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What effects does peer group study have on students' learning in commerce mathematics? A case study of diverse ethnic learning

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Lau Chun Yun, C. Curtin University of Technology, Sarawak Campus, Malaysia What effects does peer group study have on students' learning in commerce mathematics? A case study of diverse ethnic learning.

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ABSTRACT

Nowadays collaborative learning (CL) has been widely known as the most effective form of learning. Yet, despite all the studies and anecdotal experiences reported by teachers and researchers, the paradigm remains largely unused in university contexts. CL is a philosophy that encompasses all elements of group work and learning situations where students cooperate in order to accomplish a specific learning objective. It is a philosophy that fits in today's globalized world and provides an opportunity for students to become better citizens of the world. CL provides the mechanism for students to interact positively with people who think differently, not only locally, but also worldwide. In order to identify the effectiveness of CL, a peer group study approach was implemented in the 2nd semester pre-university mathematics program 2005. This paper describes a case study that explores and identifies the advantages of the peer group study approach on learning mathematics. In particular the case study aims to investigate the effectiveness of CL to enhance and enrich students' learning experience, and promote a positive attitude towards the subject matter. Through analysis of pre-and post-study questionnaires, learning journals and data sources, it was found that peer group study approach was invaluable in facilitating the understanding of mathematical concepts and acquiring problem-solving skills. The collaborative social context where interaction with peers was centralized played a key role in developing social interaction and communication skills of students. Social context highlights that learning and personal development cannot be disassociated from each other.

INTRODUCTION

"Learning is enhanced when it is more like a team effort than a solo race. Good learning, like good work, is collaborative and social, not competitive and isolated. Sharing one's ideas and responding to others' improves thinking and deepens understanding." (Wiersema 2000)

According to Gokhale (1995), "the concept of collaborative learning, the grouping and pairing of students for the purpose of achieving an academic goal, has been widely researched and advocated throughout the professional literature." CL is a philosophy that fits in today's globalized world where people are "...working together, building together, changing together, improving together" (Wiersema 2000). Because of the advances in technology and changes in the organizational infrastructure, an emphasis on teamwork within the workforce has increased. Workers are required to be able to think creatively, solve problems, and make decisions as a team (Gokhale 1995). In cooperative classroom, different people learning to work together towards a common goal will be provided an opportunity to become better citizens of the world. It provides the mechanism for students to interact positively with people who think differently, not only locally, but also worldwide. In today's world, our graduates need to have more than the body of knowledge and skills of the specific discipline. Employers also now expect them to have generic personal attributes that make them a valuable and worthy employee. Therefore, the learning goals should be characterized by the high quality of their skills, knowledge and attitudes relevant for employment, particularly in the knowledge-based services and professions.

To be a competent and globalized person, graduates must be able to work in team where good interpersonal skills and the capacity to work both autonomously and collaboratively as a professional are required. As mentioned by Harvey (2003), "...apart from some professional practice areas, little of the 'knowledge' is applied in job settings. Thus, employers are more concerned about a variety of personal and interpersonal skills and abilities than they are job-related knowledge." CL experiences have promoted interpersonal attraction and interethnic interaction in both instructional and free-time activities (Slavin 1990, Cooper et al. 1980, cited in Arends 1994). Students who are actively involved in the learning process are much more likely to become interested in learning, and their interest in the subject matter will improve (Astin 1997, Kulick & Kulick 1979, cited in Panitz & Panitz n.d.). According to Gokhale (1995), "...the active exchange of ideas within small groups not only increases interest among the participants but also promotes critical thinking." The shared learning among students while working collaboratively provides an opportunity to engage students in discussion, take responsibility for their own learning, and thus become critical thinkers (Totten et al., cited in Gokhale 1995). Moreover, research has shown that the benefits of understanding each other's differences and learning how to resolve social problems accrue from collaborative learning with students of varied racial or ethnic backgrounds (Johnson & Johnson 1985b, Slavin 1980, cited in Panitz & Panitz n.d.).

Yet, despite all the studies and anecdotal experiences reported by teachers and researchers, the paradigm remains largely unused in university contexts. Most research studies on CL have been done at the primary and secondary levels, and there is little empirical evidence on its effectiveness at the college level (Gokhale 1995). The present research was designed to study the effectiveness of CL as it relates to learning outcomes at the university level. A peer group study approach was implemented in the 2nd semester pre-university mathematics program 2005. This paper describes a case study that explores and identifies the advantages of the peer group study approach on learning mathematics. In particular the case study aims to investigate the effectiveness of CL to enhance and enrich students' learning experience; promote a positive attitude towards the subject matter; further develop students' social interaction skills and improve communication skills.

This study explores how CL influences the dependent variables in order to address the research concerns listed above. Dependent variables including enhancement and enrichment in students' learning experience, positive attitude towards the subject matter, social interaction skills development and communication skills improvement are all-important components to further understanding the effectiveness of CL in the university mathematics classroom. In CL classroom, it was hypothesized that:

- Hypothesis 1: students' learning experience will be enhanced and enriched under CL approach.
- Hypothesis 2: a positive attitude towards the subject matter among students will be promoted under CL approach.
- Hypothesis 3: students' social interaction skills will be further developed under CL approach.
- Hypothesis 4: students' communication skills will be improved under CL approach.

LITERATURE REVIEW

"The learning of mathematics is often viewed as isolated, individualistic matter wherein one sits alone with pen-and paper and struggles to understand the material and concepts at hand. This process can often be quite lonely and frustrating. It is therefore not surprising that many students are afraid of mathematics. They believe that only a few talented individuals can successfully compete in the mathematical realm. Despite an overwhelming acceptance of collaborative learning among researchers and educational organizations, this strategy is not very frequently used at tertiary level in mathematics. A closer look at past literature shows that collaborative learning is more often used in subject areas like English than in mathematics. Recent research in mathematics education has increasingly focused on new ways of conceptualizing mathematics teaching and learning" (D'Souza & Wood 2002, cited in D'Souza & Wood 2003).

Staarman, Krol & Meijden (2005) cite studies by Saloman & Perkins (1998) and Webb (1991) that claim nowadays learning is considered as a collective participatory process where active knowledge is constructed and peer interaction is considered from a cognitive elaboration approach. This approach emphasizes the cognitive processes performed by students working together, where social interaction benefits learning (Staarman, Krol & Meijden 2005). As Ali (2005) mentioned, “studies showed several positive effects of collaborative learning: (i) students became acquainted more quickly, (ii) students became accustomed to speaking with confidence in the class using correct terminology, (iii) the instructor was able to observe the effectiveness of the presentation, and (iv) the classroom was more relaxed and more friendly.” Student’s ability to develop ideas, refine thought processes, and think critically is a preeminent goal in contemporary teaching and learning environments (Hennessy & Evans 2006).

Collaborative learning is the instructional use of small groups where peer interaction plays a key role in learning; it helps increase student involvement, improve problem-solving and communication skills, and enhance student achievement (Yazici 2005). Hennessy & Evans (2006) cite studies by Box & Little (2003) and Tinto (1987) that show small-group learning is positively correlated with increases in student academic performance, student self-esteem, and/or student self-concept, which in turn demonstrates an increased motivation for learning. Research has shown that students’ learning increases dramatically when classes are structured around peer learning that occurs outside the classroom (Tinto 1998, cited in Lundberg 2003). Through CL, students are allowed to explore and discover mathematical concepts and the dynamics of the classroom can be changed by encouraging and motivating all levels of students (Kasturiarachi 2004). It is claimed (Hennessy & Evans 2006) that team learning attempts to introduce students to real world experiences in the classroom. As the increasing demand of team work in this challenging and hi-tech world, collaborative learning will serve as a means used to prepare students for their future undertakings, and help building up the main personal attributes (eg. social interaction and communication skills, critical thinking, problem-solving skills, accepting diversity, etc.) necessary for working in team.

For the purpose of this research, collaborative learning describes the philosophy of the teaching learning approach in classrooms where students work in groups toward a common academic goal. Peer group study describes the CL approach that extends beyond the classroom to include online chats to the meetings in which discussion, sharing, problem solving occurs.

RESEARCH METHODOLOGY

The author’s approach to the investigation is to use a combination of positivistic and phenomenological to explore the effectiveness of peer group learning approach in commerce mathematics. Phenomenological approach is a potentially powerful way of making sense of education practitioners’ (and learner’) sense-making, and can provide new insights into the uniquely complex processes of teaching and learning. The most distinguishing feature of empirical phenomenology is to focus on the meaning of human beings make of their experience (Hennie n.d.). Under this paradigm, qualitative data emphasizing on quality and depth has been collected and analysed in this research study conducted in the Mathematics classroom. Moreover, ‘a phenomenological paradigm is aimed at capturing the essence of the phenomena and extracting data which is rich in its explanation and analysis. Under such a paradigm, full access to the knowledge and meaning of those involved in the phenomena can be gained and consequently validity is high’ (Hussey & Hussey 1997, pg. 58). However, to ensure the quality findings of this research study, it is important to have valid and reliable data collected. Thus, quantitative data has also been used to obtain reliable information in this case study. Reliability is one aspect of the credibility of the findings (Hussey & Hussey 1997, pg. 57).

Participants

From the two cohorts of students enrolled in pre-university studies, I chose those enrolled in 2nd semester mathematics program 2005. This is because I am one of their lecturers approaching them frequently; thus, their needs and learning patterns can be observed accurately and easily.

73 students, aged between 18-20, participated in this case study. There were 5 sections of the Commerce Mathematics class. Each section had an average of 20 students in it. Since Curtin serves diverse countries around the world, the students participating in the study represent a variety of ethnic backgrounds: 54% Chinese Malaysian, 27% Native Malaysian, 6% Malay, 6% African, 4% Chinese, 2% Indian Malaysian, and less than 1% Middle Eastian. Collaborative learning strategies had been regularly used in these math classrooms throughout the school semester and the data were collected from the students twice during the semester (beginning and end of the semester).

Survey Instrument

Questionnaire I (see Appendix I)

This questionnaire was developed by the author. To permit any flexibility and allow participants to give more discriminating responses, 20 Likert-type items on a four-point scale had been developed in the questionnaire. The participants were asked to fill up the questionnaires in their math classes twice during the school semester: approximately one week after school began and 2 weeks before school ended. The purpose of this questionnaire is to get feedback on students' learning preferences that help them learn better, and feedback on the development of social interaction skills and its effect on learning. Questions two, three, four, five and six assess the extent of students' enhancement and enrichment in learning, while questions one, seven, eight, eighteen and nineteen assess the extent of students' positive attitude towards the subject matter. The extent of students' social interaction skills are assessed using questions nine, twelve, thirteen and sixteen, and students' communication skills are assessed using questions ten, eleven, fourteen, fifteen, seventeen and twenty

Questionnaire II (see Appendix II)

This questionnaire had been designed by the author to collect qualitative feedback on participants' peer learning experience after the study. There are four closed questions (see Appendix II). The participants were asked to fill up the questionnaires at the end of the semester: approximately two weeks before the school ended.

Data sources

Furthermore, weekly learning journals had also been used to collect qualitative data on students' development and growth in the learning process. Also, students' final exam scores had been collected from year 2004 (where peer group approach was not implemented) and year 2005 (where peer group approach was implemented) for comparison.

Procedures

Most of these students were previously educated in a traditional education system where teacher is the sole determiner of what is "right" in the classroom. Most students, in this system, learn to conform to expectations without critique, to refrain from questioning teacher directives, to seek permission from the teacher to move about the room, and to look to the teacher for judgmental and evaluative feedback. So, it is quite challenging to these students to work in groups where they are required to be autonomous, initiative and responsible for not their own learning, but also their peers' learning. Thus, preparing classes for using CL is the key to success. It is mandatory to explain in detail why I am using CL, as well as describing the benefits and results (Panitz & Panitz n.d.). So a half-day workshop had been conducted at the beginning of the semester to provide students a rationale and philosophical basis for its use. These students were divided into few groups (3 or 4 persons each) to do a research on CL and present their findings in the workshop. My task in the workshop was to summarize what the students had presented. The students had initially learned how to work in team throughout the process of preparation and presentation for the workshop. Since there were few groups to present the same topic, this has made the workshop enriched with abundant and diverse CL literature.

"In order to help students begin the process of working collaboratively, it is necessary to provide activities which will foster a cooperative environment and encourage students to get to know each other from different perspectives" (Weinstein & Goodman 1980, William 1992, Johnson & Johnson 1985, 1990, cited in Panitz & Panitz n.d.). Thus there were few games, conducted at the end of the

session, featuring teamwork were planned and administered by the students. Students' involvement in conducting the workshop would not only help them learn to work in groups and know each other well, but also the literature of teamwork would be reinforced.

Groups can be formed using self-selection, random assignment, or criterion-based selection. This study used self-selection, where students chose their own group members. A group size of three or four was used in this study. These students worked in the same groups, in and out of the classroom, throughout the whole semester (approximately 5 months). A group meeting outside the classroom must be conducted at least once per week. In the meeting, students could discuss on any issues or difficulties they'd encountered in their learning and share their learning experience with their peers. After each meeting, a learning journal was produced to report on what had been discussed, what they'd learned from peers, the difficulties that the group had encountered and how they managed them, what the group strived to achieve, group members' contribution, and so on. Besides, in the classroom, the students had been requested to work in their own groups; they shared and contributed ideas in solving exercise worksheet problems, or commented on others' ideas and opinions. The author's role in the peer group learning process was to serve as a facilitator or mentor to the students. Through the learning journal or the informal conversation with students in the classroom, the author might keep track of students' development and growth in their learning process from time to time so that useful and helpful feedback could be provided to the students in time.

RESULTS

Scale reliability

The instrument used to test the levels of the participants' learning experience and social interaction and communication skills development was highly reliable. Reliability for the Questionnaire I was determined by using a statistical analysis program, SPSS. The alpha reliability for the 20-item instrument was 0.82.

Since Questionnaire I was used in the pre-study and post-study, the difference between the pre-study and post-study ratings was meaningful. The student t-test is a technique that can be used for related samples (Hussey & Hussey 1997). As mentioned by Rosie Shier (2004), 'a paired t-test is used to compare two population means where you have two samples in which observations in one sample can be paired with observations in the other sample.' Thus, paired t-test was used in this study to analyse data collected through questionnaires. The t-test result indicates the extent to which the two samples differ so that the null hypothesis can be rejected (Hussey & Hussey 1997). In this matched pairs design, ratings from each participant before and after the study applied had been analysed to determine the effectiveness of CL approach in the classroom. The mean rating on each dependent variable stated earlier from each participant in the pre-study had been matched with the one from the same participant in the post-study. Hence, any confounding variables that may obscure the effects of another can be avoided. The one-tailed hypothesis and the significance level of 0.05 were used in this study. Research Question 1:

Will there be a significant enhancement and enrichment in students' learning experience before and after implementing CL approach in the classroom?

H0 : There will be no significant difference in students' learning experience under CL approach.

H1 : Students' learning experience will be enhanced and enriched under CL approach.

The mean of the post-study (POSTMIN1 = 3.041) for the participants that studied collaboratively was a bit higher than the one of pre-study (PREMEAN1 = 2.929). The t-test yielded a value ($t = -1.688$, $df = 72$, $p < 0.05$) that was statistically significant. The results are given in Table 1.1 and 1.2. Hence, it was concluded that there was significant enhancement and enrichment in students' learning experience before and after implementing CL approach in the classroom, which was not due to chance.

Table 1.1: Paired Samples Statistics 1

Table 1.1: Paired Samples Statistics 1

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	PREMEAN1	2.929	73	.3935	.0461
	POSTMIN1	3.041	73	.3943	.0462

Table 1.2: Paired Samples Test 1

Table 1.2: Paired Samples Test 1

		Paired Differences			t	df	Sig. (1-tailed)
		Mean	Std. Deviation	Std. Error Mean			
Pair 1	PREMEAN1 - POSTMIN1	-.112	.5686	.0666	-2.45	.020	.0188

Note: Comparison variables: All the times = 4, Often = 3, Seldom = 2, Never = 1

Research Question 2:

Will there be a significant improvement in students' attitude towards the subject matter before and after implementing CL approach in the classroom?

- H0: There will be no significant difference in students' attitude towards the subject matter under CL approach.
- H2: A positive attitude towards the subject matter among students will be promoted under CL approach.

The mean of the post-study (POSTMIN2 = 3.071) for the participants that studied collaboratively was higher than the one of pre-study (PREMEAN2 = 2.912). A t-test on the data showed that this difference was significant ($t = -2.135$, $df = 72$, $p < 0.05$). The results are given in Table 2.1 and 2.2. Hence, it was concluded that there was significant improvement in students' learning experience before and after implementing CL approach in the classroom, which was not due to chance.

Table 2.1: Paired Samples Statistics 2

Table 2.1: Paired Samples Statistics 2

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	PREMEAN2	2.912	73	.4176	.0489
	POSTMIN2	3.071	73	.4325	.0506

Table 2.2: Paired Samples Test 2

Table 2.2: Paired Samples Test 2

		Paired Differences			t	df	Sig. (1-tailed)
		Mean	Std. Deviation	Std. Error Mean			
Pair 1	PREMEAN2 - POSTMIN2	-.159	.6359	.0744	-2.07	-0.11	.033

Note: Comparison variables: All the times = 4, Often = 3, Seldom = 2, Never = 1

Research Question 3:

Will there be a significant further development in students' social interaction skills before and after implementing CL approach in the classroom?

H0: There will be no significant difference in students' social interaction skills under CL approach.

H3: Students' social interaction skills will be further developed under CL approach.

The mean of the post-study (POSTMIN3 = 3.116) for the participants that studied collaboratively was higher than the one of pre-study (PREMEAN3 = 2.675). The t-test yielded a value ($t = -5.746$, $df = 72$, $p < 0.05$) that was statistically significant. The results are given in Table 3.1 and 3.2. Hence, it was concluded that there was significant further development in students' social interaction skills before and after implementing CL approach in the classroom.

Table 3.1: Paired Samples Statistics 3

Table 3.1: Paired Samples Statistics 3

Pair 1	PREMEAN3	Mean	N	Std. Deviation	Std. Error Mean
	POSTMIN3	3.116	73	.4914	.0575

Table 3.2: Paired Samples Test 3

Table 3.2: Paired Samples Test 3

Pair 1	PREMEAN3 POSTMIN3	Paired Differences			t	df	Sig. (1-tailed)
		Mean	Std. Deviation	Std. Error Mean			
		-.442	.6389	.0799	-2.206	72	.016

Note. Comparisons made for: All the times = 4, Other = 3, Difficult = 2, Heavy = 1

Research Question 4:

Will there be a significant improvement in students’ communication skills before and after implementing CL approach in the classroom?

H0: There will be no significant difference in students’ communication skills under CL approach.

H4: Students’ communication skills will be improved under CL approach.

The mean of the post-study (POSTMIN4 = 3.025) for the participants that studied collaboratively was higher than the one of pre-study (PREMEAN4 = 2.858). The t-test yielded a value (t = -2.206, df = 72, p < 0.05) that was statistically significant. The results are shown in Table 4.1 and 4.2. Hence, there is strong evidence showing that students’ communication skills before and after implementing CL approach in the classroom had been improved significantly, not due to chance.

Table 4.1: Paired Samples Statistics 4

Table 4.1: Paired Samples Statistics 4

Pair 1	PREMEAN4	Mean	N	Std. Deviation	Std. Error Mean
	POSTMIN4	3.025	73	.4720	.0552

Table 4.2: Paired Samples Test 4

Table 4.2: Paired Samples Test 4

Pair 1	PREMEAN4 POSTMIN4	Paired Differences			t	df	Sig. (1-tailed)
		Mean	Std. Deviation	Std. Error Mean			
		-.167	.6492	.0753	-2.206	72	.016

Note. Comparisons made for: All the times = 4, Other = 3, Difficult = 2, Heavy = 1

Another set of questionnaires (see Appendix II) was administered at the end of the semester in order to collect qualitative feedback from the participants to determine if the peer group approach had helped them learn Mathematics in one way and if the participants had enjoyed studying in groups. Again, it also helped to identify the types of social interaction and communication skills further developed among the participants throughout the peer learning process. The author had found that 89% of the participants had enjoyed studying in groups and 93.2% of them agreed that peer group study had helped learn Commerce Mathematics to some degree. Furthermore, the results had shown that the social interaction skills (top ten listing) among the participants had been further developed, which were ordered as follows: asking for help (90.4%), sharing ideas (86.3%), helping others (80.8%), communicating clearly (71.2%), accepting differences (71.2%), active listening (69.9%), staying with the team (68.5%), taking turns to complete tasks (64.4%), participating equally (61.6%) and sharing tasks (61.6%). It was also reported that the communication skills among the participants after the study had been improved. The types of communication skills that had been improved includes using facial expression (75.3%), giving feedback (63%), showing genuine interest (57.5%), effective negotiation skills (53.4%) and running effective meetings (46.6%). The results are shown in Figure 1, 2, 3 & 4 respectively.

Figure 1: Percentage of participants enjoying peer group learning

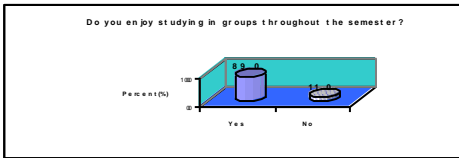


Figure 2: Percentage of participants found peer group study helpful in learning Commerce Mathematic

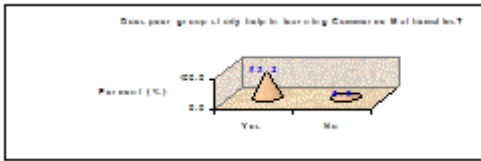


Figure 3: Percentage of participants by further developed social interaction skills

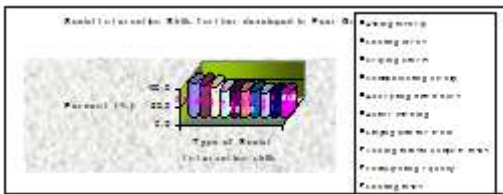
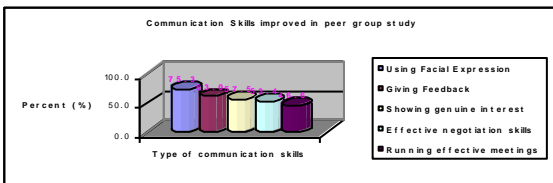


Figure 4: Percentage of participants by improved communication skills



A sample of the top 52 final exam scores in year 2004 and year 2005 had been extracted and analysed. It is mentioned (Coakes & Steed 2003) that an independent group t-test is appropriate when different participants have performed in each of the different conditions. Hence, independent groups t-test assuming unequal variances was used in this case study. The one-tailed hypothesis and the significance level of 0.05 were used.

- H0 : There will be no significant difference between the final exam scores in year 2004 and year 2005.
- H1: The final exam scores in year 2005 will significantly increase compared to the final exam scores in year 2004.

Referring to Table 5, the mean score in year 2005 (77.7) were very much higher than the one in year 2004 (50.6). The one-tailed significance for the two samples indicated that $p < 0.05$ and thus was significant. The author therefore accepted alternate hypothesis and rejected null hypothesis. That is, there is high significant increase in 2005 final exam scores compared to 2004 final exam scores.

Table 5: Independent groups t-test result

t-Test: Two-Sample Assuming Unequal Variances		
	Exam Scores 2004	Exam Scores 2005
Mean	50.6	77.7
Variance	241.58	90.44
Observations	52	52
Hypothesized Mean Difference	0	
tF	54	
t Stat	-10.74613136	
P(T<=t) one-tail	8.47527E-22	
t Critical one-tail	1.663197009	

Besides, the written comments on the benefits of peer group learning approach, extracts from learning journals, had been analysed. In order to analyse the open-ended informal responses, they were divided into three categories: A. Benefits focusing on the process of peer group learning, B. Benefits focusing on social and emotional aspects, and C. Negative aspects of peer group learning. Most of the participants felt that peer group learning helped them better understand the materials. In addition, because of the group interaction, which helped the participants learn from each other's scholarship, skills and experience, most participants found it interesting and fun when learning in peer group. A couple of participants mentioned that some group members were not cooperative, not contributing at all. The comments along with the number of participants who made those comments are described in Table 6.

Table 6: Categorical description of students' open-ended responses regarding peer group learning

A. Benefits focusing on the process of peer group learning	
Comments (# of responses):	
Helped better understanding	(25)
Discussed and shared ideas and information	(20)
Helped each other	(12)
Learned from each other	(10)
Shared problems and stress	(3)
B. Benefits focusing on social and emotional aspects	
It was interesting and fun.	(12)
It developed interpersonal relationships.	(10)
It was motivating.	(5)
It created an environment of active, involved, exploratory learning.	(3)
C. Negative aspects of peer group learning	
Group member was not cooperative, not contributing at all.	(3)
Group member was selfish with his/her knowledge, not willing to share.	(1)

DISCUSSION AND CONCLUSION

From this research study, it can be concluded that peer group learning approach had not only significantly enhanced and enriched students' learning experience in commerce mathematics classroom, but also promoted a positive attitude towards the subject matter. Furthermore, this approach had been useful in further developing social interaction skills and improving communication skills among students. When comparing the final exam scores in year 2004 and 2005, it was found that there was significant improvement in students' performance under CL approach given that other factors were not considered. However, the students enrolled in two different years were assumed to have reached similar performance level since they had the similar school entrance mathematics examination results. Again, 90% of these students were mostly used to the traditional education system where spoon-feeding was commonly used as a major teaching approach by teachers before enrolling in pre-university studies program at Curtin Sarawak. Under CL approach, most of the students indicated that they had enjoyed peer learning process, which helped them learn the subject materials very well. It is evident that these students had learned to ask for help when necessary, share ideas with others, help others, communicate clearly, accept others' differences and so on; the social interaction skills had been further developed. Moreover, the result has shown that students' communication skills had improved; using facial expressions, giving feedback, showing genuine interest, effective negotiation skills, running effective meetings. The students found that it was interesting and fun while learning together with their peers where they might share their learning experience, comment and justify others' ideas, and help and encourage each other. The diversity of the students didn't hinder the learning outcomes.

Overall, it was found that peer group study approach was invaluable in facilitating the understanding of mathematical concepts and acquiring problem-solving skills. The collaborative social context where interaction with peers was centralized played a key role in developing social interaction and communication skills of students. Social context highlights that learning and personal development cannot be disassociated from each other. As the increasing demand of team work in this challenging and hi-tech world, collaborative learning will be served as a means used to prepare students for their future undertakings, and help building up the main personal attributes necessary for working in team. Today it is very important to learn how to work with people we don't know and with diverse ethnicity. Not only that, we have to learn to adapt. Thus, university is a very appropriate place to equip students with necessary generic skills, which are very important to be a competent and globalized citizen.

In addition, the study indicated that ethnic diversity did not detract from learning: peer group study enhanced learning. However, what is not confirmed from this study is any conclusions about any one ethnic group's approach and acceptance of peer group study to enhance learning. That is, the research did not set out to identify changes to any one ethnic group in students' learning. This remains research for the future. Furthermore, a larger sample size with more classrooms involved will provide more valid and reliable information relevant to the questions asked in this study. Further research studies can examine the effects of different variables in the collaborative learning process; group selection and size, structure of collaborative learning, differences in preference for collaborative learning associated with gender and ethnicity, structure of group assessment, and possibly effectiveness due to different learning styles.

REFERENCES

- Ali, S. (2005). Effective teaching pedagogies for undergraduate computer science. *Mathematics and Computer Education* 39(3), p. 243. Retrieved January 8, 2006, from ProQuest database.
- Arends, R. (1994) *Learning to teach*, 3rd edn, McGraw-Hill, New York
- Coakes, S.J. and Steed, L.G. (2003) *SPSS analysis without anguish: version 11.0 for windows*, John Wiley & Sons Australia, Ltd.
- D'Souza, S.M. and Wood, L.N. (2003). Tertiary students' views about group work in mathematics. Retrieved July 18, 2006, from <http://www.aare.edu.au/03pap/dso03154.pdf>
- Gokhale, A.A. (1995). Collaborative learning enhances critical thinking. *Journal of Technology Education* 7(1), pp.1-8.
- Harvey, L. (2003). Transitions from higher education to work. Retrieved June 28, 2006, from <http://www.shu.ac.uk/research/cre/publications/d1transitions.doc>
- Hennessy, D. and Evans, R. (2006). Small-group learning in the community college classroom. *The Community College Enterprise* 12(1), p. 93. Retrieved June 18, 2006, from ProQuest database.
- Hussey, J. and Hussey, R. (1997) *Business research: A practical guide for undergraduate and postgraduate students*, Palgrave, New York
- Kasturiarachi, A.B. (2004). Counting on cooperative learning to uncover the richness in undergraduate mathematics. *Primus: Problems, Resources, and Issues in Mathematics Undergraduate Studies* 14(1), p. 55. Retrieved December 15, 2005, from ProQuest database.
- Lundberg, C.A. (2003). Nontraditional college students and the role of collaborative learning as a tool for science mastery. *School Science and Mathematics* 103(1), p. 8. Retrieved June 28, 2006, from ProQuest database.
- Panitz, T. and Panitz, P. (n.d.). Encouraging the use of collaborative learning in higher education. Retrieved Jan 13, 2004, from <http://home.capecod.net/~tpanitz/tedsarticles/encouragingcl.htm>
- Shier, R. (2004). Statistics: Paired t-tests. Retrieved March 29, 2006, from <http://mlsc.lboro.ac.uk/documents/Pairedttest.pdf>
- Staarman, J.K., Krol, K., and Van der Meijden, H. (2005). Peer Interaction in three collaborative learning Environment. *The Journal of Classroom Interaction* 40(1), p. 29. Retrieved January 28, 2006, from ProQuest database.
- Van der mescht, H. (2004). Phenomenology in education: A case study in educational leadership. *Indo-Pacific Journal of Phenomenology* 4, pp.1-2.

Wiersema, N. (2000). How does collaborative learning actually work in a classroom and how do students react to it? A brief reflection. Retrieved November 28, 2005, from <http://www.city.londonmet.ac.uk/deliberations/collab.learning/wiersema.html>

Yazici, H.J. (2005). A study of collaborative learning style and team learning performance. *Education & Training* 47(2/3), p. 216. Retrieved December 20, 2005, from ProQuest database.

APPENDIX I:
Questionnaire I

Please indicate the EXTENT of your involvement with the following statements by using the scale below.

1	2	3	4
Never	Seldom	Often	All the times

- Learning in groups affects me positively towards the subject matter.
- I learn best within a group.
- I value talking with my group peers.
- I discuss assignment requirements with others in my class.
- I discuss concepts and issues with others in my class.
- I believe I better understand after I have talked to my classmates.
- I am motivated to learn while working in groups.
- My interest in learning the subject increases while working in groups.
- I have positive relationships with one or two peers; show the capacity to really care about them and miss them if they are absent.
- I express wishes and preferences clearly; give reasons for actions and positions.
- I listen to my peers attentively so that I may contribute further to discussion and/or exchange of information.
- I negotiate and compromise with others appropriately.
- I accept and enjoy peers of ethnic groups other than my own.
- I interact nonverbally with other peers with smiles, waves, nods, etc.
- I express frustrations and anger effectively and without escalating disagreements or harming others.
- I am not easily intimidated by bullies.
- I assert my own rights and needs appropriately.
- I approach others positively.
- I feel free to express doubts and feelings.
- I use empathy in my communication with peers.

APPENDIX II: Questionnaire II

Do you think that the group study has helped you in learning Mathematics to certain extent?

- Yes No

Do you enjoy studying in groups?

- Yes No

Why? _____

Which of the following social interaction skills has been further developed after working and learning in groups? (pls √)

- | | | | |
|--|--|--|---------------------------------|
| <input type="checkbox"/> Taking turns to complete tasks | <input type="checkbox"/> Accepting differences | <input type="checkbox"/> Sharing tasks | Others
Pls specify:
_____ |
| <input type="checkbox"/> Praising others (not put downs) | <input type="checkbox"/> Active listening | <input type="checkbox"/> Celebrating success | _____ |
| <input type="checkbox"/> Sharing materials | <input type="checkbox"/> Resolving conflicts | <input type="checkbox"/> Helping others | _____ |
| <input type="checkbox"/> Asking for help | <input type="checkbox"/> Following directions | <input type="checkbox"/> Using names | |
| <input type="checkbox"/> Using quiet voices | <input type="checkbox"/> Paraphrasing | <input type="checkbox"/> Encouraging others | |
| <input type="checkbox"/> Participating equally | <input type="checkbox"/> Managing materials | <input type="checkbox"/> Patient waiting | |
| <input type="checkbox"/> Staying on task | <input type="checkbox"/> Staying with the team | <input type="checkbox"/> Communicating clearly | |
| <input type="checkbox"/> Saying kind things | <input type="checkbox"/> Sharing ideas | <input type="checkbox"/> Recording ideas | |

Which of the following communication skills has been improved after working and learning in groups?

- | | | |
|--|---|--|
| <input type="checkbox"/> Use of facial expressions like smiles, gestures, eye contact and posture | <input type="checkbox"/> Effective negotiation skills | <input type="checkbox"/> Showing genuine interest, paired with patience and understanding of the different culture while communicating |
| <input type="checkbox"/> Give feedback, ie. restate, repeat or summarize what we've heard to ensure our understandings | <input type="checkbox"/> Running effective meetings | |

Student Name: _____

Group No.: _____