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Evaluation of the effectiveness of cooperative learning structures in improving students' performance

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EVALUATION OF THE EFFECTIVENESS OF COOPERATIVE LEARNING STRUCTURES IN IMPROVING STUDENTS' PERFORMANCE

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ABSTRACT

In a desperate attempt to improve high school classroom performances, recently, schools have begun to move towards incorporating cooperative learning strategies into their classrooms. Generally, cooperative learning strategies can be described as the use of small groups to encourage learners work together and accomplish shared goals and subsequently maximize theirs and others' potential. In an attempt to evaluate the effectiveness of this strategy on classroom learning, this study compares the gains in means of scores between a group taught using cooperative learning strategies and another group taught using non-cooperative learning strategies.

Fifty-three students taking Algebra I were given a pretest before administering this strategy then a posttests afterwards to determine the normalized gain based on the Hake equation. Thirty-one students participated in cooperative learning out of which 77% showed a net mean positive gain whereas, the 22 students in the non-cooperative group had a positive gain of 54%. Comparison of these results did not indicate any statistical significance between the two groups. However, it was observed that students who worked in cooperative groups were more engaged, more responsible in completing group assignments and more organized while working in their respective groups. These results may encourage the practice of cooperative learning strategies in a high school-level setting.

INTRODUCTION

The Louisiana public school system is faced with a big challenge – to improve the academic performance of students in public schools. Failure to meet this challenge could result in state take-over of schools, as has already occurred with some public schools in East Baton Rouge parish. In a move by the state to correct this problem, a few numbers of the failing public schools have been converted into charter schools leading to reduced funding to public schools. This could adversely affect the job security for teachers' and other school employees.

In response to this challenge, teachers are trying new teaching strategies to improve their students' performance in the classroom. One of the teaching approaches being emphasized is cooperative learning (CL). Cooperative learning refers to an instruction method in which students are various performance levels work together in small groups toward a common goal. There are many studies reported which indicate the cooperative learning environment is more effective than the individual learning environment. According to Sloffer, Dueber, and Duffy (1999), Johnson and Johnson (1996), there is persuasive evidence that cooperative team activities achieve at higher levels of thought and retain information longer than students who work individually. The shared learning gives students an opportunity to engage in discussion, take responsibility for their own learning, and thus become critical thinkers (Totten, Sills, Digby, & Russ, 1991). Students who cooperate are introduced to an environment that prepares them well to succeed in the workforce by putting emphasis on teamwork activities (McLoughlin & Luca, 2002; Romano & Nunamaker, 1998).

Despite the documented success of CL, it is seldom practiced in classrooms because promoting it within a classroom setting is not always easy due to resistance from both the instructors and their students. There are two major difficulties to the successful implementation of a CL environment at the secondary school level. First, most secondary school teachers lack training in CL. Second, middle and high school students lack the social skills necessary to work effectively in cooperative groups. Herreid (1998) found that, even for those students who are socially adept, adapting to the new expectations and roles fostered by the environment can be threatening. When students work in groups, the noise level increases significantly, leading the instructors to feel as though they have lost control of the class. Students can be resistant of cooperative learning activities, especially when they are held accountable individually for a group assignment. In addition, the higher achieving students who have been successful in the more traditional, lecture-based environments frequently view cooperative assignments as a threat to their performance and, ultimately, their grade.

From my personal observations, professional training workshops are generally offered at the beginning of an academic year or semester, guiding teachers on how to deliver effective instruction and how to manage student behavior in classroom. Normally there are few seminars on cooperative learning. During the first few days of a new school term, routines, procedures and rules are emphasized with respect to classroom management, but little attention is given to training students on how to work in a cooperative group setting. New and especially inexperienced teachers implement group work simply by putting two or more individuals in the same group and assigning them the same task, which is not a guarantee of true collaboration. For effective collaboration

to be realized, students and teachers need to be trained on how to work in groups and on how to apply proven structures.

Research indicates that traditional CL can be improved by applying the structured cooperative learning approach (Kagan and associates 1998). This pedagogical approach has two goals. One goal is to foster positive, cooperative relationships between learners studying a subject in a class. The second goal is to increase academic achievement for all learners.

Kagan has developed roughly 200 classroom "structures", which may be thought of as steps to classroom activities. These structures stress positive interpersonal peer relationships, equality, self-esteem, and achievement. Students can work together by following the steps to the structure, using material or content selected either by the teacher or by the students themselves. The structures have various aims, such as: building team spirit and positive relationships among students; information sharing; critical thinking; communication skills; and mastery (learning/remembering). Many of the structures can fulfill a number of aims simultaneously, depending on how the teacher uses them. Structures can be mixed and matched, and adapted to the particular student group.

Problem Statement

Proponents of cooperative learning strategies suggest that if students at secondary school level were trained to work collaboratively and if proven structures were implemented, the cooperative learning method could be more effective and efficient than the individual learning.

Based on the preceding findings, this study investigates the effectiveness of structured cooperative strategies which focus on subject mastery while at the same time seeks to incorporate the necessary social skills to work effectively in groups. Kagan (1998) explained that, more than just clever classroom routines, the structures are based on four factors that are considered essential to the structured approach to cooperative learning. These were positive interdependence; individual accountability; equal participation; and simultaneous interaction. In this study, students' cooperative learning outcomes were assessed by calculating cooperative learning gains using pretests and posttests (Hake, 1998).

BACKGROUND LITERATURE

Collaborative Learning

Since the beginning of formal education in US schools and classrooms, students have been grouped in various ways, including individual, subset, and whole class groups (Baines et al. 2003). Many studies have been undertaken to assess which kind of grouping is most effective (Slavin 1995). While it has been commonly thought that learning and social benefits accrue from effective group work, there has not been common agreement over what group work is, and how it can be made effective. Thus, different researchers (Kutnick et al. 2005; Lou et al. 1996; O'Donnell & King 1999; Slavin et al. 2003; Webb & Palincsar 1996) have reached different conclusions. Some common conclusions include the following points: that children work more effectively in smaller than larger groups; the collaborative approaches to group work are generally more effective than individualistic and competitive approaches; there are modest academic gains; and pro-social and pro-school attitudes improve significantly in collaborative groups.

Collaborative learning has been described as "the use of small groups through which students work together to accomplish shared goals and to maximize their own and others' potential" (Johnson, Johnson and Holubec (ASCD 1994). It is an umbrella term for a variety of educational approaches involving joint effort by learners. The activities vary widely, but most center on the learner's exploration or application of the curriculum. The teacher's role is to create an environment where young people are willing and able to work collaboratively. The environment must also provide plenty of

opportunities and stimulating contexts for learners to work with others, and in which they feel safe to share their emerging ideas and understanding.

Grouping Students

Grouping students in the mathematics setting is very important and effective according to one group (Lee, 2006). Lee, the author of The Power of Groupthink, states that when people pool their knowledge, they can outperform the brightest of individuals. He and his group of researchers at the University of Illinois conducted a study that included 760 college students. They asked the students to crack a code, a task that tested mathematics and logic skills. Some of the students worked alone while others worked in small groups. The groups outshone even the top-scoring solo individuals in this study. One of the researchers explained that groups have an edge because they build on each other's insights, making it easier to recognize correct answers.

According to Theodore Panitz (2000), the author of Using Cooperative Learning in the Mathematics Classroom, there are many benefits to cooperative learning. It not only benefits the students and their learning, but it also benefits the teacher. As she interviewed her students after they had worked in groups, one of her students responded to her question by saying, "Before your class, I disliked math. I was always getting aggravated and scared by it. Working together with those around me in a group was a great help in understanding the material and the many different ways in which a problem can be tackled and solved" (Panitz, 2000, p.8). Thus, grouping students motivates them to learn, their critical thinking skills are enhanced, and students become better acquainted with their peers while still enjoying mathematics.

In her study of Group and Individual Work (2006), Williamson concluded that group work increased the opportunities for communication and made problem solving a richer experience for students. She found that the teams that worked together were very confident and felt less frustrated with the material. The groups that worked together also had no problem with reporting to the class on something they had produced as a group.

Traditional Learning versus Structured Collaborative Methods

Although different educational, social, and economic arguments have been advanced to explain the potential of collaborative learning and justify its use, it has been argued that the basic rationale for choosing collaborative learning as the preferred educational approach should be its relative effectiveness and efficiency in comparison with more traditional individual learning. These methods can be either traditional collaborative ones, such as in face-to-face problem-based learning, or computer-mediated environments. Collaborative learning environments take on a great variety of forms. They can, for example, differ in size, composition, pursued goal, supporting tools, synchronicity, common knowledge distribution, division of tasks, and so forth. However, independent of this, they all ask for a certain mutual and shared effort of the members of the group (Teasley and Roschelle (1993)).

Even though collaborative learning has been found to be relatively effective, not many teachers allow students to work in collaborative groups. Teachers have expressed particular concern about loss of classroom control, increased disruption and off-task behavior (Cohen & Intilli 1981; Cohen 1994). They also worry that children have difficulty learning from one another (Lewis & Cowie 1993), that the nature of group work is time consuming, that the assessment of children in interactive groups is difficult

(Plummer & Dudley 1993), and that positive outcomes are limited to the more academically able students. Teachers have also expressed the view that pupils, particularly boys, will misbehave during group work and that discussion within group work may cause conflict between pupils (Cowie 1994). Galton (1990), for example, found that some children often feel insecure and threatened when told to work in groups and pupils responded to this threat by withdrawal from participation or looking to the teacher to give legitimacy to their responses within groups.

Studies have shown that there is increased student achievement in collaborative learning after undertaking training in social skills. It should be evident that, to achieve effective collaborative learning at the secondary school level, training students on social skills would be more necessary since students are socially immature as compared to college students. As a result, the move is to upgrade the traditional collaborative learning practice to the more effective structured collaborative learning.

The Structured Approach to Cooperative Learning

In the structured collaborative method, a clear understanding of the basis for success and failure of group work in the classroom is established. The social pedagogic approach focuses on relationships between pupil groups (their size and composition), learning tasks, supportive interactions with peers and teachers, and whether pupils have received training for effective group work (Blatchford et al. 2003). For effective collaboration, group members must actively communicate and interact with each other with the intention of establishing a common focus and achieving a common goal (Akkerman et al. 2007; Beers et al. 2006). To achieve this, valuable knowledge and information held by each group member must be actively shared (i.e., the information

must be retrieved and explicated), discussed (i.e., the information must be processed), and remembered (i.e., the information must be personalized and stored).

The choice of structured over traditional collaborative learning can be based on the following conclusions:

1. Relationships are fundamental for effective group working. Pupils often feel threatened and do not understand how to work in a group with their peers. It has also been found that teachers often cannot overcome this lack of group work skills in their classrooms. Conversely, it was also found that most teachers and pupils appreciated that supportive relationships are essential for the promotion of learning, and that relationships built upon trust between peers and between children and teachers, along with the ability to communicate, effectively resolve problems with partners (Hall 1994; Kutnick et al. 2005).

2. Effective group work involves an effective classroom context. If group work is to be effective, pupils must be able to work in a socially inclusive manner with all other members of their class without domination by same-gender or friendship preference groups, as noted in Kutnick & Kington (2005), and Kutnick et al. (2005). For pupils to draw upon supportive relationships, and to be less dependent on their teachers for their learning, the physical layout (e.g., seating and furniture), the curriculum, and the interactional contexts of the classroom (e.g., group composition and size) must be co-ordinate to support group work.

3. Adults need to structure and support group work experiences. Teachers are essential for the organization of the learning experience of their pupils, but as described in traditional collaboration, they rarely draw upon social pedagogic principles that would

relate pupil group size and composition to learning task and interaction and which would promote group work among the children.

Creating Effective Collaborative Groups

There is a consensus that rules must be outlined to have an effective collaborative activity. Sample rules and procedures would include the following practices:

- Balance the groups with recorders, readers, presenters; this helps build the group with the various strengths of the individual students.
- Designate specific roles such as: organizer, recorder, and spokesperson.
- Make each student accountable for his or her assigned task. Various forms or checklists can be easily developed. Students could be required to write exactly what their role was, how long they took to complete the task, and any other information pertinent to the particular assignment.
- Carefully monitor the progress of the groups. Students soon understand that this is not the time to visit. The teacher should walk around the room, answering questions, giving suggestions, and keeping students focused on the task.

- Train students to respond to a signal that will call their attention to the teacher. This should be practiced until they can respond quickly. Examples of common methods used to calling students to attention are a bell, raised hand, a whistle, or a tap on the desk. A classroom engaged in collaborative learning tends to get rather noisy, so it should be understood that great things are happening despite the "noise”.

Types of Structures and Their Usage

Kagan (1994; Kagan and Kagan, 1998) has developed roughly 200 classroom "structures", which may be thought of as steps to classroom activities. These structures stress positive interpersonal peer relationships, equality, self-esteem, and achievement. Students can work together by following the steps to the structure, using material or content selected by the students themselves or by the teacher. The structures have various aims, such as: building team spirit and positive relationships among students; information sharing; critical thinking; communication skills; and mastery (learning/remembering) of specified material. Many of the structures can fulfill a number of aims simultaneously, depending on how the teacher uses them. Structures can be mixed and matched, and adapted to the particular student group.

Here are a few examples from Kagan's (1994) book on cooperative learning. They range from simple to complex and the application in a given classroom would depend on the maturity level of the students and the subject matter.

- Think-Pair-Share - The teacher poses a question to the class. The students think about their response, and then students' pair with a partner to talk over their ideas. Finally, students share their ideas with the class.
- Rally table - Students are working in pairs, within their teams. Students will take turns writing on one piece of paper or completing a task.
- Numbered Heads Together - Students within the team count off from one to four. The teacher poses a question and the students in each quartet put their heads together to discuss the answer. The teacher randomly calls a number and from

each team the student with that number writes the answer on the team response board.

- Showdown - Each student writes his answer on his individual response board. When everyone in the group is ready, the leader says "Showdown" and team members compare and discuss their answers.
- Teammates Consult - All students have their own copy of the same worksheet or assignment questions. A large cup is placed in the center of each team, and students begin by placing their pencils in the cup. With pencils still in the cup, they discuss their answers to the first question. When all team members are ready, they remove their pencils from the cup and write their answers without talking. They repeat this process with the remaining questions.
- 4S Brainstorming - Students in the group have roles: Speed Captain (prompts more ideas), Super Supporter (encourages/recognizes all ideas), Synergy Guru (encourages members to build upon one another's ideas), and Recorders (writes ideas). Members carry out their respective roles while the team generates a variety of possible responses.

Characteristics of Structured Collaborative Learning

The "PIES" Concept

More than just clever classroom routines, each Kagan structure is based on four factors that Dr. Kagan considers essential to his structured approach to cooperative learning: (P) positive interdependence; (I) individual accountability; (E) equal participation; and (S) simultaneous interaction.

Positive interdependence means a "win-win" condition in which the success of one student is linked to the success of others in the class in a positive way. In other words, students need each other to succeed, and a gain for one student is a gain for others. In this kind of relationship, students care about each other and help each other so that all learn. In the interdependent relationship, a loss for one student is a loss for the whole group; in other words, the failure of one member is not merely an individual failure but a group failure, if the group did not adequately support the learner. Yet an individual success can be a group success if the group helped each team member succeed.

We can contrast the concept of positive interdependence with negative interdependence, where one student's failure could be another student's gain, such as when teachers grade on a curve (norm-referenced grading). With norm-referenced grading, a student doing badly increases the chance that another learner's score will be rated more highly. Thus, a loss for one student becomes a gain for another. Negative interdependence is often characterized by competitive rather than cooperative relationships between learners.

Cooperative learning teachers reject norm-referenced grading in favor of criterion-referenced grading. With criterion-referenced grading, any learner can do well assuming s/he meets the specified criteria. Some cooperative learning teachers also use specific incentives and rewards in addition to positively interdependent task design to increase the level of positive interdependence among a team or in a class.

A complete lack of interdependence means that the performance of one learner has no effect on another learner. Positive interdependence is built into Kagan structures

in that the activity cannot be successful unless the students cooperate. The students need each other for success. They cannot do the activity alone, and if they do not cooperate well the result will be failure; yet if they cooperate well the result will be success. While there are various models of cooperative learning, of which Kagan's structured approach is only one, all cooperative learning theorists and practitioners agree that cooperative learning must incorporate the concept of positive interdependence, and this characteristic distinguishes it from mere "group work".

Cooperative learning research has found positive interdependence to create better results in terms of learner achievement, human relationships, and psychological health, versus negative interdependence or no interdependence (Johnson and Johnson, 1989).

Individual accountability means that there must be a procedure to check that each participant individually contributes a fair share to a group effort. It also means that criteria must exist by which to evaluate the quality of the effort/result of each member. Accountability procedures could be implemented via devices such as teacher or peer observation, and require students to report on what the partner said. Equal participation means that all students receive the same chances and incentives to be involved in class. For example in Timed Pair Share, each member is given exactly the same amount of time to speak regardless of individual differences of age, background, personality, or language skill. Without using a structured approach (for example, asking two students to talk for four minutes, versus allowing each student two minutes), the teacher may find that the more extroverted student would be inclined to do more or even all of the talking.

Simultaneous interaction means that all students are actively engaged at the same time during the class. An example would be 20 pairs of students in a 40-person class all talking/listening simultaneously, as opposed to one student out of 40 answering a teacher's question, while all the others are or are not listening or participating. In Kagan's view, these four characteristics (PIES) must be built into the activity itself (i.e. be part of the task design). His over 200 structures were designed with the four elements in mind.

Multiple Intelligences and Structural Approach

Gardner (1993) identified numerous kinds of human intelligence, among which are: interpersonal; knowing how to effectively interact with others; the ability to know oneself; mathematical; musical; linguistic; bodily kinesthetic; and spatial. In Gardner's view, people may differ in their natural talents but all talents are important, can be honed, and are worthy of appreciation.

Kagan and Kagan (1998) present cooperative learning (CL) activities that promote the various multiple intelligences (MI), via peer collaborative tasks involving music or skills such as drawing, classifying, computing, moving the body, requiring students to collaborate in teams (interpersonal), or be introspective (intrapersonal), etc. Use of interpersonal intelligence CL structures enables the teacher to target interpersonal effectiveness as a skill for student development, which in turn helps foster peaceful classroom social environments. Intrapersonal intelligence is also linked to positive human relationships; research shows that persons who do not understand themselves are incapable of understanding others, and are thus incapable of responding appropriately to others (Ciaramicoli & Ketcham, 2000; Goleman, 1995; Goodman, 2002;

Kagan and Kagan, 1998; Meyers, 1994). Using a variety of MI activities in class highlights the MIs of students. As students witness the diverse abilities of peers, and notice their usefulness while performing the structured activities, they learn to appreciate and value each other's differing skills and gifts.

The Structural Approach Used to Create a Peaceful Classroom

As described above, structures can be used to create equal opportunities for all students in the classroom. These structures foster cooperation among students, positive interpersonal relationships; listening, turn taking, self-expression, and other appropriate communication and social skills; critical thinking, respect for diverse persons and abilities; appreciation of various viewpoints; and consensus-building. Learning appropriate (nonviolent) communication skills and appreciating diversity in all its forms can be a foundation upon which to create a peaceful classroom. Dr. Kagan believes using his structures can help build personal character, because while students are performing the activities, they can, at the same time, practice skills, or fulfill roles such as leadership, helpfulness, caring, impulse control, understanding, praising, kindness, cooperation, courtesy, citizenship, and others associated with virtuous character. Students who carry the knowledge of socially appropriate behavior, critical thinking, and appreciation of differences with them outside of the classroom will be better equipped to evaluate information and interact peacefully with others. Researchers (Cohen, et al, 1990; Johnson and Johnson, 1989; Johnson, Johnson, & Smith, 1991; Miller and Harrington, 1990; Ochi and Sugie, 2001; Slavin and Cooper, 1999) have found the results of cooperative learning to include higher self esteem, more positive peer relationships including improved inter-ethnic/cross-cultural relationships and lowered

levels of prejudice, and equal or higher academic achievement, compared to classrooms where students worked without cooperation (independently) or structured competitively (negative interdependence).

Dr. Kagan and other cooperative learning theorists/practitioners believe that traditional competitive classrooms do not foster pro-social human behaviors. In a classroom where no student-to-student interaction occurs, students do not learn to interact with each other, share information with each other, or help each other succeed. In a classroom where student-to-student interaction occurs but is not properly managed, structured, or planned by the teacher, the result can be unequal participation, competitiveness, and non-peaceful interaction. Kagan writes:

> We need to include cooperative learning experiences in our classrooms, because . . . students no longer come to school with an established caring and cooperative orientation . . . Additionally, we need cooperative learning if we are to preserve democracy. Exclusive use of autocratic, teacher-dominated classroom structures leaves students unprepared for participation in a democratic society. Democracy is not nurtured by a system, which models autocratic decision-making, and expects passive obedience among pupils. (Kagan, 1994, pp. 2-10).

Cooperative learning can be easily combined with a student-centered curriculum. With the structured approach, the content can be chosen by the students themselves, and the students' own ideas and input can become the main lesson material.

Potential Difficulties Related to Cooperative Learning

Cooperative learning may not be appropriate for the teacher who wishes to be the center of attention in the class, since CL makes students the focus of attention, especially if used in conjunction with a student-centered syllabus or curriculum. Although CL can be combined with other approaches, including teacher-centered and materials-centered approaches, it is essentially a student-centered approach. CL takes

some time for teachers to learn, although Kagan's approach attempts to simplify the process by providing teachers with ready-made structures for a variety of pedagogical purposes. Teachers, who wish to focus only on academic results rather than including the psychological health of students and positive interpersonal relationships, may be uninterested in the approach. It is important to note, however, that CL can also be used to help students master specified material.

MATERIALS AND METHODS

Population Description

The participants in this study were all true freshman (non-repeating) ninth grade Algebra I students ranging from fourteen to sixteen years in age. The study was conducted during the academic year of 2009 – 2010 in an urban public high school located in East Baton Rouge, Louisiana. These students were all part of the freshman academy program, which means they were all enrolled in the same four core subjects. The total school population, in 2009, was about 750 and nearly all of them were African American who were offered either free or reduced lunches. The school is classified as a Title 1 school and is in a high needs part of the city. The ninth graders were about 160 students and were taught by two teachers for the Algebra I course. Fifty-three students participated and successfully completed the study. Among the students that this researcher taught, fifty-three completed both pretest and posttest. The 9^{th} grade students' ethnicity and socioeconomic status mirrored that of the entire school.

Procedure

For the purpose of this study, the outcome variable is the student gain, defined as either raw gain or normalized gain. There were four classes included in the study, two in the morning and two in the afternoon. One morning class and one afternoon class were randomly selected as the experimental groups while the remaining morning and afternoon classes were designated as control groups. Cooperative learning strategies were practiced with the experimental group while only traditional grouping was done with the control group. Generally the duration of instruction was fifty minutes every day.

The cooperative and the non-cooperative groups differed also in the number of students that were enrolled in the respective classes. The design plan is represented in table 1.

Table 1. Research design plan

	Morning A.M	Afternoon P.M.
Non-cooperative group (Control group)	2nd period	5th Period
Cooperative group (Experimental group)	4th Period	7th Period

Pretest and posttest were administered to both the experimental and control groups to assess the students' ability to learn and retain the subject material. In the experimental group, structured cooperative learning (CL) strategies were practiced. Emphasis was also placed on students' social skills, and all students were held individually accountable while working in their respective groups. In contrast, the NCL group practiced traditional group strategies. Students occasionally worked in small groups but they were not structured. Students were not individually held accountable within their groups, and group members were not trained in social skills.

Implementing Cooperative Learning

During this pre-experiment period, structured cooperative strategies were applied to the experimental group. The students were trained how to form effective groups, to

communicate, participate in group tasks, and act according to assigned individual responsibility. Normally there were three or four students in each group, and students were changed between groups depending on the task or unit that was being taught. The two main strategies that were practiced were think- pair-share and round table discussion. In the think-pair-share strategy the teacher posed a question to the class. The students were given time to think about their response, and then students' paired with a partner to talk over their ideas. Finally, students shared their ideas with the class. In the round table strategy students worked in pairs within their teams. They took turns writing on one piece of paper in completing a task. They then presented their results to the class and answered questions from the entire class. Students' motivation was enhanced by giving them freedom to make their own groups and to assign mathematical names to their respective groups. Normally students were assigned roles considering their strengths and abilities. For example a student who portrayed strength in leadership became the group captain while one with good communication skills became the group presenter. The assessment was based on individual contributions and on the performance of the entire group.

The students' social skills were great component in the cooperative learning strategies. The purpose was to train them how to work effectively in teams. The students in the CL group were required to sign a letter of concept that they would behave themselves responsibly in their groups. Students were regularly reminded to respect the opinions of other students and give others time to present their results without interruptions. If a student in a group violated this rule the violator and the entire team were penalized by loosing. This made sure that team members checked on each

other's behavior. If the offence was repeated regularly, the parents or guardian were contacted either by a letter or by telephone. The teacher had the right to transfer a group member to another group where he or she would be productive. The training on social socials was incorporated in the instructions and no extra time was allocated for this activity.

Administering the Pretest and Posttest

I obtained permission to conduct this study from the Institutional Review Board at Louisiana State University A&M. all participants were required to have a letter of consent signed by a parent or guardian. Fifty-three students participated in the cooperative learning group while 22 students participated in the non-cooperative learning group. Students who failed to complete both the pretest and posttest in unit 3 were excluded from the data analysis. Table 2 shows the numbers of students who completed the unit 3 benchmark tests.

Table 2. Group category, number of students and teaching strategy

Group Category	Number of students	Teaching strategy
Experimental group	31	Cooperative Learning (CL)
Control group	22	Non-Cooperative Learning (NCL)

Before each unit was introduced, a pretest was administered to all students in both the CL and NCL groups. The unit 1 benchmark pretest and posttest were

administered during the first six weeks, and the unit 2 benchmark pretest and posttest were administered during the second six weeks. This was done to accustom the students to the benchmark tests and to the pretest-posttest format. By the time the unit 3 benchmark pretest and posttest were administered, all students were accustomed to taking the tests, and they had also adjusted to the academic and social challenges of high school. The Unit 3 pretest was administered at the beginning of the third six weeks. In an effort to prevent the students from memorizing the questions, the pretest was neither returned to the students, nor was it discussed or reviewed.

Assessment Instrument

The unit 3 benchmark assessment test was used for both Pretest and Posttest. A private company Edusoft, Inc., which operates as a subsidiary of the Riverside Publishing Company, creates the benchmark tests. The company is based in San Francisco, California and was founded in 2000. The benchmark exams modules help to administer standards-aligned school-wide or district-wide assessment programs. These tests are standards-based assessment solutions that make it easy for districts to collect, analyze and act on student performance data to improve classroom instruction and student performance. Although the benchmark tests were created in a different state, they are linked to specific objectives in the state of Louisiana and the East Baton Rouge School district. I extended the testing time in order to fit the needs of my students. Students started with the constructed response question and then completed the objectives question part during the second day of testing. If a student missed the test, time was allocated to complete the test later.

Analysis of the Pretest and Posttest

Using Hake's (1998) formula, normalized learning gains were calculated for both CL and NCL groups. Hake defined normalized learning gain as:

Normalized gain = (posttest score – pretest score) ÷ (max score – pretest score).

For example, a score of 80% on a pretest combined with a posttest score of 90% would yield a learning gain of 0.5. Thus, the student learned 50% of what could have been learned as measured by the test. If a student answered all questions correctly on the posttest, the learning gain would be 1. The learning gain metric has a singularity if a student scored perfectly on the pretest. When this occurred, a score of 99 was recorded for that test. The effects of teaching strategies on normalized learning mean gains were analyzed using a spread sheet.

RESULTS AND DISCUSSIONS

The students' scores on the unit 3 benchmark pretest and posttest varied widely for both groups (table 3). It is evident that the gain realized by the cooperative group was greater compared to the gain in non-cooperative group. The cooperative learning group had an average raw gain score of 3.81± 0.64 resulting in a 57% net gain in raw score while the non-cooperative group had raw gain of 2.27± 0.73 that resulting in a 37% net gain in raw scores. This suggests that a larger net gain was realized in the cooperative learning group compared to the non-cooperative learning group. The raw gain in the CL group ranged from -2 to +11 number of correct answers , while in the NCL group the range was from -4 to + 8 number of correct answers. There were some negative raw gains because several students scored higher on the pretest than on the posttest (Appendix A and B).

Distribution of Normalized Gains

Figures 1and 2 show the distribution of normalized gain scores for cooperative and non-cooperative groups respectively. The mean normalized gain for the CL group was 0.27 ± 0.05. Likewise, that of the NCL was 0.15 ± 0.06. The data are clustered closer to the mean in the CL group. 77% of the students showed a positive gain while 23% showed no or slightly negative gain in the CL group. In comparison, 68% of the students in the NCL group showed a positive gain while 32% showed no or slightly negative gain.

Table 3. Pretest, posttest and normalized gain results for both CL and NCL groups that show mean, Standard deviation and standard errors.

	Pretest and posttest for CL and NCL groups							
	Cooperative Learning (CL) n = 31				Non- Cooperative Learning (NCL) n = 22			
	Pretest	posttest	Raw Gain	Normalized Gain	Pretest	Posttest	Raw Gain	Normalized Gain
Range	2-12	4-17	-2-11	-0.2 - 0.7	2-12	3-19	-4-8	-0.3- 0.8
Mean	6.50	10.34	3.81	0.27	6.10	8.41	2.27	0.15
Standard deviation	2.36	4.18	3.58	0.25	3.28	4.24	3.41	0.27
Error of the Mean	0.42	0.75	0.64	0.04	0.70	0.90	0.73	0.06

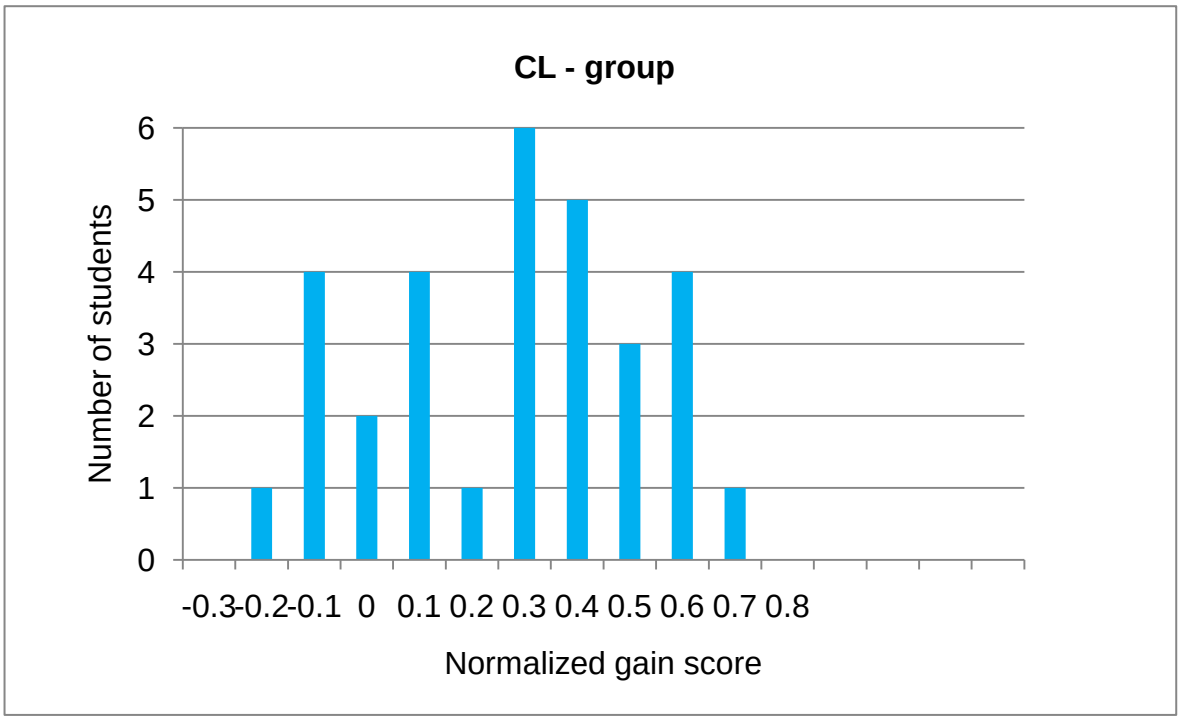

Figure 1. A histogram displaying distribution of normalized gain scores for CL group.

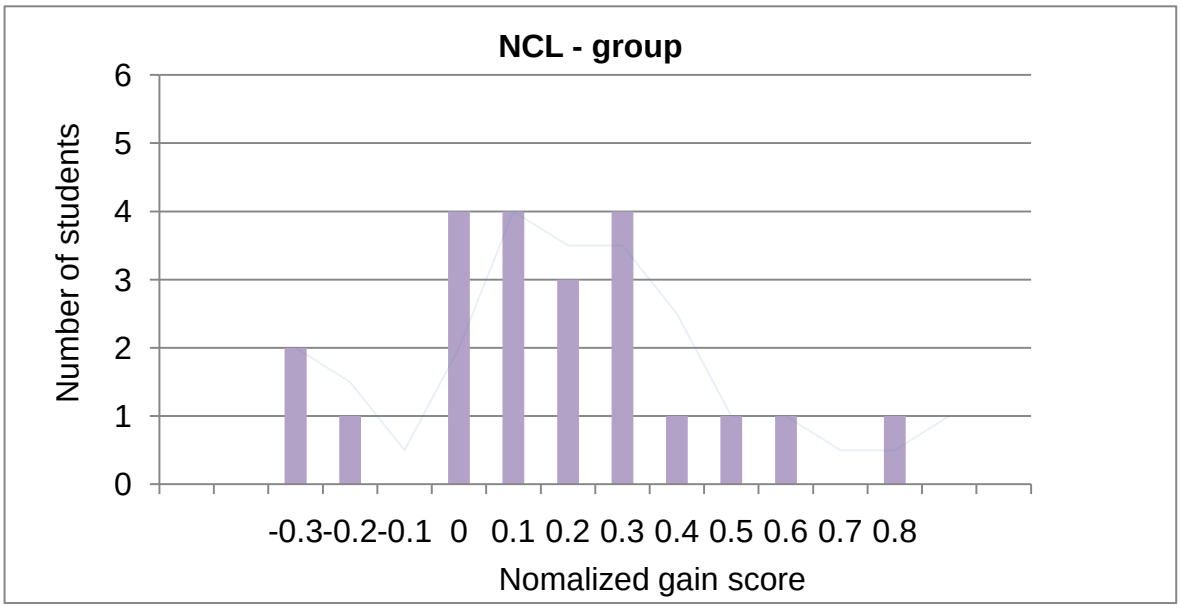

Figure 2. A histogram displaying distribution of normalized gain scores for NCL group.

Comparing the Pretest and Posttest Scores

Student performance in the pretest and posttest for the cooperative learning group was compared (Figure 3). The average posttest score was 10.34 ±0.75 while the average pretest score was 6.50 ±0.42. The positive net gain indicates that students learned after the five weeks of instruction. Figure 4 shows the comparison between the pretest and posttest scores for the NCL group. The average posttest score was 8.41 ± 0.90 while the average pretest score was 6.10± 0.70. This is also evidence those students in the NCL group gained knowledge after the study period. The calculated one-tailed t-test for the CL group yielded a p-value of 8.9×10^{-7}. This very small p-value indicates that the difference between the average means for pretest and posttest is statistically significant above the 95% confidence level. This suggests that students realized gain in knowledge. Likewise, the t-test result for the NCL group yield a p-value of 0.003. This also suggests that the difference between the average means for pretest and posttest in the NCL group is statistically significant above the 95% confidence level. Again, there was a positive gain in knowledge in the non-cooperative group.

Comparing Prior Knowledge between the Groups

A comparison of pretest scores between the CL and NCL groups was performed to check for possible differences in prior knowledge (Figure 5). The CL group mean pretest score (6.50 ±0.42) was very close to that of the NCL group (6.10± 0.70). The two-way t-test yielded a p-value of 0.674. This suggests that there was no statistically significant difference in prior knowledge between the two groups; that is, all the students in both groups had similar knowledge background.

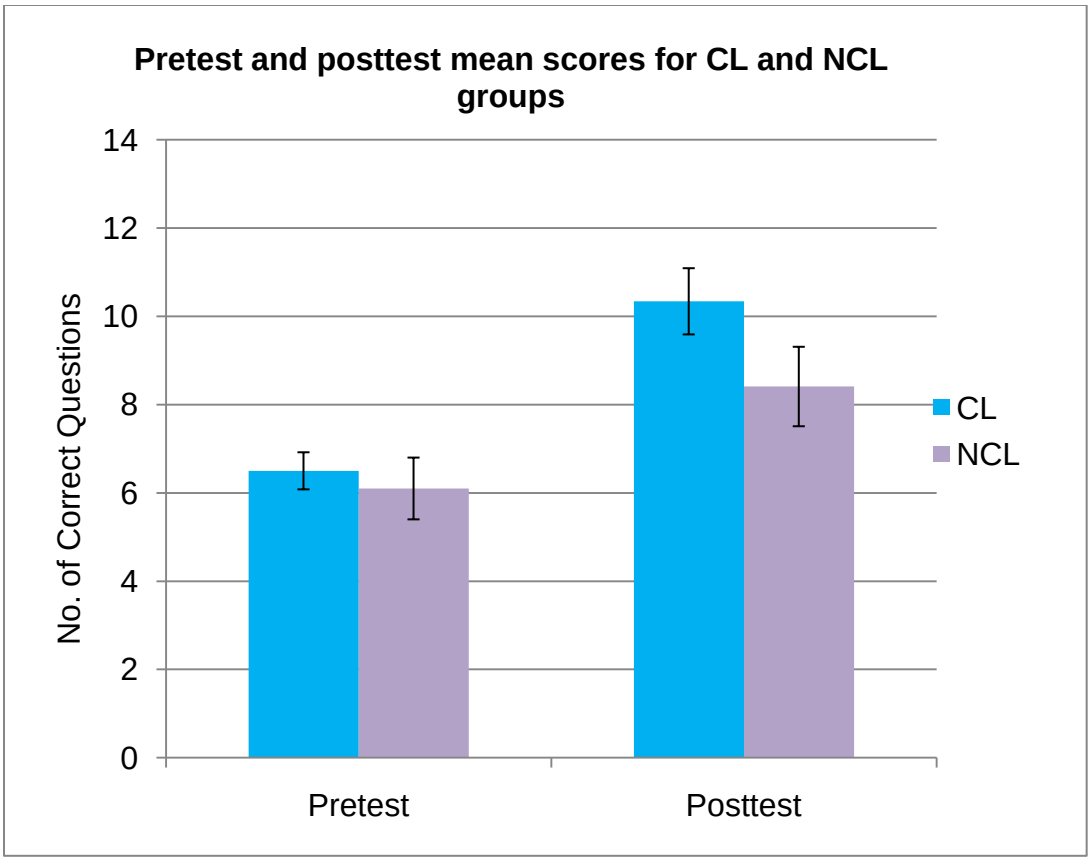

Figure 3.Comparison of average values of pretest and posttest scores for the cooperative learning and non-cooperative groups. P (one tail t-test) values are both less than zero at 95% confidence level.

Comparing Mean Normalized Gains

The final comparison was made on the normalized gain between the experimental and the control groups (table 7). The normalized gain measures the fraction of the available improvement realized. The average normalized gain for the CL group was calculated to be 0.27 ± 0.04 while that of the NCL was found to be 0.15 ± 0.06. The two-way t-test yielded a borderline p-value of 0.055. This suggests that there is no statistically significant difference between the two groups based on the 95% confidence level.

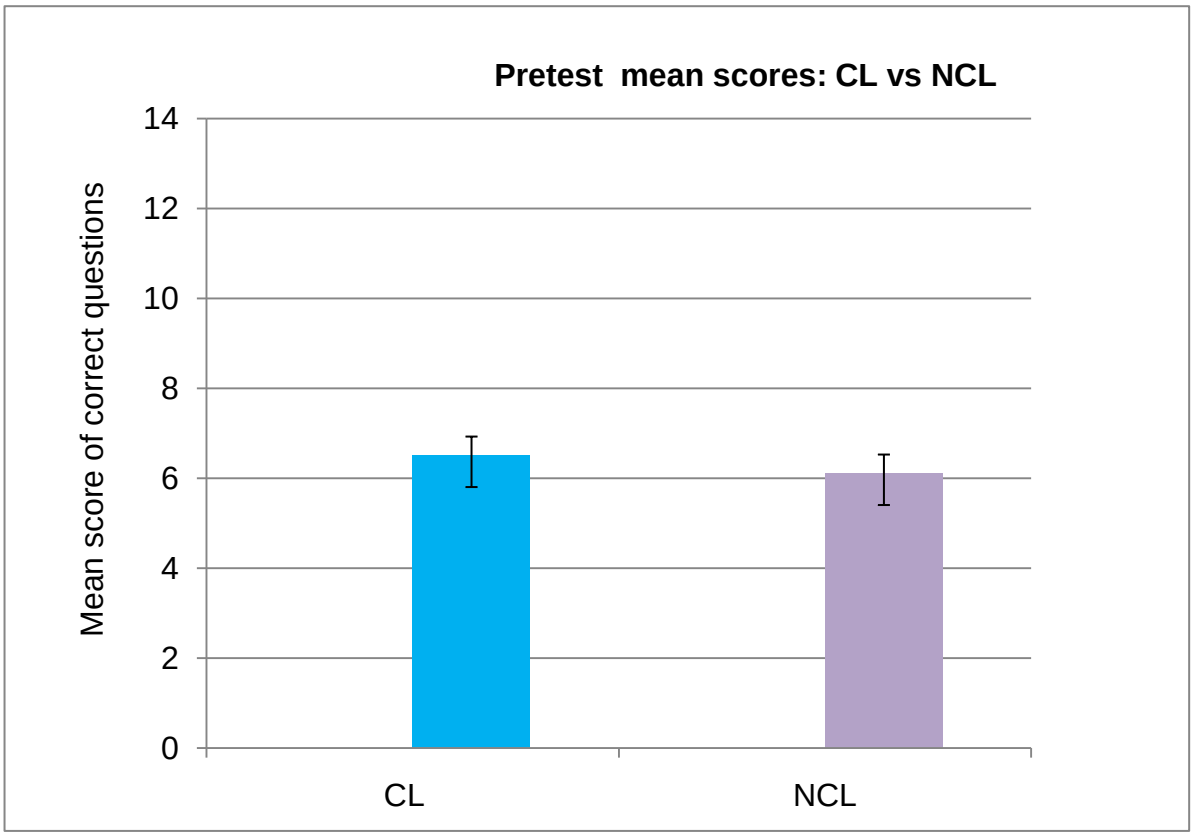

Figure 4. Comparing CL and NCL pretest average scores. The difference in the average scores in both groups is very small.

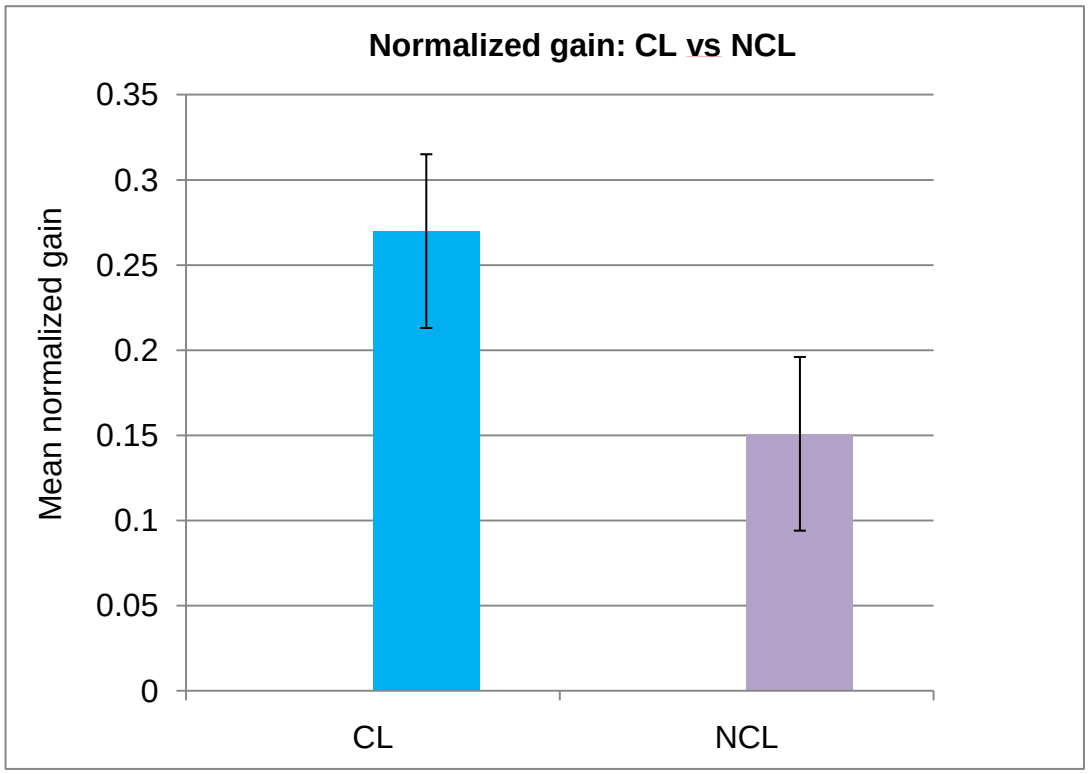

Figure 5.Comparison of mean normalized gains between CL and NCL groups.

Limitations

The data in this study are limited to only one public school district in Louisiana and specifically to the 9th grade level. The school is located in an urban area, and almost all students are African Americans who receive either free or reduced lunches.

For a variety of reasons, not all students in my classes completed the unit 3 pretest and posttest, and these students were excluded from this study. Some students were absent because of behavior problems. Others failed to complete both tests because their schedules were changed between the two Algebra teachers. Other students transferred between different schools during the course of the study. All these factors reduced the size of the samples in both experimental and control groups which consequently lower the validity of the study.

SUMMARY AND CONCLUSION

This study evaluated the effectiveness of cooperative learning structures in improving student performance. Both the cooperative learning group and the non-cooperative learning group showed net positive learning gains but the cooperative group achieved a relatively greater gain, although the difference was only marginally significant statistically. This suggests that learning by structured cooperative strategies may not have a significant advantage over learning by traditional group method.

Although the findings were not statistically significant, the practice of cooperative strategies seems to have a positive effect on student learning. For example, it was clearly observed that students who worked in structured cooperative groups were more engaged during their group activities. Many students became accountable to the work they were assigned to and the groups became more organized. The teacher became more of a facilitator than an instructor thus improving teacher-student connection. And finally, due to the active involvement by the students in naming and managing their groups, the level of students' motivation increased thus creating an overall positive learning environment.

The results of this study should encourage teachers to practice structured cooperative learning strategies in their classrooms in order to promote students' participation and student-centered instruction.

This study also yields several important recommendations for additional research. Areas for further studies include the role of structured cooperative learning strategies to students' long-term knowledge retention, and preparation of a qualitative survey to assess students' perception of structured cooperative learning.

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APPENDIX A

RAW DATA: COOPERATIVE LEARNING GROUP

Student No.	Pretest	Posttest	Raw Gain (post-pre)	Normalized Gain
1	3	8	5	0.28
2	5	4	-1	-0.06
3	5	15	10	0.63
4	6	5	-1	-0.07
5	12	16	4	0.44
6	8	8	0	0.00
7	5	6	1	0.06
8	10	16	6	0.55
9	5	5	0	0.00
10	7	13	6	0.43
11	7	11	4	0.29
12	12	17	5	0.56
13	6	12	6	0.40
14	8	17	9	0.69
15	9	7	-2	-0.17
16	8	16	8	0.62
17	6	5	-1	-0.07
18	9	15	6	0.50
19	6	10	4	0.27
20	5	9	4	0.25
21	5	7	2	0.13
22	8	9	1	0.08
23	6	4	-2	-0.13
24	2	7	5	0.26
25	7	11	4	0.29
26	7	13	6	0.43
27	6	7	1	0.07
28	7	12	5	0.36
29	4	13	9	0.53
30	4	7	3	0.18
31	3	14	11	0.61
Mean score	6.50	10.34	4.1	0.27

APPENDEX B

RAW DATA: NON-COOPERATIVE LEARNING GROUP

Student No.	Pretest	Posttest	Raw Gain (post-pre)	Normalized Gain
1	4	8	5	0.29
2	2	8	6	0.32
3	9	16	7	0.58
4	3	5	2	0.11
5	7	4	-3	-0.21
6	9	11	2	0.17
7	4	10	6	0.35
8	12	12	0	0.00
9	5	13	8	0.50
10	6	11	5	0.33
11	11	8	-3	-0.30
12	9	9	0	0.00
13	2	5	3	0.16
14	3	3	0	0.00
15	4	4	0	0.00
16	3	4	1	0.06
17	2	3	1	0.05
18	6	7	1	0.07
19	5	9	4	0.25
20	8	10	2	0.15
21	9	5	-4	-0.33
22	12	19	7	0.78
Average score	6.10	8.41	2.2	0.15

VITA

Jonah Mungai Njenga was born in Kenya. After graduating high school, he was enrolled in East China University of Science and Technology in Shanghai, China, and received a bachelor of science in chemical engineering in July 1991. In December 1995, he graduated from Louisiana State University with a master in civil and environmental engineering. He entered Louisiana State University Graduate School in June 2008 and is a candidate for the Master of Natural Sciences degree. He expects to graduate in December 2010.