this typical classroom setup, the goals are predominantly individualistic. Students work individually and compete against one another. They are usually concerned with the improvement of their own grade. Even the physical structure of the classroom clearly reflects this mode of learning. You see rows and columns of chairs and the teacher’s table situated in front.

This is in contrast with a cooperative learning classroom. The physical make-up of the table and chairs suggests a different process of learning. In a cooperative learning classroom, the chairs are usually arranged in groups of three or four. According to Johnson, Johnson and Holubc, (1994): "Cooperative learning (CL) is the instructional use of small groups through which students work together to maximize their own and each others learning." In this type of classroom, the students interact with their groups and perform task-oriented activities designed by the teacher. Whereas traditional learning is teacher-centered, a cooperative classroom is student-centered. The effectiveness of CL lies in the core concepts being promoted: positive interdependence, individual accountability, equal opportunities for success and improvement of social skills (Slavin, 1995). In CL, the role of the teacher is that of a facilitator and ensures that CL activities are carried out by each of the CL groups.

CL is a package of learning methods designed to enhance student learning. Some of the modern methods of cooperative learning are (Slavin, 1995): Learning Together & Alone, Teams-Games-Tournaments, Group Investigation, Constructive Controversy, Jigsaw, Student Teams Achievement Divisions and Complex Instruction.

Cooperative Learning with Teams-Games-Tournaments (TGT)

In this study, the experimental group (CLM) used the Teams-Games-Tournaments cooperative learning method. Teams-Games-Tournaments (TGT), originally developed by David DeVries and Keith Edwards, was the first and oldest of the Johns Hopkins cooperative learning methods. In TGT, students are assigned to three or four-member teams that are mixed in performance and gender. The teacher presents the lesson and then students work with their teams to ensure that all

the members have mastered the lesson. The students then play academic games and tournaments either weekly or at the end of the unit. Here, the students play games at three to four-person tournament tables with members from the other teams who have comparable past performances and have contributed tournament points to their team total. A bumping mechanism keeps the game fair (Slavin, 1995). This means that high achievers play against high achievers from other teams and low achievers play against low achievers from other teams. The top scorers from each tournament table brings the maximum number of points to his/her team regardless of which table it is; thus, providing equal opportunities for success for high and low performing individuals. At the end of the game, high performing groups earn rewards.

TGT promotes the core concepts of cooperative learning and provides a dimension of fun and excitement into it through the utilization of academic games and tournaments. Team members help each other prepare for the games by studying notes, exercises and discussing problems to one another in one or two sessions during the class period or outside the class schedule. When team members go to their respective tournament tables they can no longer help each other; thus, ensuring individual accountability. After the games, a unit test is usually administered to measure the individual performances of the students. At this point, the students should have reviewed the lessons while in the process of preparing for the games.

Classroom organization

The study groups were composed of two second year classes at UP High School in Cebu. The first group – the NCLM group, with 34 students (N1=34), used the traditional learning methods and ICT. The second group – the CLM group, with 33 students (N2 = 33), used the TGT

cooperative learning method and ICT. Within each group, ten subgroups were used to facilitate group-based classroom activities. Each subgroup (SG) usually had three to four members. The criteria for group creation were based on the academic performance of the students. A three or four-member SG represented a cross-section of the class in terms of their academic abilities. This means that average academic performances of the SG's were comparable at the time the SG's were created. Though each class was provided with group-based learning activities, the major difference was in the manner within which these activities were implemented. The designs for each learning environments are as follows:

Table 2. Comparison of NCLM and TGT Designs

Non-Cooperative Learning Method (NCLM)	Teams-Games-Tournaments (TGT)
Segment I – Teacher presents lesson II – Students/Groups perform individual/group activities III – Evaluation: Students take individual assessment activities	Segment I – Teacher presents lesson II – Groups perform cooperative learning activities – Groups prepare for the games or Tournaments III – Students play academic games and tournaments IV – High-Performance groups are Rewarded V – Evaluation: Students take Individual assessment activities

In NCLM, the primary function of each group was to make sure that group-based activities were accomplished at the end of the allotted period. Students collaborated to complete a particular task. In this situation, group interactivity was only up to the level of collaboration. On the other hand, the function of each group in a TGT learning environment transcended beyond collaboration and took it a step further up to the level of cooperation. Thus, the primary aim of the group structure in the CLM group was not only to foster collaboration in the performance of group-based learning activities but also to ensure that every member of the group understood the

curriculum material and prepared the members for the series of games and tournaments. In this sense, the group was both a teaching and a learning unit.

Hardware and Software Requirements

In this study, students utilized the Leader.NET (Learning Enhancement and Development Extension Room) of UP High for computer related activities and explorations. On the hardware side, the center was equipped with 10 workstations, 1 server, 1 printer, 1 telephone and 1 modem. The place was also equipped with a broadband Internet connection. Each group was assigned to one-computer during ICT-enabled activities.

On the software side, the study maximized the availability of Microsoft operating systems and Microsoft Office applications. Aside from proprietary software, the students also used open source and free programs for the geometry activities.

ICT integration activities in the Geometry class consisted of the following:

1. Setting up of the UP High School Virtual Learning Environment

At the start of the second grading period, a virtual learning environment was set up at UP Cebu College for the online component of the course. This online environment was aptly called UP High School in Cebu Virtual Learning Environment (UPHS-VLE). UPHS-VLE served as the web portal for the delivery of some curriculum materials in the Geometry class. This digital infrastructure provided students with the capability to access course-related materials anytime and anywhere. The virtual classroom operated 24 hours a day and 7 days a week. Among the services offered by UPHS-VLE are: (1) Forums, (2) Journals, (3) Quizzes, (4) Resources, (5) Choices, (6) Surveys, (7) Assignments, (8) Chats, and (9) Workshops. To be able to participate

in the online activities, students were required to create their own user accounts and enroll in the UPHS–VLE. Figure 1 shows a screenshot of the UPHS–VLE.

The entire UPHS–VLE system was installed using open source and free programs. These are: (1)Modular Object Oriented Dynamic Learning Environment (MOODLE) – a software package for producing web–based courses, (2) Apache Web Server, (3) PHP and (4) MYSQL.

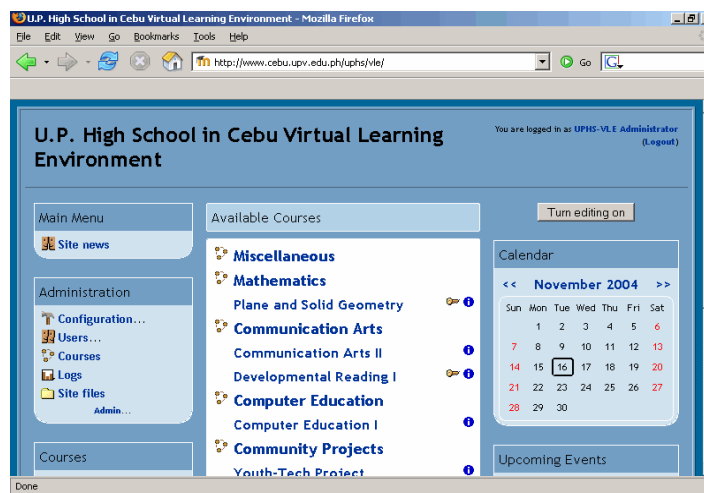


Figure 1. UP High School in Cebu Virtual Learning Environment (UPHS – VLE)

2. Webquest

Another ICT–enabled activity given to the students was Webquest. “A WebQuest,” according to Bernie Dodge, the originator of the WebQuest concept, “is an inquiry–oriented activity in which most or all of the information used by learners is drawn from the Web. WebQuests are designed to use learners' time well, to focus on *using* information rather than on looking for it, and to support learners' thinking at the levels of analysis, synthesis, and evaluation.” (Starr, 2002)

Students from the two sections were tasked to complete a Webquest on tessellations in two weeks. Upon completion of the activity, an individual quiz was given to the NCLM class to

assess their knowledge on tessellations. On the other hand, students in the TGT class played a game on tessellations before they took the individual quiz.

3. Use of MS Powerpoint Presentation in Games and Tournaments

In the traditional implementation of TGT, the teacher uses cards the size of a business/calling card. For 10 tournament tables and 20 questions, a teacher prepares 10 sets of 20 question cards and 10 sets of 20 answer cards. He/She also prepares 10 sets of 20 numbered cards. For a single game, a teacher must prepare 400 cards for the questions and answers. This translates to a significant amount of time and material resources spent for preparations.

In this study, implementation of TGT was modified through the use of computers and a presentation program called Microsoft Powerpoint. Instead of creating 400 cards for a 10-table and 20-item game, a presentation was created using the advance features of the software. After the file was created, the presentation was copied in each of the 10 computers. Figure 2 shows a screenshot of a game that uses Microsoft Powerpoint. Figure 3 shows the students competing in a game.

4. Other ICT Integration Initiatives

Aside from the three activities cited above,

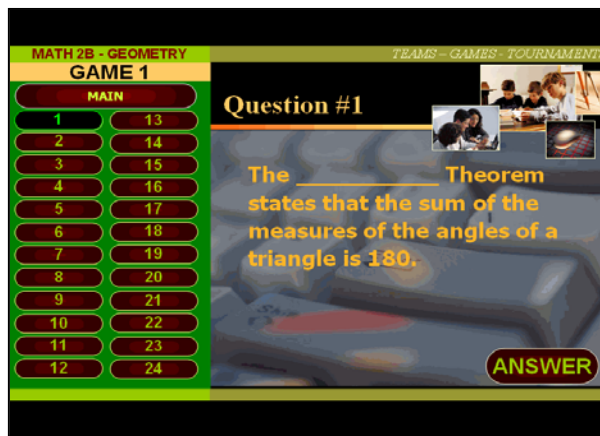


Figure 2: Screenshot of a TGT Presentation



Figure 3: Students competing in a game.

students were also introduced to mathematics online puzzles. They searched the net for concepts in geometry, joined the Yahoo group in Geometry and used the email services provided by Yahoo.

Results and Discussion

A pre-test and a post-test were administered before and after the study to determine the impact of cooperative learning on student achievement. The assessment instrument consisted of 35 standardized multiple choice items in Geometry. Specifically, the purpose of both tests was to answer the following questions:

1. Is there a significant difference in the pre-test mean scores obtained by students in the NCLM and CLM classes?
2. Is there a significant difference in the post-test mean scores obtained by students in the NCLM and CLM classes?
3. Is there a significant improvement in the pre-test and post-test scores obtained by students in the NCLM and CLM classes?
4. Is there a significant difference in the mean gains of students in the NCLM and CLM classes?
5. Is there a significant difference in the mean score of the NCLM and CLM classes in the pre-test and post-test against the accepted passing score?

Table 2: Comparison of Mean Scores Obtained by NCLM and CLM Classes in the Pre-Test

Groups	N	Mean	Difference Between Means	Computed t-value	Critical t-value at p=0.05
NCLM	34	16.94	1.15	1.10	1.96
CLM	33	18.09			

The table above shows that the mean score of students in the CLM class is higher than the mean score of students in the NCLM class. The difference between the two means is 1.15. At the 5% level of significance, the computed t-value is 1.10 which is less than the critical t-value of 1.96.

This shows that there is no significant difference in the performance of the two groups during the pre-test. This means that the levels of the students at the start of the study are comparable.

Table 3: Comparison of Mean Scores Obtained by NCLM and CLM in the Post-Test

Groups	N	Mean	Difference Between Means	Computed t-value	Critical t-value at p=0.05
NCLM	34	25.56	2.99	2.90***	1.96
CLM	33	28.55			

*** - significant

After two months of administering NCLM and CLM to the two classes, a post-test was conducted to determine the improvement levels of the students. Based on the table above, the mean score of the students in the NCLM and CLM classes are 25.56 and 28.55, respectively. The computed t-value is 2.90. This is greater than the critical t-value of 1.96 at the 5% significance level. This means that there is a significant difference in the achievement scores between NCLM and CLM groups. Students in the CLM group performed better compared to the students in the NCLM group during the post examination.

Table 4: Mean Gains in the Pre-Test and Post-Test Obtained by NCLM and CLM

Groups	N	Pre-Test Means	Post-Test Means	Mean Gain	Std. Deviation	Computed t-value	Critical t-value
NCLM	34	16.94	25.56	8.62	4.71	10.67***	1.96
CLM	33	18.09	28.55	10.45	4.96	12.10***	1.96

The table reveals the following information obtained by the students in the pre-test and post-test. NCLM obtained a pre-test mean score of 16.94, post-test mean score of 25.56, and mean gain of 8.62. CLM obtained a pre-test mean score of 18.09, post-test mean score of 28.55, and mean gain of 10.45. When the t-tests were computed, the values obtained were 10.67 for NCLM and 12.10 for CLM. At the 5% level of significance, the computed values were greater than the critical t-value of 1.96. This means that there is a significant improvement in the performance of students after going through the NCLM and CLM.

Table 5: Comparison of Mean Gains Obtained by NCLM and CLM

Groups	N	Mean Gains	Difference Between Means	Computed t-value	Critical t-value at p=0.05
NCLM	34	8.62	1.84	1.55	1.96
CLM	33	10.45			

Table 5 shows a comparison of the mean gains between the NCLM and CLM groups. The mean gain of CLM (10.45) is higher than the mean gain of NCLM (8.62). At the 5% level of significance, the computed t-value is 1.55. This is less than the critical t-value of 1.96. This implies that there is no significant difference in the mean gains of the NCLM and CLM groups.

Table 6: Comparison of NCLM Pre-Test and Post-Test Mean Scores Against the Passing Score

Groups	N	Pre-Test Means	Passing Score	Mean Difference	Computed t-value	Critical t-value at p=0.05
Pre-Test	34	16.94	18	1.06	1.35	1.96
Post-Test	34	25.56	18	7.56	9.46***	1.96

The table above shows the performance of the NCLM group in the 35-item pre-test and post-test against the passing score of 18. At the start of the second grading period, the mean score of the class (16.94) was slightly lower than the passing score. When a post-test was administered at the end of the grading period, the mean score (25.56) was greater than the passing score. At 5% level of significance, the computed t-values for the pre-test and post-test are 1.35 and 9.46, respectively. The pre-test t-value is less than the critical t-value of 1.96. This means that there is no significant difference between the actual pre-test mean score and the passing score. On the other hand, the post-test t-value is greater than the critical t-value of 1.96. This means that there is a significant difference between the actual post-test mean score and the passing score.

Table 7: Comparison of CLM Pre-Test and Post-Test Mean Scores Against the Passing Score

Groups	N	Pre-Test Means	Passing Score	Mean Difference	Computed t-value	Critical t-value at p=0.05
Pre-Test	33	18.09	18	0.09	0.13	1.96
Post-Test	33	28.55	18	10.55	16.26***	1.96

As shown in the table above, the difference between the pre-test mean score of the CLM group and the passing score is 0.09. The difference between the post-test mean score and the passing score is 10.55. Since the computed t-value at 5% significance level for the pre-test is less than the critical t-value of 1.96, there is no significant difference between the pre-test mean score and the passing score. For the post-test, the computed t-value is greater than 1.96. This means that there is a significant difference between the post-test mean score and the passing score.

The results in the survey reveal that students in a class using both ICT and cooperative learning performed better than students who were not using cooperative learning at all. This implies that the positive effects of ICT integration in the classroom can be maximized if implemented in conjunction with a proven pedagogical approach such as cooperative learning.

Conclusion

The study showed a significant improvement in the performance of the students upon completion of the learning activities. In both of these cooperative and non-cooperative groups, ICT was integrated into the activities of the students. Group-based learning activities were designed to address the prevailing scarcity of computing resources, and create an environment that fosters collaboration among the students. ICT-enhanced learning challenges the teachers to develop innovative teaching strategies that can improve student learning.

The positive impact of technology integration in learning of mathematics is clearly highlighted by a project entitled “The Apple Classrooms of Tomorrow (ACOT)”. Highlights of the Apple K–12 Effectiveness Reports on high school mathematics shows that (Marshall, 2002):

- Students who use computers in mathematics have more positive attitudes about their mathematics abilities and about mathematics in general, and show significant gains in problem–solving ability and content knowledge.
- Students who work in small groups on geometry problems using geometry software showed improvement on higher–level problem solving and applying mathematics applications and received significantly higher scores on standardized final exams.
- Students using computers for algebra did significantly better on a knowledge test than a traditionally taught group; the computer group retained more information and scored significantly higher on measures of transfer to other areas of mathematics.

However, it should be emphasized that reinvention of the classroom and ultimately the school does not end with the provision of ICT resources. Computers alone will not significantly improve learning outcomes. The application of technology in the classroom should be within the framework of applying effective pedagogical approaches. This study has shown that the combination of ICT and cooperative learning proved to be more successful in terms of student achievement.

ICT presents itself as a very effective tool in enhancing the delivery of educational services. The emergence of the public and private sectors’ initiatives which include (1) the provision of computers and Internet access to schools nationwide; (2) the training of teachers on the use of

ICT, and (3) the development of digital learning objects, among other things, is a testament to the ubiquitous nature of ICT.

The final and critical piece may yet turn out to be teachers' philosophies of learning and teaching and whether they can be brought around to be supportive of constructivist applications of computer technology (Becker, 2001).

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