Vol 5 No.1 December 2007 ISSN: 2094-1064 Liceo Journal of Higher Education Research
doi: http://dx.doi.org/10.7828/ljher.v5i1.14

Influence of Cooperative Learning on Chemistry Students' Achievement, Self-efficacy and Attitude

RICHIE GRACE M. LAGO
richie_lago@yahoo.com
ABUNDOL A. NAWANG
Bundxix613@yahoo.com
Liceo de Cagayan Universito

Date Submitted: February 4, 2007
Final Revision Accepted: June 8, 2007

Abstract - The study utilized the quasi-experimental research design and it also made use of non-equivalent comparison group design. The experimental group was taught using the cooperative learning method while the comparison group was taught using the lecture-discussion method. The respondents consisted of 112 first year Associate in Health Science Education (ASHE) students who were enrolled in General Chemistry classes at Liceo de Cagayan University, Cagayan de Oro City during the second semester of school year 2005-2006. The experimental group was first oriented with cooperative learning method using numbered heads together model for two weeks and was taught using numbered heads together strategy for six weeks. The comparison group was taught using the lecture-discussion approach for the same period of time. Findings show that there is a significant difference in the students' achievement for both groups. T-test revealed that there is a significant difference in the student's self-efficacy for both groups. Furthermore, the study also revealed that there is a significant difference on students' attitude towards chemistry for both groups. However it was found out that the experimental group had a more positive attitude towards chemistry.

Key words – Numbered-Heads Together Model, cooperative learning, chemistry students' achievement

INTRODUCTION

Over the past twenty years studies in chemistry teaching have revealed that majority of chemistry students at all levels, including the graduate level, learn chemistry concepts by rote and solve chemistry problems by using algorithmic methods. Although many students perform satisfactorily on examinations, it was found in interviews that students have gross misconceptions regarding chemical phenomena. The challenges of finding effective teaching strategies that address individual differences have been foremost in the minds of educators for some time, and the challenges are increasing (Bodner 1986). Several studies have stressed the importance of students' active role in the learning process (Brown and Campione, 1986; Fraser 1988). In particular, from a constructivist's perspective, student interaction with one another, with the learning material or with the teacher is a significant activity for effective learning. (Bishop 1985; Clement 1991; Jaworski [1992], as cited by Webb 1991).

As educational research expands its view of the impact of new programs and practices, the new ways of characterizing and measuring progress are being discovered. It may be too early to say with certainty that, as a result of widespread use of cooperative learning, dramatic improvements have occurred in addition to individual student learning. However, the evidence of improvement is promising in three dimensions of schooling. First, school wide programs that apply cooperative learning strategies across the curriculum have begun to document substantial gains in student achievement. Second, greater use of cooperative learning is being perceived as a sturdy and empowering context for peer mediation and conflict resolution among students. Third, adoption of cooperative learning strategies in the classroom is providing a nurturing and stimulating context for the collaboration that underly successful school reform.

Cooperative learning is a strategy that involves students in established, sustained learning groups or teams and one of the most popularly validated teaching strategies used for group instruction or for peer tutoring. This technique requires that student should work together in usually mixed ability groups (Orlich and Harder 1994). The group work is an integral part of, not an adjunct to, the achievement of the learning goals of the class. Cooperative learning fosters individual accountability in a context of group independence in which students discover information and they teach that material to their group, and perhaps to the class as a whole. The teacher's role changes as Alison King (1993) said, "From sage on the stage to guide on the side." Although they learn in groups, the students are evaluated individually on the learning they have achieved.

According to Slavin (1990), there are two cognitive theories - the developmental and elaboration - that are directly applied to cooperative learning. The developmental theory assumes that interaction among students around appropriate task increases

their mastery of critical concepts. Damon (1984) also stressed that when students interact with other students, they have to explain and discuss each others' perspective leading to greater understanding of the material to be learned. Slavin (1990) added that the struggle to resolve potential conflicts during cooperative activity results in the development of higher level of understanding and thinking. On the other hand, the elaboration theory suggests that one of the most effective means of learning is to explain the material to others. Cooperative learning activities enhance elaborative thinking and more frequent giving and receiving of explanations have the potential to increase depth of understanding, the quality of reasoning, and the accuracy of long-term retention (Johnson 1986). Therefore, the use of cooperative learning methods should lead to improve student learning and retention from both the developmental and cognitive theoretical bases (Flowers 1994).

Student interaction makes cooperative learning powerful. To accomplish the group's task, students must exchange ideas, make plans, and propose solutions. It is the teacher's job to encourage such exchange and to structure the student's work so communication is on-task and productive. Teachers who use this type of active learning believe that knowledge is gained through the interaction of students with others and with the material being taught (Breslow 1999). Researchers have seen that when students are actively involved in the learning process, their learning is improved. Motivational theorists often stress the role of rewarding in explaining the effect of small-group interaction. They tend to stress the importance of grades and other incentives as the causal agents responsible for the power of small-group interaction. Such theorists tend to emphasize individual accountability and rewards for appropriate group functioning in small-group learning and to be critical of undifferentiated group grading for team work, where all team members receive the same grade regardless of differences in contribution to the total-effort (Cooper and Robinson 1998).

Cooperative learning has many outcomes. It helps students build a feeling of community in the classroom and fosters a warmer classroom climate, thereby promotes learning and achievement. By challenging and encouraging each other to truly understand the material. Students strive to understand different ways of explaining concepts and different perspectives on solving problems, thus they become more willing to take on tough tasks because they expect to succeed and their attitude towards the subject becomes more positive. Their potential for achievement becomes enormous (Towns 1998). Cooperative learning, however, is a complex activity that looks daunting from the start. One learns eventually that developing the perfect lecture or test is also a quite complex undertaking, but one sees at the very beginning that cooperative learning strategies require careful planning. Those who use cooperative learning routinely discover in the long term that their investment of time pays off. The students soon become active learners, applying their own energy to lessons and moving forward at their own momentum.

There are three types of student learning situations, according to Johnson (1991). College instructors may structure their lessons according to these three types

of situations: competitive, individualistic, and cooperative. The competitive learning situation develops the student's competitiveness. It is like a win-lose situation where students work to outperform their classmates, creating a negative interdependence as the best grades are seen as very limited. The individualistic situation emphasizes self-interest: where students work on their own and ignore others. They have independent learning goals and have their own set of materials. Their success depends on how they achieve their assigned goals. Cooperative learning situation emphasizes students' working together to achieve common or shared goals. In cooperative learning, students learn to work together in group towards accomplishing goals that benefit each member of the group. The strategy is to use small groups to achieve the learning goals-members of the group "sink or swim together" (Rule and Lassila 2000).

Teachers who use cooperative learning believe that knowledge can best be gained through the interaction of the students not only with them, but also with the material being taught (Breslow 1999). Facilitating interaction among students is not enough since students' activeness is often expressed in personal interaction unrelated to school work, perhaps in negative behavior that leads to discipline problems. The desired outcome is to increase task-related interaction that promotes learning. Although most teachers are implementing a variety of new instructional formats made possible by advances in technology and training, many find that a well-balanced program still includes on a regular basis occasion when students are all attending to the same instructional event at once. When implementing cooperative learning, the first step is to specify clearly the academic task, and the cooperative learning structure is explained to the students (Gokhale 1993).

As part of the instruction, students are encouraged to discuss solutions to the problems and to listen carefully to the comments of each member of the group and to willingly consider their own judgment and opinions. Promoting students' activeness in learning chemistry in small-group cooperative setting seems to be more feasible for high-ability students. The real challenge remains among low-ability students. Cooperative learning strategies are strengthened by their reliance on the social aspect of learning. Students like to socialize, and acquiring academic competence often involves skills better nurtured in groups where modeling and feedbacking occur frequently than in independent work. Cooperative learning, as an instructional methodology provides opportunities for students to develop skills in group interactions and in working with others that are needed in today's world (Kerka 1990).

According to Johnson and Johnson (1986), cooperative learning experiences promote more positive attitudes towards the instructional experience than competitive or individualistic methodologies. In addition, cooperative learning has positive effects on students' achievement or retention of information. According to Mckeachie (1986), students are likely to acquire critical thinking skills and metacognitive learning strategies, such as learning how to learn in smallgroup cooperative settings as opposed to listening lectures. Cooperative learning encourages students to participate actively in the learning process. In a successful case, students promote each other's success by

helping, supporting, encouraging, and praising each other to learn. When students have to organize their thoughts to explain ideas to teammates, they must engage in cognitive elaboration that enhances their own understanding (Aksela 2000).

Cooperative learning is very versatile. It complements virtually every pedagogical approach known to promote effective learning, and it works in all subjects area at all levels of education. This learning encourages students to verbalize and compare their ideas with the ideas and feelings of other students, which is useful when they solve problems. Cooperative learning can change the verbal interaction patterns, so that they make greater use of specific verbal patterns believed to be related to increased learning (Dumas 2003).

Cohen (1994) stated that cooperative learning represents a valuable strategy for helping students attain high academic standard. After nearly fifty years of research and scores of studies, there is a strong agreement among researchers that cooperative method usually has positive effects on the students' achievement. However, achievement effects are not seen for all forms of cooperative learning. It depends on the implementation of cooperative learning methods that are characterized by at least two essential elements: positive interdependence an individual accountability (Slavin 1990). Gokhale (1995) in his study, Collaborative Learning Enhances Critical Thinking, revealed that students who participated in collaborative learning had performed significantly better on a critical thinking test than students who studied individually. It was also found that the groups did equally well on the drill-and-practice test.

Recent research by Cornelly (1998) indicates that as students solve a case, they develop higher order thinking skills of analysis and application. Moreover, collaborative group work provides scaffolding for lower achieving students as sharing and comparing of responses evolve through discussion. It has been reported that small-group cooperative instruction has a powerful effect on a variety of additional outcome measures, including higher-order (critical) thinking skills and cognitive development.

There are several theories regarding the impact of small-group instruction. In the cognitive perspective, small-group instruction allows students to rehearse and relate course material into existing schema or conceptual framework, thus producing a deeper, contextualized level of content understanding. When peers work together there is a great deal of modeling, cognitive, disequilibria, feedback and perspective taking that emerges as students explain and receive explanation from their colleagues (Cooper and Robinson 1998).

The main goal of cooperative learning is to help students expand their repertoire of problem-solving approaches, while its minor goal is to help them develop collaborative skills - leaderships, decision-making, communication, etc. These goals can only be achieved if students have enough time to develop group dynamics, and overcome difficulties in working together.

Cooperative groups should remain together for at least a month for the dynamics to develop. Many researches have shown that students who learn cooperatively get higher grades than students who try to learn the same material individually. This

was supported by Tschumi (1991) who experimental once with the students working individually and twice using group work. In the first class, only 39% of the students earned grades of C or better. However, students in classes taught had earned better grades. Those earning A's in the course included 6.4% (first offering) and 11.5% (second offering) of those who worked cooperatively and only 3% of those who worked individually. There was student resentment about group work in the first cooperative offering and almost none in the second offering, presumably because Tschumi showed the students the comparison between the grades for the lecture class and the first cooperative class.

Felder (1994) stated that obstacles to the widespread implementation of cooperative learning at the college level are insignificant however. The approach requires faculty members to move away from the safe, teacher-centered methods that keep them in full control of their classes to methods that deliberately turn some control over to students. Although studies have been conducted on small-group instruction for many years, there has been a dramatic increase recently. For example, a preliminary report of the NISE (National Institute for Science Education) meta-analysis group indicated a doubling of research reports from the 1987-1989 period to the 1990-1992 period in both engineering and science, and another doubling from 1990-1992 to 1993-1995. For the years prior to 1987, there was very little work reported in the data bases utilized (Cooper and Robinson 1998).

Despite the relative increases in the number of reports on small-group instruction in SMET (Science, Mathematics, Engineering and Technology) disciplines in the last 5-7 years, the absolute number is still small. The studies, which meet traditional standards of quantitative research control, are very limited particularly in physics, chemistry, biology and engineering. The quantity and quality of research reports in mathematics is generally better, perhaps due to the early and powerful influence of Uri Treisman and the various math reform movements. In a recent search of the ERIC (Educational Resource Information Center) data base, the number of reports listed under the descriptors cooperative learning and higher education was 699. The time period covered in the search was 1992 through August 1996. Of these 699 reports, covering a nearly five-year span, only 11 were in chemistry, 12 in physics, 13 in biology and 19 in engineering. In contrast, 58 citations were found in mathematics (Cooper and Robinson, 1998).

There is less preliminary evidence that cooperative, small-group procedures can affect a wide range of outcome measure such as achievement, liking for science and math, critical thinking and retention. There is evidence that this technique may be particularly effective for women and minority students. There is also evidence that cooperative techniques may increase the likelihood that bright students who historically avoid SMET disciplines may be attracted to cooperatively-taught SMET courses (Tobias 1992). There is a considerable empirical evidence at the precollegiate level and some evidence at the collegiate level that cooperative procedures can have significant impacts on such prosocial outcomes as active listening, altruism, and teamwork both

type of self-concept (performance based and reference based) increased at significant level for students who were exposed to cooperative learning as compared to students in a traditional classroom.

The study of Kiokaew (1998) revealed that students in both public schools and Islamic private schools taught by using cooperative learning method had a significant higher achievement than those taught by the IPST (Institute for the Promotion of Teaching Science and Technology) teacher's manual method. It was also observed that students in the experimental group had good attitudes towards cooperative learning. It was believed that cooperative, small-group instruction can have a powerful impact on a large number of educational outcomes for many students.

The study of Luna (1998) revealed that cooperative learning groups learned better than the students exposed to traditional method. This was due to the fact that the students were made to discuss and interact among themselves and the lesson was better retained in their minds. Likewise, Herrera (2002) concluded in his study, "Group Activity Method: Its Influence on Students' Performance in Elementary Statistics and Attitude towards Mathematics", that group activity method has significantly influenced the performance scores of the students. Students in the group activity method performed better than students in the traditional method of teaching. Casinillo (1999) in his study, "Gender and Groupings: Their Effects on Problem-Solving Achievement Scores", concluded that achievement and attitudes of the students are positive when they solve problems cooperatively.

Tandog, as cited by Herrera (2002) in his study, "The Effect of Cooperative Learning on Students Achievement in Plane Trigonometry and their Attitude", found that there was no change in the attitude of the students towards mathematics as affected by cooperative learning method. Nonetheless, there was an improvement in the analysis and application domain of the students towards mathematics as influenced by cooperative learning method. Thus, there was a significant change in the performance of the learners when they were exposed to cooperative learning setting of instruction than the traditional method.

The review of related studies reveals that only very few studies on cooperative learning in chemistry were made. Thus, this study is deemed necessary to help chemistry students learn effectively by finding the learning method that works effectively.

There are three popular models of cooperative learning, each with a prominent advocate among successful others. The models overlap significantly in their research base and to some extent in their practice. Nevertheless, they have their own distinctive qualities. Student Team Learning Model / Student Teams Achievement Divisions (STAD), promoted by Slavin, focuses on task structure, team composition, and reward systems. In most forms of Student Team Learning, task structure ensures that every team member participates. Team's composition is carefully determined to create learning groups. The skills of teamwork are taught and nurtured as needed to support the academic work. Academic success the goal of teamwork; social coherence is more and intended side effect.

One of the widely used programmatic version of this model is Numbered-Heads-Together, makes drills and quick reviews of facts engaging and productive for the whole class. It will add depth to students' participation in more complex academic work as well. Learning Together, advocated by Johnson and Johnson, is more directly concerned with group process and interpersonal skills. While group skills are taught in the context of learning activities, social coherence is viewed as an important goal in itself.

Structural Approach advocated by Kagan, aims for improved efficiency in academic learning and improved social skills. This model views lessons as compositions of interlocking parts, some of which demand cooperation while others do not. The cooperative structures he uses serve different purposes, which he classifies as team building, class building, mastery, thinking skills, information sharing, and communication skills (Leighton 1999).

Although most teachers are implementing a variety of new instructional formats made possible by advances in technology and training, many find that well-balanced programs still include on a regular basis occasions when students are attending to the same instructional event at once - a lecture, demonstration, or film, for example. Several very simple tactics can ensure that students maintain engagement and integrate lesson content with their prior knowledge. Like more elaborate cooperative learning strategies that are used over a longer period, Numbered-Heads-Together Model provides an incentive for students to harness their interest in socializing to an academic agenda, to invest in the learning of their teammates, and to work hard by themselves.

FRAMEWORK

This study is anchored on the cognitive theory of Jerome Bruner. To Bruner, the acquisition of knowledge, whatever its form, is a dynamic interactive process. To him, "learning at its best is thinking". An individual learns best when he can share cooperatively in the selection, organization, and management of the learning experiences. Cooperation enhances learning in several ways. In engaging the students to work in an interactive process, the teacher does not have to condition them to do it because they are already interacting in their daily school activities. There is always an exchange of ideas when they are talking about current issues they are trying to settle. Questions are raised and information is gathered particularly on troublesome aspects of the subject; intellectual work occurs in this situation.

When the students' concentration is evident, the seriousness of the matter is real. The groups' exchanges of questions and explanations intensify the dynamic interaction. Students develop intellectual independence in expressing themselves to others to verbalize their ideas and to compare their ideas and feelings to that of the others. The interactive process can also help students to learn respect for one another's strengths and limitations and to accept these differences. In the interactive process, the students can develop creativity and the ability to work cooperatively. The students' ability to

interact is enhanced when there is a real group work.

In cooperative learning, Bruner's theory is applied because students learn to ask questions and to verify answers with group mates. Aside from thinking and processing information, they also learn to express themselves in brainstorming session, thereby solving some posted problems. Cooperative learning, therefore, is a dynamic process. The benefits of cooperative learning are much more likely to emerge in the classroom if students have the opportunity to be actively involved with each other, have frequent dialogues and discussions, and form close relationships within the class.

Cooperative learning activities provide more of the opportunities than whole-class learning. Cooperative learning is both an instructional technique and a teaching philosophy encouraging students to work together to maximize learning. There are two essential components in all cooperative learning methods: a cooperative task (which is a feature of most group work) and cooperative incentive structure (which is unique to cooperative learning). This means that students carry out a task in groups of two or more, and they are encouraged and motivated to help one another to learn (instead of competing with one another). Furthermore, they are dependent upon the efforts of one another to achieve success and that they are rewarded on the basis of the learning of all team members.

According to Sutton (1992), there are five basic elements that need to be included for small-group work to be considered truly cooperative (Killen 1996). The first element is positive interdependence; students within groups must truly be dependent on one another. Second element is face-to-face interaction - the interaction and verbal interchange among students that are promoted by positive interdependence which have the greatest effect on educational outcomes. The third element is individual accountability. All students within a group are responsible for learning the material. The fourth element is the appropriate use of interpersonal skills in the group. Finally, students must be given enough time for analyzing how well their groups are functioning (Killen 1996).

The best argument for cooperative learning is that it increases cognitive achievement. Robert F. Slavin reported that 49 out of 68 studies have results that favored cooperative learning method over traditional methods. Achievement gains can be found across a wide range of subjects and cognitive levels. Another powerful argument for cooperative learning is that it promotes affective achievement. When students begin to succeed, then they begin to feel more confident, which leads to a higher self-esteem and efficacy. It is the teacher's job to encourage such exchange and to structure the students' work so their communication is on-task and productive.

Introducing students to interpersonal skills is the first step to get the group work together by making eye contact, encouraging fellow group members, using quiet voices, and disagreeing without hostility. These habits will become part of the cooperative group repertoire, but the students will need practice. Frequent monitoring and reinforcement are essential to assure that learning is actually occurring in the groups. Establishing rules for group behavior that will promote equal exchanges among members must be

implemented.

Cooperative learning as a strategy can be used in abstract concepts in chemistry such as matter, energy, and atomic structure. To be more effective in this strategy, the teacher should give emphasis on the students' role as member of the group to ensure better interaction with one another. With this, solving problems and presentation of ideas in the group will give them confidence to finish the task assigned to them. As illustrated in the schematic diagram, the study's independent variables were the methods of teaching, namely lecture-discussion method and cooperative learning method using the Numbered-Heads-Together model. The researchers introduced two topics in chemistry (Matter and Energy and Atomic Structure). One group used the lecture-discussion method while the other groups used the Numbered-Heads-Together method. The dependent variables were the students' cognitive achievement, self-efficacy and attitude towards Chemistry.

OBJECTIVES OF THE STUDY

This study determined the effect of cooperative learning method using the Numbered-Heads-Together model on the students' achievement, self-efficacy, and attitude towards Chemistry. Specifically, this study sought to achieve the following objectives: (1) to compare the students' achievement as influenced by cooperative learning and lecture – discussion methods; (2) to measure the effects of cooperative learning strategy on the students' self – efficacy; and (3) to determine the effect of cooperative learning method on the students' attitude towards chemistry.

METHODOLOGY

The study employed the quasi-experimental research design involving two groups: experimental group and comparison group. The two groups were intact classes of the Associate in Health Science Education freshmen enrolled during the second semester of SY 2005-2006 at the Liceo de Cagayan University. No pre-experimental sampling was done since the two groups were both intact classes. Thus, the following non-equivalent comparison group design was adopted:

Experimental Group	O1	X	O2
Comparison Group	O1		O2

X stands for the experimental treatment (cooperative learning method) while O1 and O2 stand for the pretest and posttest respectively. The experimental group was taught using the Numbered-Heads-Together model for cooperative learning method while the comparison group was taught with the same topics using the lecture-discussion method. There were 64 students for the experimental group and 48 students for the comparison group. Both groups were matched based on the schedule of classes, teacher handling the subject, and classroom assignment.

An achievement test was developed by the researchers to measure students'

performance freshmen enrolled in the selected topics. The T2-item instrument (see Appendix D) was pilot tested to Engineering freshmen General Inorganic Chemistry. A pretest and posttest were then conducted to measure the achievement of the students. A table of specification (see Appendix B) showing the distribution of the test items on the two topics and the cognitive skills to be tested was made. The cognitive skills tested were knowledge, comprehension, application and analysis. The instrument's computed reliability coefficient using Kuder-Richardson Formula 20 was 0.52, indicating that the instrument was reliable (see Appendix C). The data were analyzed quantitatively and qualitatively. Qualitative analysis of the test included content validation. The achievement test was item-analyzed by a Mathematics professor of Mindanao Polytechnic State College for the correctness of content, representation of the chemistry concepts used, and appropriateness of language used.

Self-efficacy and attitude towards Chemistry among the students were measured using the Chemistry Self-Efficacy, Attitude and Experiences Questionnaire (CSEAEQ) which was administered to both groups. The instrument was taken from the study of Dagcuta (2003). The self-efficacy scales contain twenty (20) statements while the attitude scale contains twenty-two (22) statements. Attitudinal and self-efficacy responses were measured using a seven-point semantic differential scale (1.0 – 3.99 = positive, 4.0 – 7.0 = negative). Results of the self-efficacy and attitude test are shown in appendix E.

One of the researchers handled both the experimental and the comparison groups. The study was conducted for six weeks, from the first week of December to the last week of January. The use of the Numbered-Heads-Together model observed the following steps: planning, forming teams, numbering the students, posing the questions, putting heads together, and calling the students' number.

In step 1, the researchers planned the lesson and identified appropriate practice materials for the implementation of the new teaching strategy. The Numbered-Heads-Together model was presented to the experimental group. In step 2, the researchers assigned fourmembers for each team. In forming the teams, the researchers followed the following procedure: (1) identify the population of the class where the study was conducted and (2) select team leaders. The selection of team leaders was based on grades in Algebra since the concepts discussed in the study deal with mathematical manipulation. Hence, the top students in the class were selected as leaders.

In step 3, the researchers provided all team members with numbers by letting each team member and the leader drew numbered small balls inside the beaker. The balls were numbered 1, 2, 3, and 4, which correspond to the number of members for each team. Each leader then submitted the list of the team members. Since the member identifier was a number, the group identifier was a letter. In step 4, the instructor posed questions for discussion. In step 5, the groups were given time to "put heads together", that is, to and figure out and discuss the answer to each question.

In step 6, the instructor called a number at random and the student with that number had to answer the question. Each group was scored based on how its group member answered the question. In the comparison group, the students were taught

by the same instructor. The topics were given and the discussion (interaction between students) and evaluation followed. The experiment was done for six weeks, three (3) hours per week.

After the equipment, the experimental and the comparison groups were given post achievement, self-efficacy, and attitude tests.

The data analysis and interpretation were facilitated using the following statistical treatment: the ANCOVA to compare means in achievement tests, the mean and standard deviation to determine the effect of cooperative learning on teaching, and the t-test to determine the difference in self-efficacy and attitude towards chemistry subject between the two groups.

RESULTS AND DISCUSSION

Comparison of student achievement

Table 1 shows the mean score of the two groups in the pretest. As revealed, the comparison group obtained a mean score of 24.67 while the experimental group got a mean score of 24.35. The scores were comparable since the difference was only 0.32. The scores further reveal that the two groups' achievement was below the passing mark, suggesting that the students had inadequate knowledge in chemistry.

Table 1. *Mean and standard deviation of the pretest and posttest of the students achievement scores in general chemistry.*

Variable	Pretest		Posttest		
	Mean Score	SD	Mean Score	SD	
Comparison	24.67	6.45	29.49		6.75
Experimental	24.35	4.75	39.41	6.02	

As also shown in Table 1, in the posttest, the experimental group got a mean score of 39.81, which was higher than the comparison group's mean score of 32.44. This implies that both comparison and experimental groups had difference in mean scores was 9.92. The difference of the pretest and posttest of control group is 4.98, while the experimental group is 10.37. The finding implies that both groups had improved in knowledge on chemistry after the presentation of the topics. However, the experimental groups had higher knowledge increment (10.37) than the comparison group (4.98). This finding suggests that cooperative learning method had greater influence on learning chemistry concepts than the discussion method. Comparing the standard deviations in the pretest and posttest of the experimental and comparison groups, the experiment had lesser spread groups indicating that's a homogeneous group while the comparison group spread indicating a heterogeneous group.

Table 2 shows the result of the analysis of covariance (ANCOVA) of the respondents' pretest and posttest scores in General Chemistry. The analysis yielded a computed F-Ratio of 40.93, which was greater than the critical F value of 3.02, which led to the rejection of the null hypothesis. Therefore, there was a significant difference in the achievement scores between the two groups of the students taught through cooperative learning method using the Numbered-Heads-Together model learned

more than the students taught through the lecture-discussion method. The result of this study is supported by the findings of Flowers (1994) and Cohen (1994) that the use of cooperative learning method led to learning and retention improvement.

Table 2. *Summary of one-way ANCOVA on students achievement score in general chemistry taught with numbered heads together model and traditional method*

Source of Variation	Adjusted Sum of Squares	Df	Adjusted Score	Computed Mean	Critical Value	F-Ratio
Treatment (Between)	1146.09	1	1146.09	40.93	3.02	
Error (Within)	3057.55 108	28.31				
Sum	4203.64	109				

Effect of Cooperative Learning Strategy on Students' Self-efficacy

On the students' self-efficacy, Table 3 shows that the students taught on lecture-discussion method got a mean score of 3.48 while those taught using the cooperative learning got a mean score of 3.19. The lesser the number, the more efficient is the result; therefore, those in the experimental group had higher self-efficacy than those in the comparison group. This means that the students exposed to correction learning was more efficient and confident while learning than those students exposed to the lecture-discussion method.

Table 3. *Summary table of self-efficacy*

Variable	Mean Score	SD	t-computed $\alpha = .05$	t-critical
Comparison (n_2= 48)	3.48	0.64	12.08	2.0
Experimental (n_1= 64)	3.19	0.86		

To determine any significant difference in the means, the T-test was used. The computed t-value was 12.08, which was higher than the critical value of 2.0 at 0.05 level of significance. Thus, the null hypothesis was rejected. In other words, there was a significant difference in the self-efficacy of both groups. Therefore, the self-efficacy of the students was influenced more when cooperative learning method was used.

Effect of Cooperative Learning Strategy on Students' Attitude

On students' attitude towards chemistry, Table 4 shows that the control group got a mean score of 2.45, which was higher than that of the experimental group (2.29). However, the difference, which was 0.16, was slight. The scores of the two groups indicated positive attitude. The lesser the value within the scale, the more position is the attitude; therefore, the students exposed to cooperative learning method developed a more position attitude towards chemistry than those exposed to lecture-discussion method.

Table 4. *Summary table of attitude*

Variable	Mean Score	SD	t- computed $\alpha = .05$	t- critical
Comparison (n_2= 48)	2.45	0.74	8.0	2.0
Experimental (n_1= 74)	2.29	0.59		

The T- test yielded a T-value 8.0, which was higher than the t-critical of 2.0 at 0.05 level of significance; hence, the null hypothesis was rejected finding that cooperative learning better develops the attitude of students toward chemistry.

CONCLUSION

The findings of the study advance the conclusion that cooperative learning method using the Number-Heads-Together model significantly increased the achievement of the students in chemistry, the students' self-efficacy in learning, and attitude towards chemistry in comparison to lecture-discussion method.

LITERATURE CITED

Aksela, M. (2000). An approach to students' thinking during experimental work through the use of cooperative learning method. York 2000 Conference.

Astin, A. W. (1993). What matters in college? Four critical years revisited. San Francisco: Jossey-Bass.

Bodner, G.M. (1986). Constructivism: a theory of knowledge. Journal of Chemical Education. pp 63.

Breslow, L. (1999). New research points to the importance of using active learning in the classroom. Teach Talk Articles in the Faculty Newsletter. Vol.XIII, No. 1, September/ October.

Cohen, E. G. (1994). Designing groupwork: strategies for the heterogeneous classroom. New York. Teachers College. Press.

Cooper, J. & Robinson, P. (1998). Small-group interaction in SMET Disciplines: a status report and an agenda for the future. Journal of College Science Teaching. National Science Teacher's Association, 1840. Wilson Blvd. Arlington, VA 22201.

Dagcuta, M.V. (2003). Chemistry and physics learning experiences, self-efficacies, and attitude towards the science of the students at the Mindanao Polytechnic State College, Cagayan de Oro City.

Damon, W. (1984). Peer education: the untapped potential. Journal of Applied Developmental Psychology, 5.

Dumas, A. (2003). Cooperative learning: response to diversity. California Department of Education.

Felder, R. M. (1994). Cooperative learning as a teaching strategy. Department of Chemical Engineering. North Carolina State University. Raleigh, NC.

Felder, R.M., & Brent, R (1994). Cooperative learning in technical courses: procedures, pitfalls, and pay offs. Division of Undergraduate Education. Grant DUE-

9354379.

Flowers, J. & Abu, R. (1994). The effects of cooperative methods on achievements, retention, and attitudes of home economics students in North Carolina. ERIC Digest.

Gokhale, A. (1995). Collaborative learning enhances critical thinking. Journal of Technology Education.

Herrera, F. (2002). Group activity method: its influence on students' performance in elementary statistics and attitude. Mindanao Polytechnic State College, Cagayan de Oro City.

Johnson D.W., Maruyama, G., Johnson, R.T., and Skon, L. (1991). Effects of cooperative competitive and individualistic goal structures on achievement: a meta-analysis. Psychological Bulletin.

Johnson, D.W., R.T. Johnson, E.J. Halubec. (1991). Circles of learning: cooperation in the classroom.

Johnson, R.T. and D.W. Johnson. (1986). Action research: cooperative learning in the science classroom. Science and Children.

Killen, R. (1996). Effective teaching strategies. Wentforth Falls, NSW, Au: Social Science Press. P. 78-95.

Leighton, M. S. (2002). Classroom teaching skills: cooperative learning. p 273-304

Luna, C.A. (1989). The effects of three methods of remedial teaching on student's achievement in selected topics of College Algebra. Doctoral Dissertation Graduate School of Education, Arts and Sciences, De La Salle University. Manila.

McKeachie, W.J. (1986). Teaching tips: a guidebook for the beginning college teacher. Lexington, MA: D.C. Heath and Company.

Orlich, D.C. & Harder, R.J. (1994). Teaching strategies: a guide to better instruction. Fourth Ed. D.C. Heath and Company: Lexington, Ma. P. 251-263.

Slavin, R. E. (1991). Cooperative learning: theory, research, and practice. Englewood Cliff, New Jersey: Prentice Hall.

Slavin, R. E. (1991). Student team learning: a practical guide to cooperative learning. Washington, DC: National Education Association. ED 339 518.

Slavin, R.E. & Robert, S.J. (1992). The cooperative elementary school: effects on students' achievement, attitudes, and social relations. Baltimore, MD: Center for Research on Effective Schooling for Disadvantage Students. ED 349 098.

Stahl, R. J. (1994). The essential elements of cooperative learning in the classroom. Washington DC: National Council for the Social Studies. ED 370 881.

Totten, S. & Sills,T. (1991). Cooperative learning: a guide to research. New York: Garland.

Webb, N. M. (1991). Task related verbal interaction and mathematics learning in small groups. Journal for Research in Mathematics Education. 22 (5).