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Does flexible grouping increase retention levels to improve test scores more than traditional lecture in the science classroom

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DOES FLEXIBLE GROUPING INCREASE RETENTION LEVELS TO IMPROVE TEST SCORES MORE THAN TRADITONAL LECTURE IN THE SCIENCE CLASSROOM

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ABSTRACT

The purpose of my research was to analyze the effect flexible grouping had on science retention scores. Education faces so many challenges today. The old way of teaching, traditional lecture is being challenged. For centuries, traditional lecture was the primary way of teaching and most colleges still use this teaching method. In this thesis traditional lecture and flexible grouping are compared. Through the use of pretests and posttests in my traditional and honors chemistry classes, I tested both strategies. Presentation of seven chapters were used for data collection and through the research, several things were discovered. In this study, honor students had more knowledge of subjects going into each subject than my traditional students. Data, collected for a year, showed no statistically significant differences between traditional lecture and flexible grouping. Through the normalized gain, it was discovered that flexible grouping did have a positive influence on student learning. The posttest scores on average were better for flexible grouping than traditional lecture.

INTRODUCTION

Historical Perspective

For centuries, many of our great scholars such as Socrates and Aristotle have learned from and have taught their students through traditional lectures. When you analyze school systems in the past, students sat in desks and listened to the teacher lecture on the subject of the day. This style, traditional lecture, has a long history and still is the foundation for most universities and other educational forums use today. According to Mariya Y. Omelicheva, and Olga Avdeyeva, lecture is arguably, the oldest known instructional technique used in the university setting(Day,1980). Since it was employed in Plato's Academy, lecture has become an indispensable part of teaching favored across the college and university curriculum. Traditional lecture is where the teacher is center of focus while the students listen to the instruction given to them by the teacher. In this setting, students are passively sitting in their seats and are not actively engaged in the instruction. According to Bonwell(1996), there are advantages and disadvantages to the lecture style of teaching. Some advantages to the lecture are: it allows the instructor maximum control of the learning experience and appeals to students who learn by listening, while some disadvantages are that students become passive and not intellectually engaged in the lesson and after fifteen to twenty minutes their attention to the lesson wanes.

What is Peer Instruction?

Traditional lecture has come under attack from many educators over the years for its presumed inability to foster higher order cognitive and attitudinal goals (Cashin, 1985). Critics of traditional lecture-based formats call for replacement with active learning approaches that provide students with an opportunity to meaningfully talk, interact, write, read and reflect on the content, ideas and issues of an particular subject (Meyers and Jones 1993).“It is clear that active processing of information, not passive reception of information, leads to learning.” (Lujuan, and DiCarlo , 2005). They also add that”” students must construct their own understanding of learning and teachers must reduce the use of the passive lecture format” (Lujuan and DiCarlo, 2005) A new trend in education today is active learning or peer instruction(Smith et al, 2009).Some of the educators that were pioneers in peer instruction were Drs. Spencer Kagan and Eric Mazur. According to Mazur (2009), Peer Instruction is a pedagogical approach in which the instructor stops lecture periodically to pose a question to the students. This process of lecturing and asking students questions during the lecture allowed students to become more engaged in the lesson. With the professor’s stoppage at certain points in the lesson to allow student to work in groups and discuss questions, students are allowed to think and become more engaged in the lesson. In theory, this engagement results in better retention of the lesson. Peer Instruction includes many activities that have different names. Think-Pair Share, Flexible Grouping, Cornell Notes and other strategies are all part of Peer Instruction. According to Lyman (1987) Think Pair Share activities pose questions to students that they must consider alone at first and then discuss with a partner or partners. Some advantages to the Think Pair Share Instructional model are: it gives an instructor a format change within the lecture; it allows the teacher to ask a different level of questions and allows the teacher to listen to different partners to gauge the understanding of the material, (Lyman, 1987). According to Fisher and Frey (2004), research shows that students who take good notes perform better on tests and is crucial for success in college. When actively engaged in taking notes, students become more focused in the learning process. The Cornell Note Taking System, first developed at Cornell University, has outlined steps in the following process: record (using columns), reduce (find key words), recap (summarize notes), recite notes, reflect and then review.(Fisher and Frey 2004).

Flexible Grouping

According to Valentino (2000), the concept of flexible grouping is not new in America. The roots of flexible grouping began in one room school houses where students of varying ages, back ground and educational abilities were grouped to meet instructional needs. Radenich and McKay (1995) defined flexible grouping as “grouping that is not static, where members frequently change.” Radenich and McKay (1995) also remind us that when teachers plan for flexible grouping, they consider the strengths and weaknesses of the group to allow the teacher to meet the need of the classroom. Valentino (2000) believes that teachers are discovering that flexible grouping make the job of teaching easier and student learning more productive. Flexible grouping according to Tomlinson (2003) is a way to encourage students to see themselves in a variety of roles with expertise and experience. With so many active instruction strategies to choose from, it can become overwhelming as to which strategy to focus on.

Despite frequently being called passive and ineffective (Mazur, 1997, Powell, 2003), the lecture remains very much alive. Wilson and Korn (2007), state that good lectures can be compelling and the suggestion that lectures are inherently ineffective after fifteen minutes has been called into question. Researchers think particularly in a large class that there should be a balance between the two teaching styles of lecture and active instruction. Walker (2008) state that active learning or peer instruction can replace lecturing with more student centered activities such as group work. He also recommends using both peer instruction and traditional lecture can increase student retention thus positively increasing test scores.

According to Smith et al (2009), research presented showed the use of both traditional lecture and peer instruction. Students were posed questions during lectures and given a chance to discuss the material in groups. Through the use of pretests and posttests, the teacher instructed them on the material presented and allowed them to review and correct any errors they made. During this experiment, several methods such as the use of active learning only, traditional lecture only and a combination of both traditional lecture and active learning were tested. Students were given several tests, both pretests and posttests on the material. Each of the described methods was tested. Each of the instructional methods did show some gain in their pretests and posttest scores, but Smith et al (2009), wondered did the grouping of students and their previous knowledge of material, influence the test results. For students who had some prior science background knowledge for a particular topic, their test results did not show any significant gains using traditional lecture or active learning when compared to students who had no prior science knowledge. When both weak and strong science students received both the instruction from the professor and a time period within the lesson for active learning, the results showed that a combination of both traditional lecturing with active learning resulted in significant gains in test scores and student retention in science.

Knight and Wood (2005) performed a similar experiment with an introductory biology course at the University of Colorado at Boulder. The researcher wanted to analyze the effects of increasing active learning in a traditional lecture- based classroom. The goal was to reduce the amount of time the teacher allotted for lecture and increase the time allotted for active learning and to analyze the effect on student's retention levels and to increase test scores in the classroom. During their two years of research, the researchers designed one class as strictly traditional lecture and the other class was to receive both traditional lecture and active learning. The researchers then flipped the procedure by giving the class that had strictly traditional lecture both traditional lecture and active learning and the class that had received both, only received the traditional lecture. Their major findings were that a balance of both lecture and peer instruction improved student performance in class. Through the use of pretests and posttests, the researchers found significant gains in test scores and student retention of course content.

A major ten- year study was done by Crouch and Mazur (2000) at Harvard University. The researchers over their years of lecturing found that their students were not retaining information. Even the best students, those who made good grades on tests, were not retaining the information past a test and Crouch and Mazur wanted to find ways to increase student's retention level in their physics courses. The researchers started to increase active learning. The researchers started to use techniques and strategies such as pretesting to get their students more engaged in the lesson. By giving their students chances to preview the material and to work in active learning groups, the researchers wanted to increase their student's conceptual learning of the course. With the pretest questions, their hope was to increase student's engagement in the lesson so that their students would become better students. Through tests and allowing students to group and discuss the subjects, they found student's level of retention were higher when they increased active learning than just lecture alone. They found that the balance of traditional lecture and peer instruction did improve test scores and student's retention levels.

The Purpose of my Study

Based on the studies summarized in this introduction, the purpose of my thesis was to compare traditional lecture with an approach using a balance of lecture and active learning. Since there are so many strategies as stated earlier, flexible grouping will be the active instruction strategy to be tested with traditional lecture. Flexible grouping is small group interaction during a lesson. Questions from the lesson are proposed to each group which ranges from two to four students with different academic levels. There are different ways of grouping students in the classroom based on academic and social skills. This difference in the level of students in the class room, according to some proponents, would allow students to interact with each other. The multiple levels in the group will allow students to perform a particular role in the group where as traditional lecture, students can get lost in the system. The purpose of my research would allow traditional lecture to occur and incorporate flexible grouping into the lesson. According to research there should be a delicate balance of active learning and traditional lecture. Many researchers say traditional lecturing would not result in good retention for tests scores. The research will compare retention levels for traditional lecture and active learning. My hypothesis was that traditional lectures produce excellent test scores and will result in a high retention level. The experiment analyzed the addition of active learning, in this case flexible grouping, as to whether it could produce the greatest retention and best test scores in my chemistry classes

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MATERIALS AND METHODS

Population Description

This study was conducted at a rural public high school in St. John the Baptist Parish in Louisiana. All activities related to the study were done during the 2012-2013 school year. The participants in the study were students ranging from the eleventh through twelfth grades in regular and honors chemistry classes. As of 2012, the student population at our school was 213 students of which 212 are African American and one student is Hispanic. Our school is a Title One school and has a 97% free or reduced lunch population. Most of our students are from low socioeconomic families. My study included 42 students composed of 18 girls and 24 boys in my classes of regular and honors chemistry. All students in both classes received and completed both pretests and posttests. Of the 212 students at our school, 14.6% are considered students with disabilities in speech, reading and language. In my classroom, there were five students classified as 504 or students with disabilities in my classroom. These students have an Individualized Education Plan, (IEP) that allowed the student to reach his or her full academic potential.

Procedure to be used in the classroom

The purpose of this study was to determine the student gain, defined as either raw or normalized gain. Being at a very small school, there were three classes involved in the study. Even though two classes were regular classes and the other one was an honors class, all were of the same subject, chemistry. All participants in the research had a signed permission slip on file to indicate, along with my Institutional Review Board,(IRB) and permission from my nor and school district that all data collected could be used in the research(Appendix B). These chapters were chosen because they are the topics that are discussed in Chemistry 101, for non science majors in colleges. The topics to be used in the research were as follows:

1. The Chemical World- students explained general terms such as the importance of chemistry in the world today and discussed the branches of chemistry.
2. Measurement and Problem Solving-students learned how to apply mathematics in chemistry and converted units such as meters into inches.
3. Matter and Energy-students discussed the phases of matter such as solids, liquids and gases.
4. Atoms and Elements-students discussed the particles of an atom such as protons, neutrons and electrons.
5. Molecules and Compounds-students examined how compounds form
6. Chemical Composition- students named compounds and wrote chemical formulas
7. Chemical Reactions- students examined how chemicals react with each other and discuss the types of reactions that occur in nature as balanced equations.

During the study, traditional lecture and flexible grouping were used. To establish a control group, the traditional lecture was given to all groups for alternating topics established in the research. To ensure that students were starting with similar knowledge, the topics listed above, all groups received a pretest and a posttest. To ensure that the experiment of flexible grouping occurred, every other topic in the chemistry course received flexible grouping. To clarify my procedure, all classes first took a pretest. Then all groups received some traditional lecture but flexible grouping took place only in the regular chemistry class while the honors class had the same topic but only received traditional lecture for that topic. After that topic was discussed for a week or for a week and three days, both groups received a posttest. All lectures were designed to last 45 minutes per class period. The students were given the guidelines to flexible grouping, which lasted about 30 minutes, and then we came together for 10 minutes to discuss their results.

In the traditional lecture only, the same procedure occurred but the students weren't allowed to interact with each other, they had to work all problems by themselves for 30 minutes and then we discussed themfor 10 minutes. After the designated time, both groups received a post test and then the results were compared for the basis of this study. The experimental group, flexible grouping, alternated for each topic depending on who received the experiment on the previous topic to ensure both groups of students received the experiment being tested. To ensure the procedures were done in flexible grouping, a white board activity was added to check for responses. A student was randomly selected from each group to explain the problem and if the group was unable to explain the problem, then points were deducted from the participation grade.

Implementing Flexible Grouping

Flexible grouping was the peer instruction strategy being tested in this research. According to Ford (2005), "the overuse of homogenous small groups often meant that students never had access to the same quality of instruction as others did because homogenous groups were based on ability". At times this allowed students to work with peers with diverse skill levels. Laird (2005) did not want teachers to rely on convenience or self-selected groups in active learning experiences. To eliminate bias from the teacher and to have a range of student ability in each group, the teacher used a Kagan Online Tool called Team Tools. Students' names were divided into their respective group according to the regular chemistry rosters and honors chemistry class roster. To ensure that my groups had a range in different abilities and to keep students from trying to predict the pattern of how groups were chosen, the computer program, Team Tools, determined the group based on the following criteria:

1. Students placed in groups depending on the pre test scores.

2. Students selected heterogeneously, mixture of academic standing and sexes.
3. Groups selected randomly.

The researcher ensured group sizes ranged from three to five students depending on the number of students on role as of August 2012. The researcher announced the Team Tool groups of the day as stated earlier and students were placed in groups after the lecture to begin work. The researcher walked around among the groups to ensure all students in each group worked together. It was stipulated that each member of the group must be able to explain the problem being discussed. One student was selected by the researcher from each group to explain the problem to the class and if that person could not explain the problem, then the group did not receive the points on the major exam related to that topic. The guidelines included students were to only interact with their own group members, no nonrelated topic discussion was to occur and all students must be engaged was discussed before flexible grouping begins on topic two, measurement and problem solving.

Administering the Pretests and Posttests

All students received a pretest related to all topics discussed in the research. The pretest came from a test bank from the Pearson Chemistry text book (Wilbraham and Staley, 2012). The program used by this text, *Exam View,* (Pearson Education 2012). To avoid bias from the teacher, the computer had selected 20 questions on each topic. The first topic, the chemical world, only had 12 questions, but students were told that every pretest had 20 questions. Students were given twenty five minutes to answer all of the questions. To ensure students take this test seriously, it was stated that the scores used were for research purposes and were not used to determine their grade, but all questions answered correctly resulted in extra points added to your topic examination given at the end of the chapter. Using the Pearson Education Software, Exam View (2012), the researcher provided questions in the form of multiple choice answers.

Testing Procedure

A sample question is provided from the unit one the chemical world topic. The questions would be similar to one stated:

Which of these steps should always be followed for effective problem solving?

a. using a trial and error approach and then evaluating,

b. performing metric conversions,

c. buying a larger quantity of material than estimated,

d. developing a plan and then implementing the plan.

The researcher gave all students form A as the pretest. All tests were done on scantron to allow the researcher to grade and record the scores quickly on Microsoft Excel. The testers were given a research number by the researcher to assure that each student remained anonymous. All documents were locked and stored in a secluded location and all scores kept electronically by the researcher. After the given amount of time of a week to week and a half, all students were given form B, which are the same questions, but this time they were randomly sorted to avoid students memorizing the answer from form A. There was discussion of the questions after the posttest but not the pretest. To properly compare data collected from the pretests and posttests, the results were properly categorized as data collected from traditional lecture only and data collected from the addition of flexible grouping with traditional lecture.

Assessing the Data

The purpose of the research was to compare the effects flexible grouping compared to traditional lecture in the retention of knowledge in the science education. Pretest and posttest scores were analyzed using normalized gain scores through calculations from the formula, (post score – pre score)/ (100 - pre score) Hake (1998). The results collected from the researchanswered the hypothesis as to whether flexible grouping does increase the retention levels of students in science education. Results compared similarly to other research based statistics to ensure the average scores, t test scores and others were compared using the inSTAT program and Graph pad data analysis. InSTAT and Graph pad are statistics programs that our Biological Department gave the LaMSTI assess to in order to perform our data analysis and to draw proper graphs for analysis. Both programs are found online and were given a free trial demonstration to complete our data. During the study, I compared a number of factors to test whether flexible grouping has an effect on the retention of science information as measured by the effects test scores. First, I compared the difficult chapters such as chapters 2, 5, 6 and 7. I wanted to know if flexible grouping helps students perform better in those difficult topics. Another key aspect that I analyzed was whether girls or boys do better with the flexible grouping or traditional lecture. Physical Science was a subject taught at our school and use the pretest and posttest to determine through the data, especially among my honors students, as to which ones had strong science standardized test scores on PLAN. PLAN is a test given to tenth graders to predict their science scores on the ACT or American College Testing exams. These factors helped me to determine whether flexible grouping had made an impact on my students' retention level as measured with comparisons of their posttest scores compared with their pretest scores on each topic indicated for research.

RESULTS

This study used flexible grouping (symbolized by fg on all graphs) and traditional lecture which was (symbolized by tl on all graphs). After the second chapter, flexible grouping was then applied to every other chapter discussed in the research. This was done to analyze its effect on the pre and post scores for each chapter. The results were then compared to traditional lecture that was done either by itself or combined with, flexible grouping.

The study was done on seven chapters in the chemistry textbook. As stated earlier, these chapters were chosen because they were the first chapters discussed in Chemistry 101, a dual enrollment class offered at our school. With so many strategies in active learning, flexible grouping was chosen because according to the research by Valentino (2000), it would allow my job to become easier and the students would have greater responsibility in their learning. For the entire school year, two regular chemistry classes were compared with one honors chemistry class. Chapter one basically served as an introductory to chemistry while chapter two began with having students perform metric conversion and mathematical operations in chemistry. As stated earlier, chapter one only had 12 questions and the rest of the chapters had 20 questions. In order to equalize my point distribution for analysis, the raw data for chapter one, was multiplied by a factor of 1.667. Both regular chemistry classes used traditional lecture for chapter one and for chapter two both groups used flexible grouping. The same procedure was done for my Honor's chemistry students. Both raw data scores had a set of N=28 thus allowing me to use the repeated measure ANOVA test with all values calculated in the Tukey-Kramer test.

The first group on all graphs were the honors chemistry students (N=14), symbolized by hrchem, the first regular chemistry, (N=20), symbolized by reg chem., in the fall and the second regular chemistry class, (N=8) symbolized also by reg chem. in the spring all received a pretests and posttests.   The data presented in Figure A-1, (Appendix A), shows to the honors chemistry students' raw scores for chapters one and two. For chapter one, traditional lecture was given while flexible grouping was used for chapter two, Figure 1 shows the normalized gain for the honors chemistry classes.

There is not a significant difference between pretest and posttest scores for traditional lecture for the honors class on the pretest. With traditional lecture pretest average of 3.5 ± 0.34 and the posttest average was 5.6 ± 0.55. The increase from pretest to posttest was not significant. There were significant increases for students receiving flexible. The average score for the pretest was 4.4 ± 0.43 and a posttest score of 7.7 ± 0.50. The gain was statistically significant, $p < 0.05$. (Refer Appendix A, Figure A- 1).

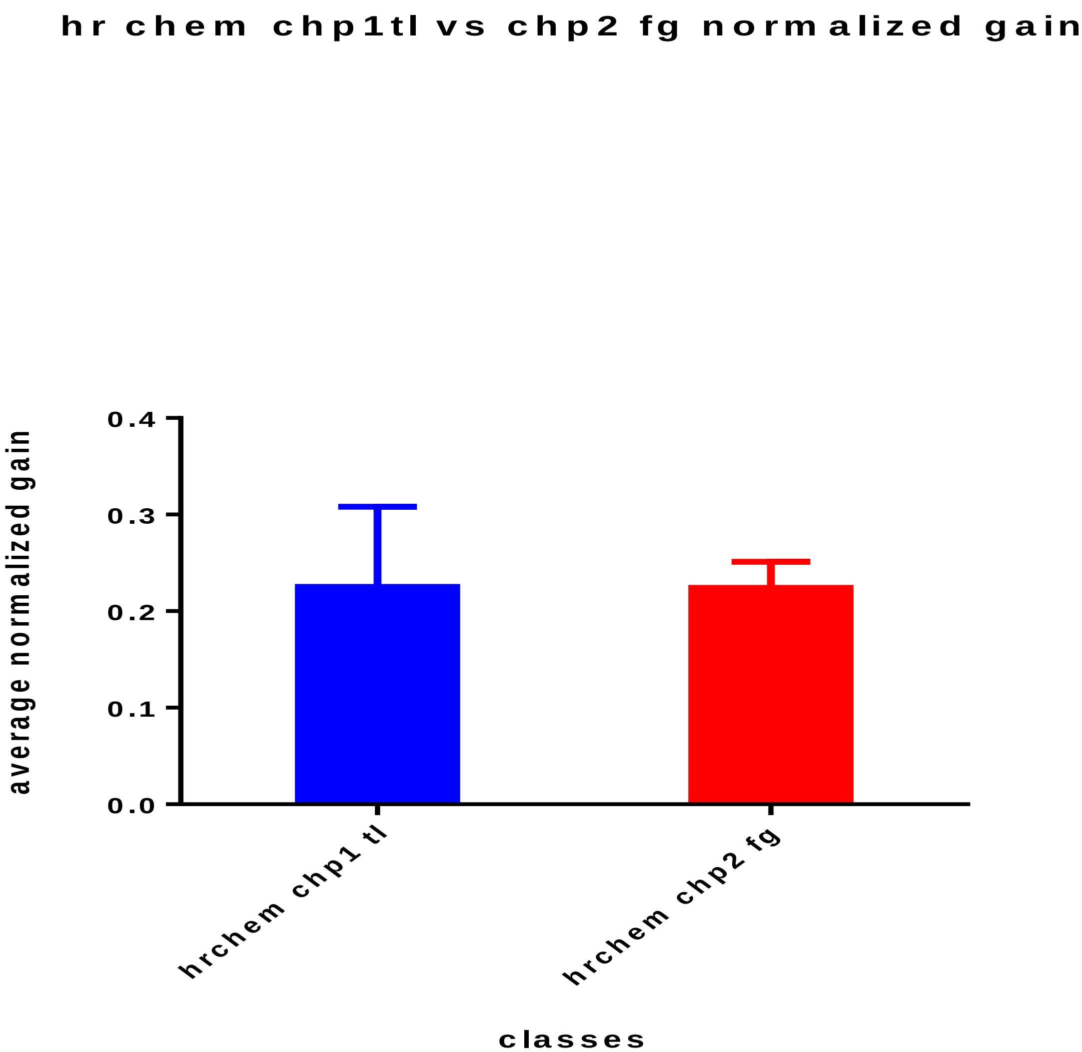

Figure 1. Normalized gains for honors chemistry students comparing chapter one and chapter two**.**

Normalized gains comparing chapter one with traditional lecture for the honors chemistry and chapter two with flexible groups. Means were compared using the Wilcox matched pair test. The mean normalized gains were 0.22 $\pm$ 0.08 for the traditional lecture and 0.22$\pm$ 0.03 for flexible grouping. The difference in normalized gain was statistically significant for these chapters of study.

The pretest and posttest scores for chapter one, which served as the introductory chapter and chapter 2 for the fall semester and spring semester regular chemistry classes are given in Figure A-2 (Appendix A). The pretest average was 6.8$\pm$ 0.56 and the posttests average was 9.1$\pm$ 0.96. This difference was not statistically significant. The mean pretest for flexible grouping was 5.3$\pm$ 0.31 and a mean posttest of 6.8$\pm$0.34. There was also no significant difference between pretests and posttests scores in this chapter.

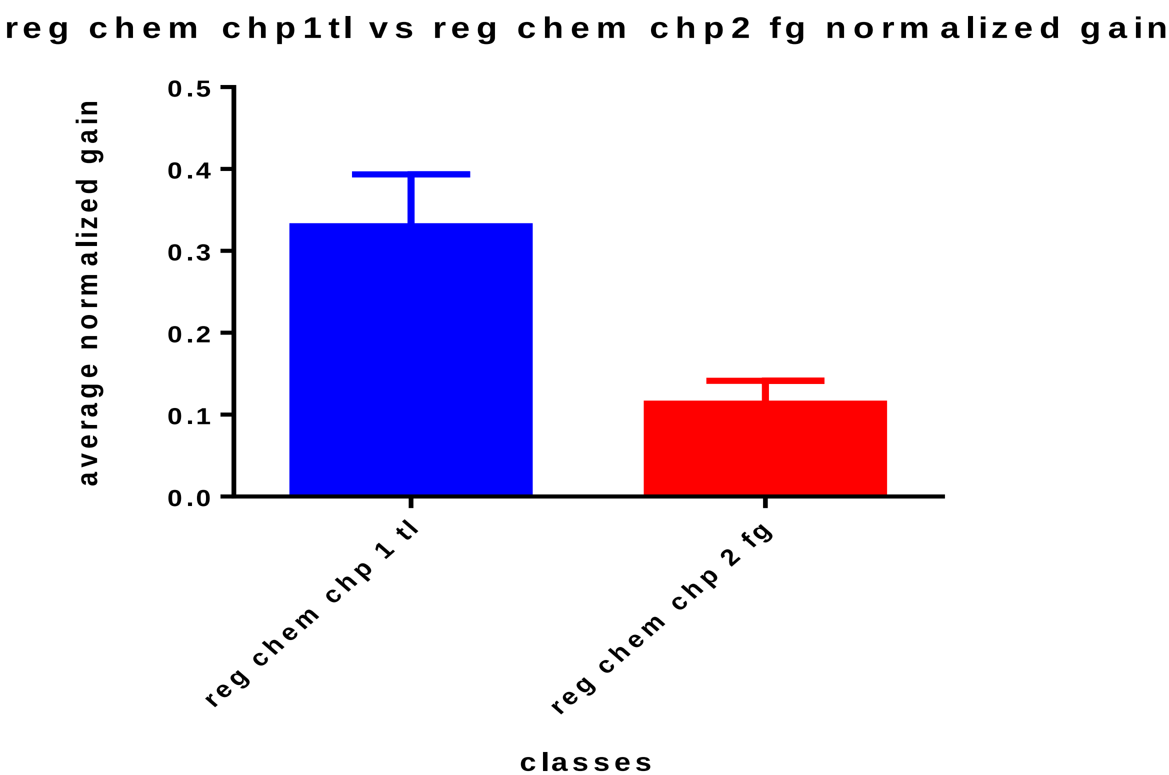

Figure 2. Average normalized gains for regular chemistry students comparing chapter one and chapter two.

The normalized gains for chapter one and chapter two are compared in Figure 2 and there were some remarkable differences. The normalized gain using traditional lecture in chapter was

0.33±0.06 and 0.11±0.28 in chapter two. My regular chemistry students did show a significant gain using flexible grouping in chapter 2(measurement and problem solving) when averages were compared using the Dunn test.

Starting with chapter three, traditional lecture and flexible grouping were alternated. In the fall, the honors class had traditional lecture for chapter three while the regular class used flexible grouping. The regular class in the spring had traditional lecture. In chapter 4, the lecture style was reversed with the honors with the honors doing flexible grouping and the fall chemistry class doing traditional lecture and the spring chemistry class receiving flexible grouping. For the presentation of results, all pretests and posttests raw scores will be presented in appendix A. The normalized gains for each chapter will be presented in the results section of the research

The regular chemistry class had a pre test score of 6.6±0.66 and a post test score of 8.0±0.45 in the fall semester.. Honor's Chemistry students did well with traditional lecture in chapter 3, but in comparison with my fall chemistry class, the spring class came in with an average of 3.3±0.41 to a post of 5.4± 0.48. Even though there is gain in both strategies, their increase was not statistically significant. (Refer to Appendix A, Figure A-3)

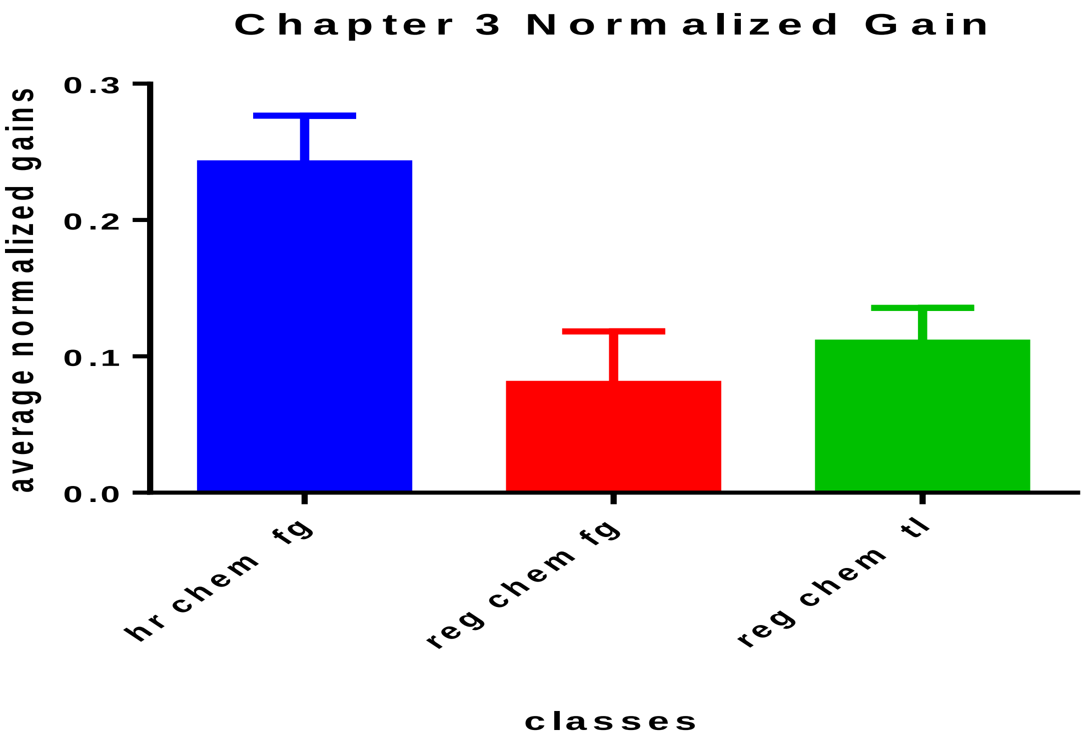

Figure 3.The average normalized gains for honors and regular chemistry for chapter 3.

The spring regular chemistry class showed the most gain in the chapter using the traditional lecture with an average normalized gain of 0.11±0.72, while the fall class in red (regular chemistry) showed the lowest gain with 0.07±0.03(Figure 3). With reference to determining matter, students showed better gains in traditional lecture amongst my regular students. The class size for the spring semester in green was only 8, but those students were also in my Earth Science class as sophomores so that can also be a factor in the better scores. The Wilcox matched pair test was used in this analysis.

In Chapter 4, the honors chemistry class continued to have high pre and post test scores, (Appendix A, Figure A-4). However, the focus here should be on the pre and post scores for my regular students. The average test scores for fall chemistry class, shown in green and purple, only increased from 4.1+0.34 to 4.95+0.41. In contrast using flexible grouping the spring regular chemistry class, increased from 4.6+0.77 to 6.75+0.70. There was some gain in all classes, but with a p>0.05, there was no significant gains in each. Chapter four began the discussion of protons, neutrons and electrons in chemistry. The Dunn test was used to analyze the data for this chapter.

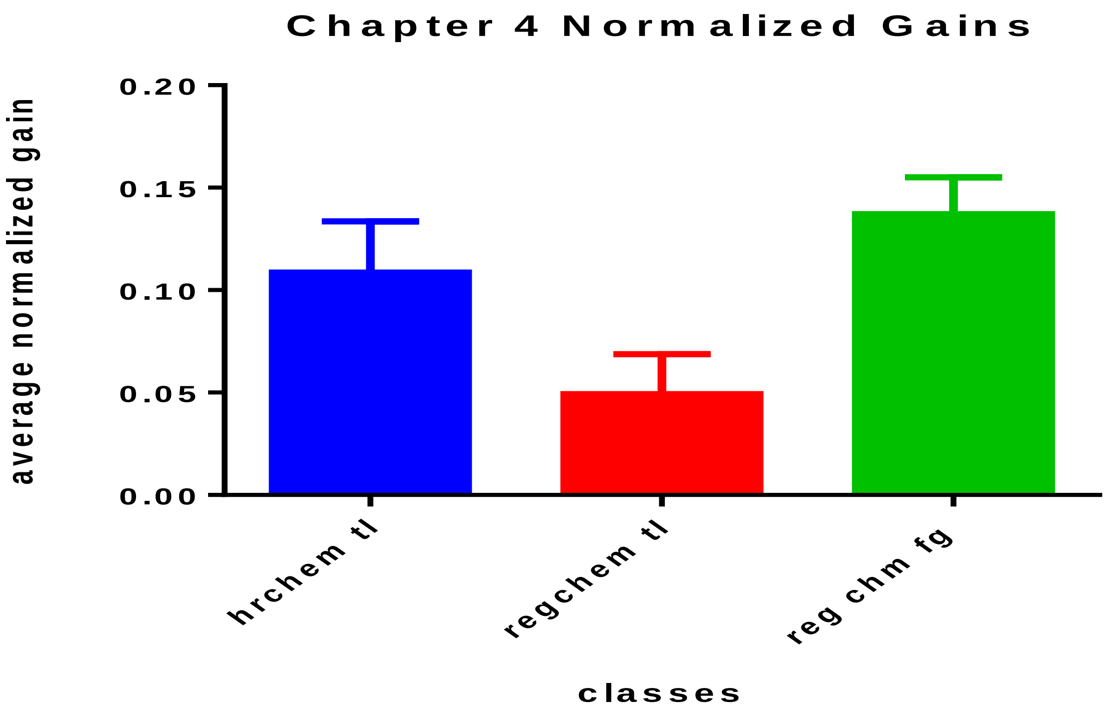

Figure 4. The average normalized gains for chapter four.

Chapter 4 begins discussing protons, electrons and neutrons in the world of chemistry. The spring regular chemistry students using flexible grouping had a higher normalized gain of 0.1370+ 0.018 (Figure 4). The fall regular chemistry class showed no significant gains in the chapter with a normalized gain of 0.05+0.01. The regular fall chemistry class was the biggest (N=20), but maybe the factor of Hurricane Isaac affected their learning.

Chapter 5 has been designated as a difficult chapter. In chapter five, students have difficult time in remembering names for chemical formulas. Students struggle with writing ionic and molecular formulas. One of the problems that I faced in teaching nomenclature is the fact that some of the students' reading levels are low and most students can't memorize formulas. As usual the honors students showed significant gains but our focus again will be our regular chemistry students. On average they showed a gain from 4.5$\pm$0.36 on the pretest to a score of 5.5$\pm$0.38 on the posttest. Even though there was gain, the $p>0.05$ showed that the gain was not significant. The fall chemistry class students used flexible grouping, while my spring chemistry students continued to show gains from 6.3$\pm$0.62 to 7.3$\pm$0.86. Even though there was gain, $p>0.05$ showed that the gain was not significant refer to Appendix A, Figure A-5.

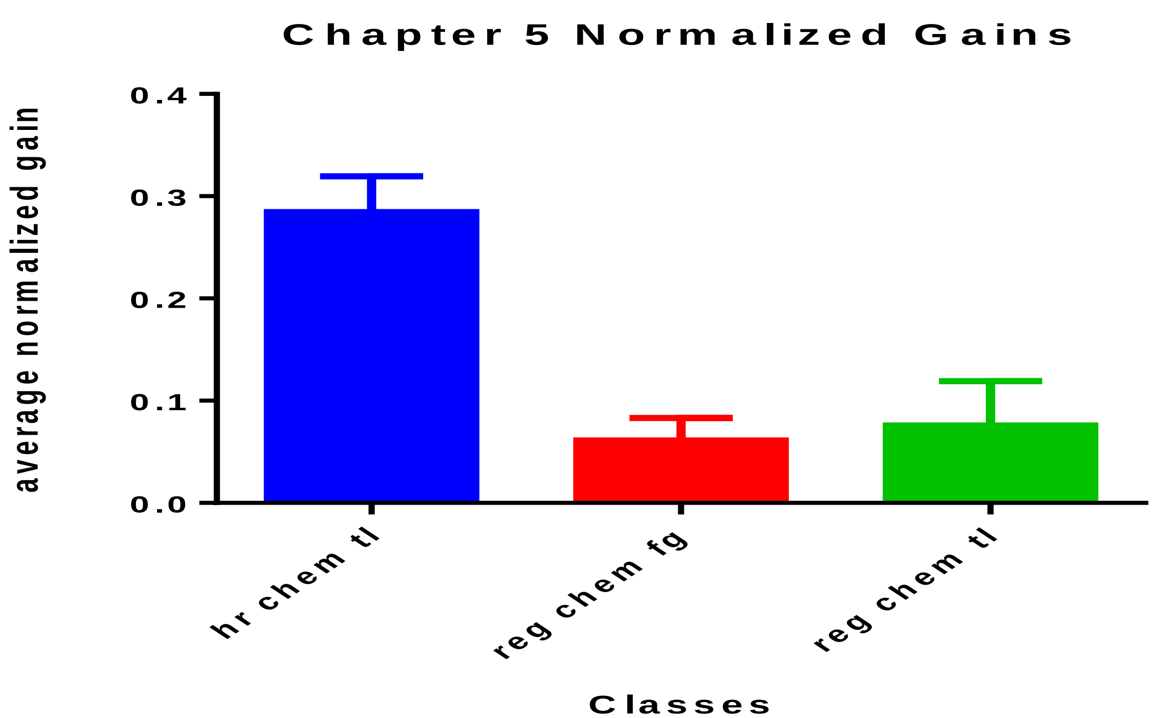

Figure 5. The average normalized gains for chapter 5.

Figure 5 shows the results from the Wilcox test. As usual, the Honor's students continue to have the highest scores in normalized gain. Most of these students are averaging a 20 in the science portion of the ACT. Our focus will continue to remain on the fall chemistry scores in red and the spring chemistry scores in green. Little normalized gains were shown for both the flexible grouping and traditional lecturing for the chapter dealing with nomenclature. The normalized gain for fall chemistry was 0.061 ± 0.02, while the spring chemistry class had normalized gain of 0.07 ± 0.04.

Chapter 6 has been designated as a difficult chapter. In this chapter, we continue to build on chapter 5, nomenclature by incorporating other important skills such as writing empirical and molecular formulas. Also in chapter 6, we use mathematical skills to convert moles into grams and vice versa. The honors students continue to outshine my regular students, but we shall continue to focus on the fact that no significant gains were observed in chapter 6 from either traditional lecture or flexible grouping with the regular chemistry students. There was improvement in the scores, but the $p>0.05$ continued to show that the gains were not significant. The pretest scores for fall regular chemistry class were 4.4 ± 0.28 to a posttest score of 5.6 ± 0.312 using traditional lecture and while the spring chemistry class using flexible grouping had pretest scores of 5.0 ± 0.5 and posttest scores of 6.0 ± 0.6.(Refer to Appendix A, Figure A-6)

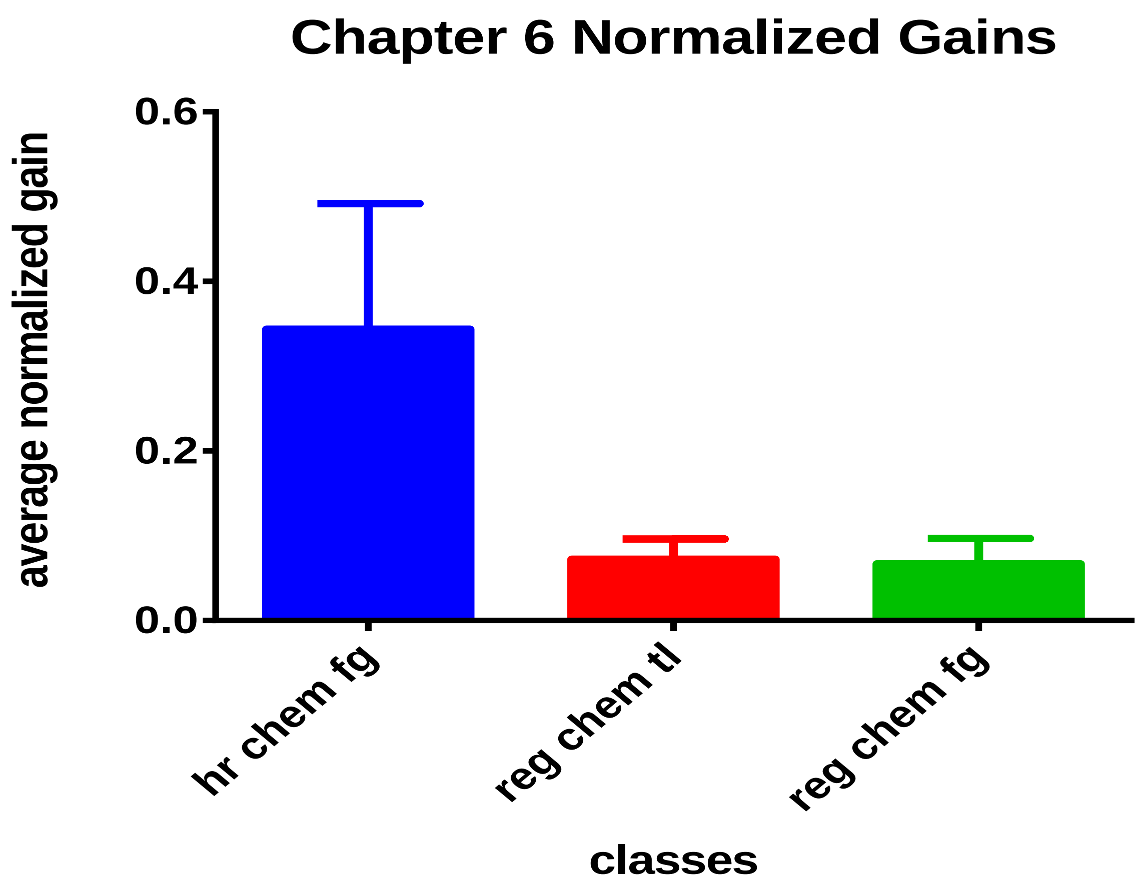

Figure 6. The average normalized gains for chapter 6.

Normalized gains for chapter 6 were consistent with the pretests and posttest scores (Figure 6). The honors students continue to excel, but in this chapter, we see that both strategies basically had the same average normalized gain in the regular chemistry classes. In the fall chemistry class, we had an average normalized gain of 0.07$\pm$0.02 while the spring class had a normalized gain of 0.06$\pm$0.03. Both strategies show me that my students continue to struggle with converted moles to mass and vice versa.

Chapter 7 represents the final difficult chapter for the study. This chapter includes one of my favorite topics, identifying and balancing chemical reactions. This was our final chapter of study before the holiday break in the fall and EOC tests in the spring. As I analyze both strategies, there was some gain in the Honor's students using flexible grouping in balancing equation. For the regular chemistry students, both strategies had basically the same results. The pretest score average for the fall regular chemistry class was 4.3$\pm$0.29 and the posttest score was 5.7$\pm$0.34 using flexible grouping. The pretest score for the spring regular chemistry class was 4.5$\pm$0.62 and a posttest score of 5.3$\pm$0.45. Even though there was gain in both strategies, with a p value >.05 and using the Dunn test, there were no significant differences in the data for this chapter. (Refer to Appendix A, Figure A-7).

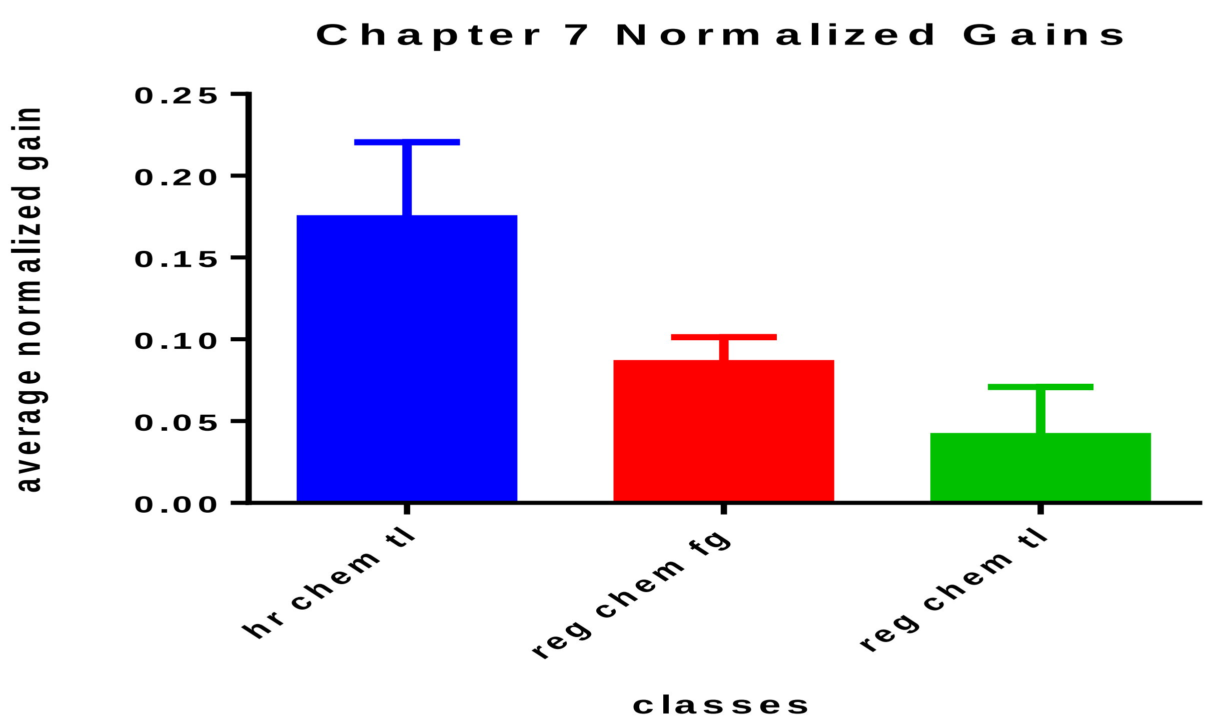

Figure 7. The average normalized gains for chapter 7.

Normalized gains for chapter 7 were calculated using the Wilcox test. Honor's chemistry continued to excel in all scoring. There was a higher normalized gain using flexible grouping in balancing equations than traditional lecture when it came to balancing equations even though the error for traditional lecture was high. Whether flexible grouping is a better strategy to use with balancing equations and will be evaluated further in the future. The normalized gain for the fall regular chemistry class using flexible grouping was 0.08±0.01 while the spring regular chemistry class was 0.04±0.03 (Figure 7).

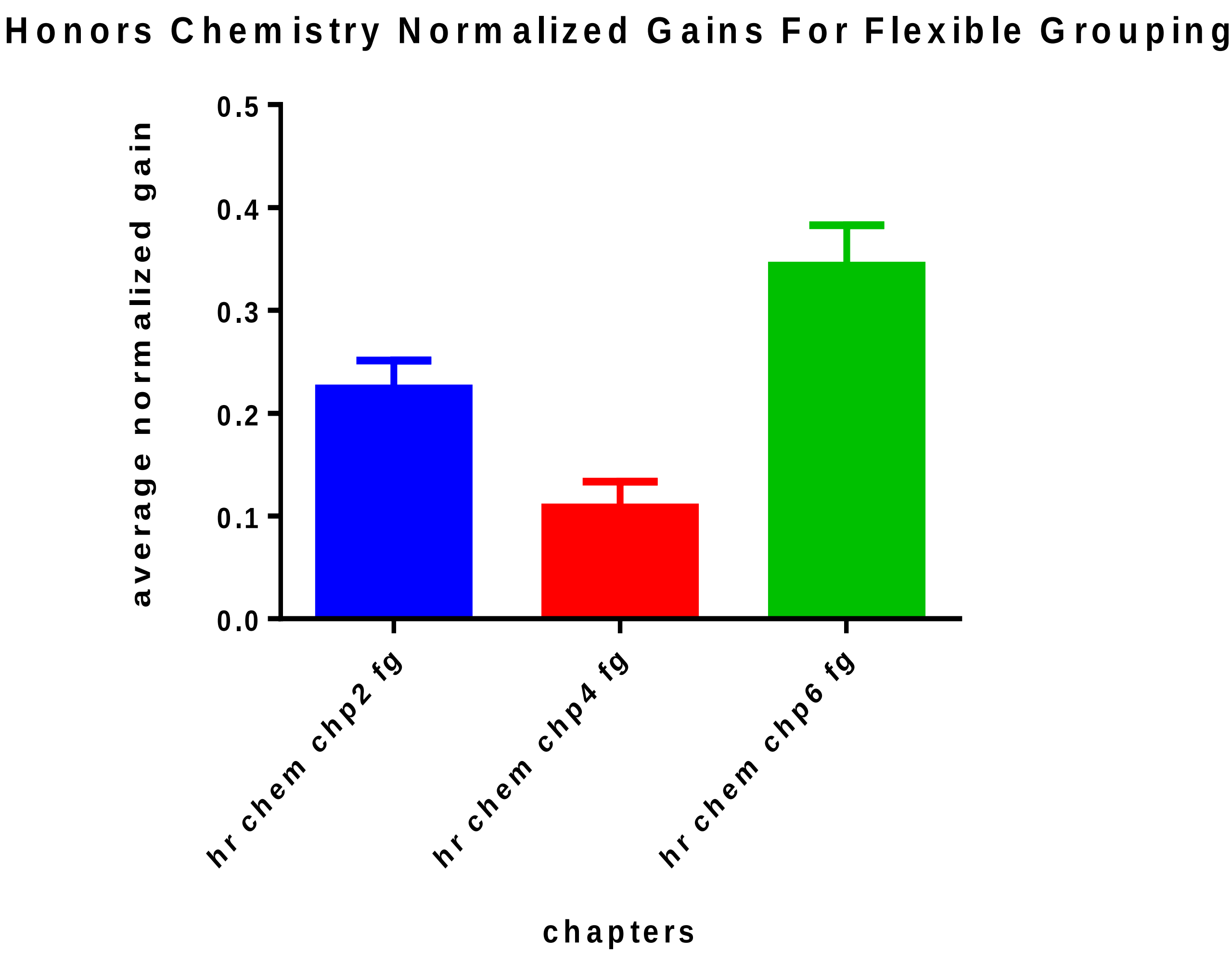

Figure 8. The average normalized gains for honors chemistry class.

Figure 8 shows the average normalized gains in my honors class for chapters two, four and six, the chapters were flexible grouping was used. The best chapter that showed the highest gain for the honors chemistry class was chapter 6. Chapter 6 was designated a difficult chapter. This chapter included empirical and molecular formulas, and converting mass to moles and vice versa. Flexible grouping as shown by the data will be used in performing conversions and writing molecular and empirical formulas.

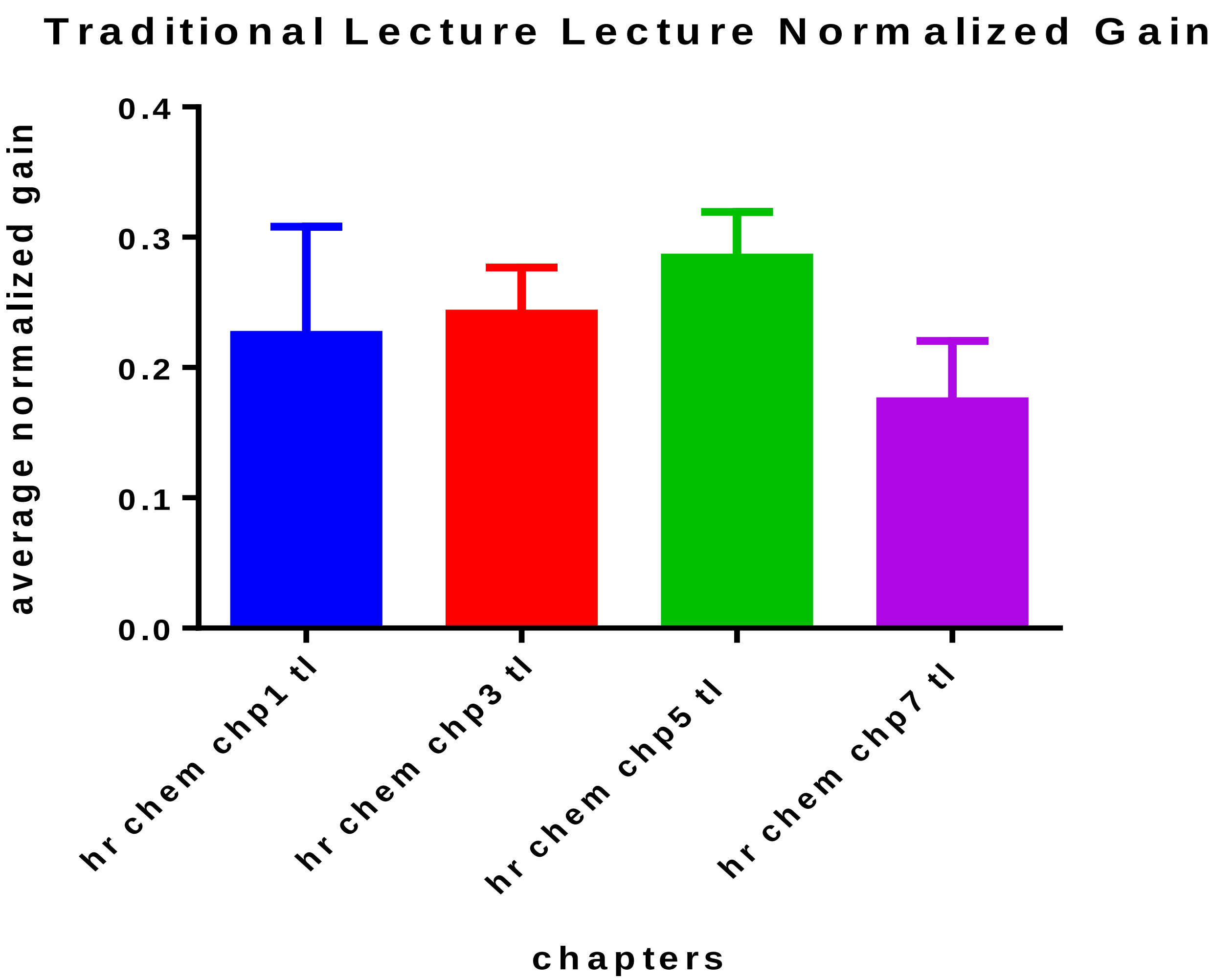

Figure 9. The average normalized gains for honors chemistry classes.

Figure 9 shows the average normalized gains in my honors class for the chapters where traditional lectures were used. Traditional lecture had positive trends on each chapter, but the highest normalized gain for honors chemistry came in chapter five. Chapter five dealt with writing ionic and molecular compound formulas. Traditional lecture will continue to be used in the chemistry class.

During my analysis, I also investigated whether boys or girls responded better to flexible grouping or traditional lecture (Figure A-8, Appendix A). This figure shows only the pre and post scores for chapter 7, the balancing equation chapter. My honors chemistry boys showed gains using traditional lecture while the highest for the girls was also my honors girls using traditional lecture. For the regular chemistry classes, both strategies did equally well with both the boys and the girls. More research will have to be done in order to determine significant gains in the sexes using both traditional and flexible grouping. All chapters were analyzed and even though there was gain in all chapters, there were no huge significant gains.

SUMMARY AND CONCLUSIONS

Through an extensive one -year study of traditional lecture and flexible grouping, I found no significant differences between the two strategies. Traditional lecture produced some good results in chapter one, the introductory chemistry, for both the regular and honors chemistry classes. In the more math intensive chapter 2, measurements and problem solving, the spring regular chemistry class showed more gains than the fall semester. Factors that could have affected the results included the size of the classes. The fall chemistry class had 20 students while the spring only had 8 students. Another factor that could have affected the pretests and posttest scores along with normalized gain was the fact that the fall students had to return to school after a nine- day break after Hurricane Isaac. Many of the students were severely affected by Hurricane Isaac. For example, after Hurricane Isaac, my life really changed because everything that my family and I owned was gone.

Chapter three continued to show basically the same results but the surprise came in chapter four. Normalized gain in chapter four for my spring regular chemistry class using traditional lecture was higher than both the honors and regular class. One of the factors that could have affected that was that those students were in my Earth Science class as tenth graders. Chapter five dealt with memorization and to my surprise, traditional lecture showed better gains when the two regular classes were compared.. Chapter six, the chapter dealing with moles and mass continued to exhibit the same results. The difficult chapter 7, balancing equations showed that both traditional lecture and flexible grouping basically produced the same results but flexible grouping was higher. Flexible grouping will be evaluated more in chapter seven and hopefully I will try flexible grouping in stoichiometry in the future. In the difficult chapter 7, balancing equations, my educational mind wondered which sex did better in that chapter, boys or girls. On average boys did better than the girls on pretests especially among honor students. Among the regular chemistry students both strategies worked well with both sexes.

To expand this study in the future and to make my research better, flexible grouping will be included in math classes at my school. Workshops will be given to set the parameters for flexible grouping so that teachers and students will know what is expected and have a better scope of the research. Since active instruction, covers a broad area, the other strategies that were mentioned in the introduction will be tested such as think-pair, Cornell notes and turn and talk all be analyzed. The study will be school- wide and once data has been collected and the best strategy determined. I will expand the study to the other high school in the district. Through the research, flexible grouping had some significant gains in all chapters discussed. Other factors such as class size could be tested. Traditional lecture will continue to be a major instructional piece in the science classes. Students need to hear the explanation of material from their teacher. Peer instruction can be very productive and based on the results of other studies and the present study, flexible grouping, will become a part of my instructional strategies in the classroom.

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APPENDIX A. GRAPHS OF RAW PRETEST AND POSTTEST SCORES

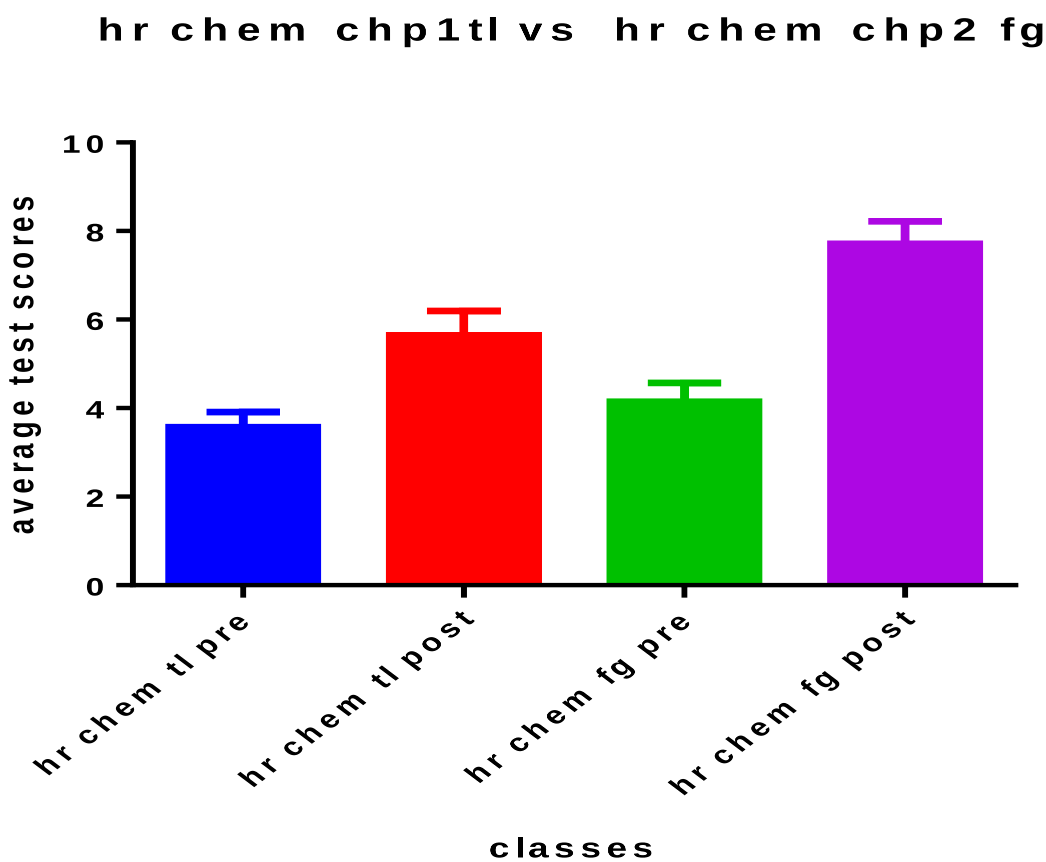

Figure A-1. Pretest and Posttest Scores for honors chemistry chapter one and chapter two.

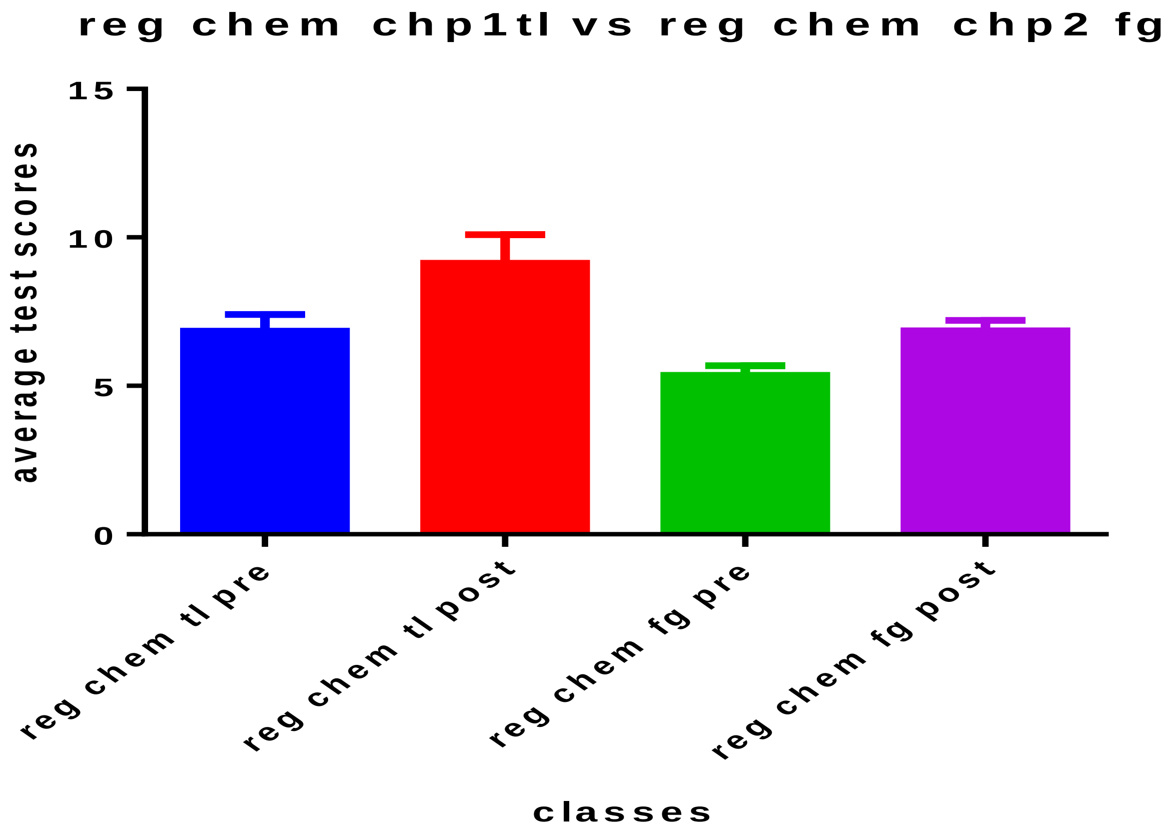

Figure A-2. Pretest and Posttest scores for regular chemistry classes.

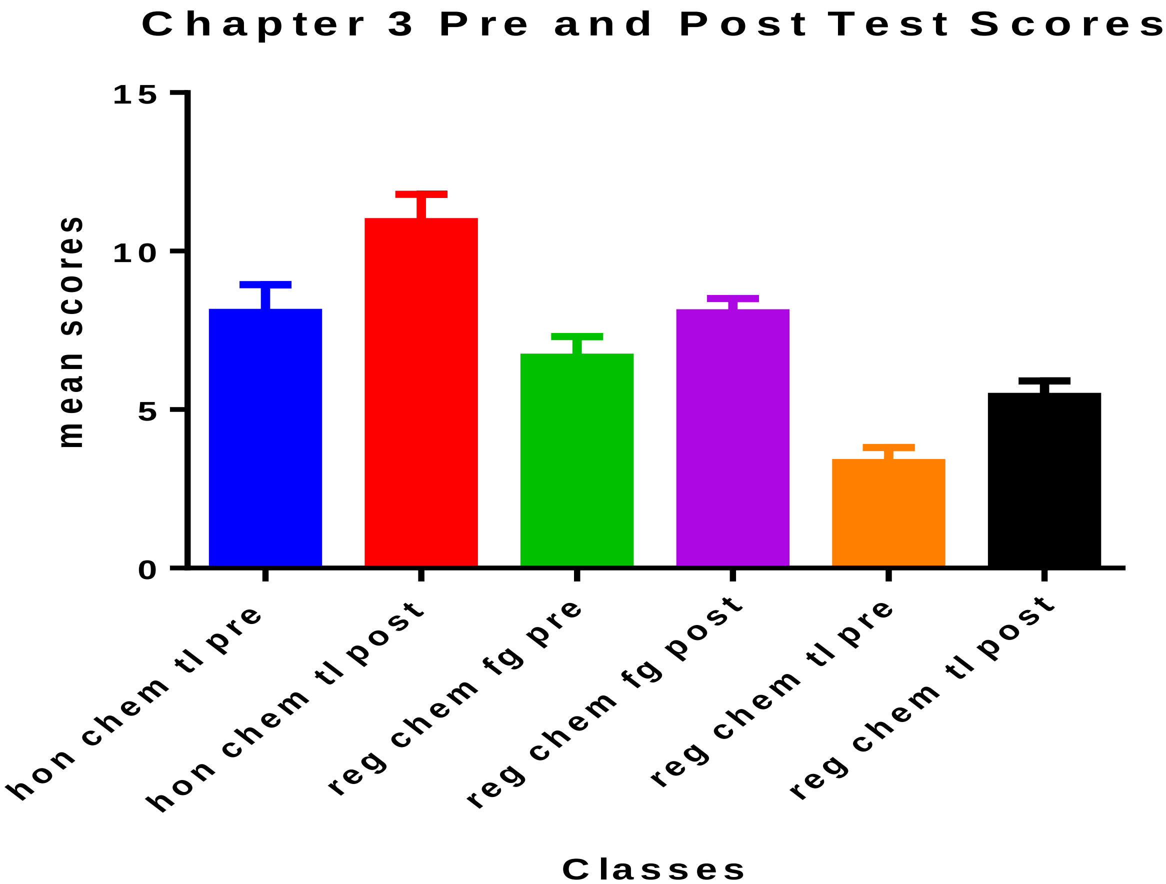

Figure A-3. The pretest and posttest average scores for chapter 3.

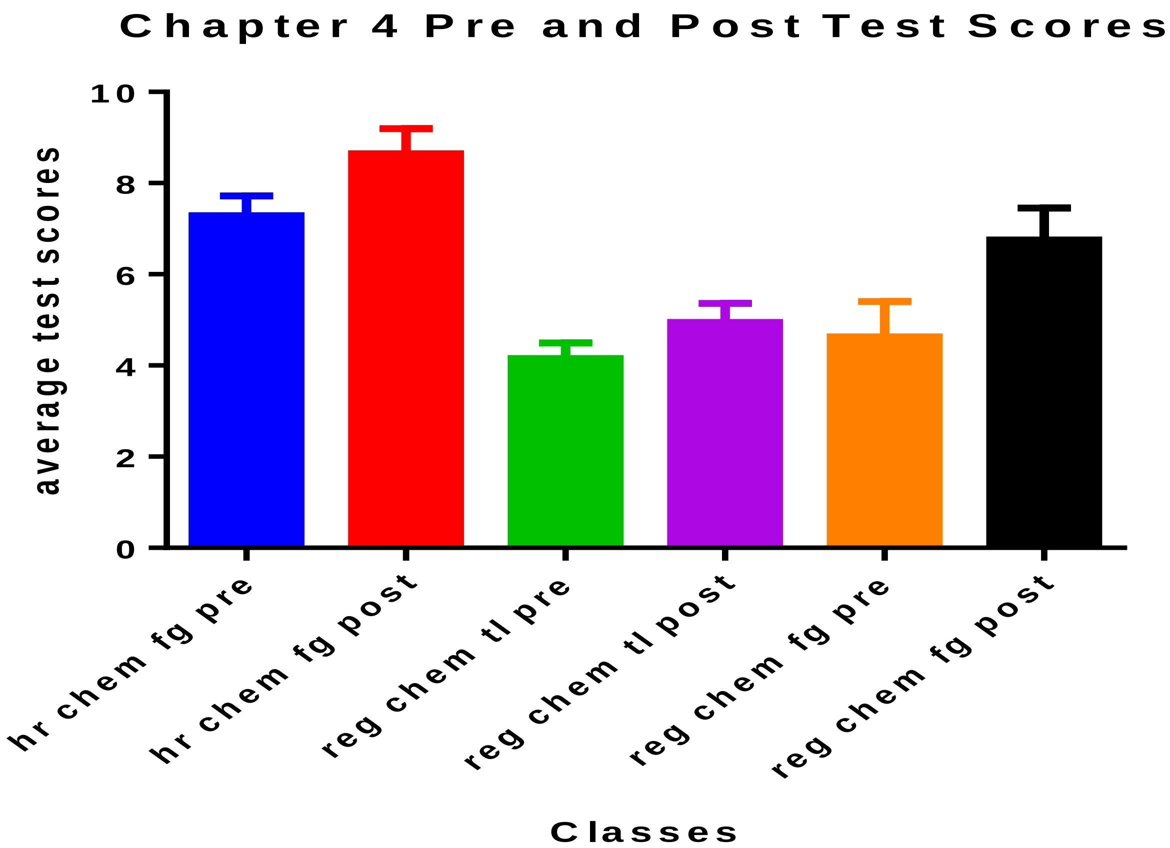

Figure A-4 . The pretest and posttest scores for chapter 4.

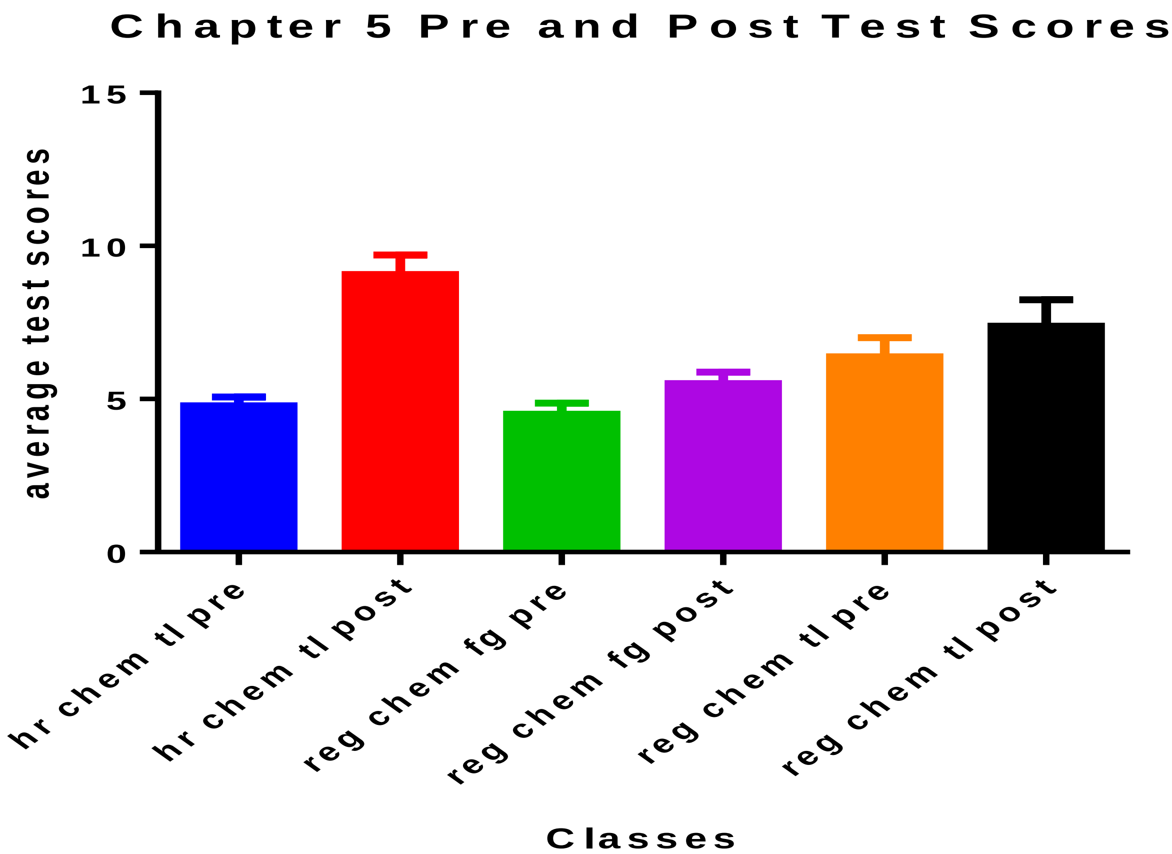

Figure A-5. The pretests and posttests for chapter 5.

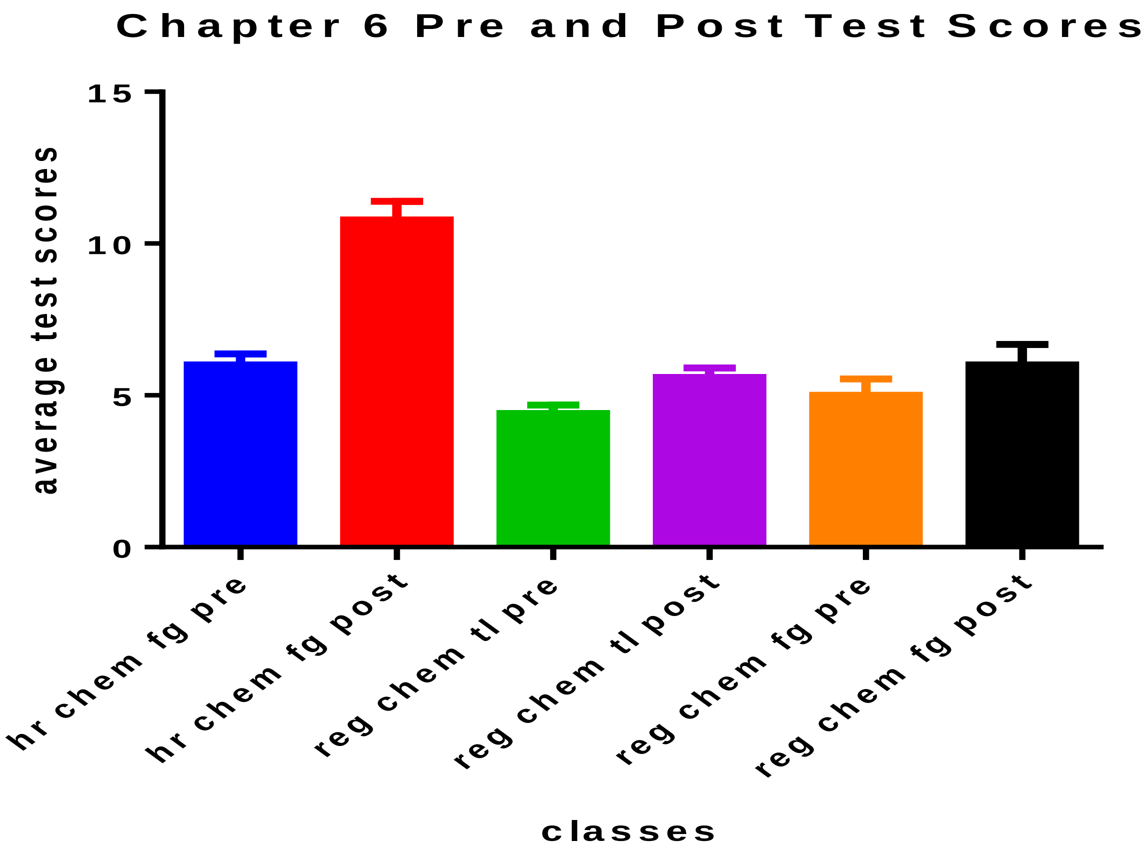

Figure A-6. The pretest and posttest scores for chapter 6.

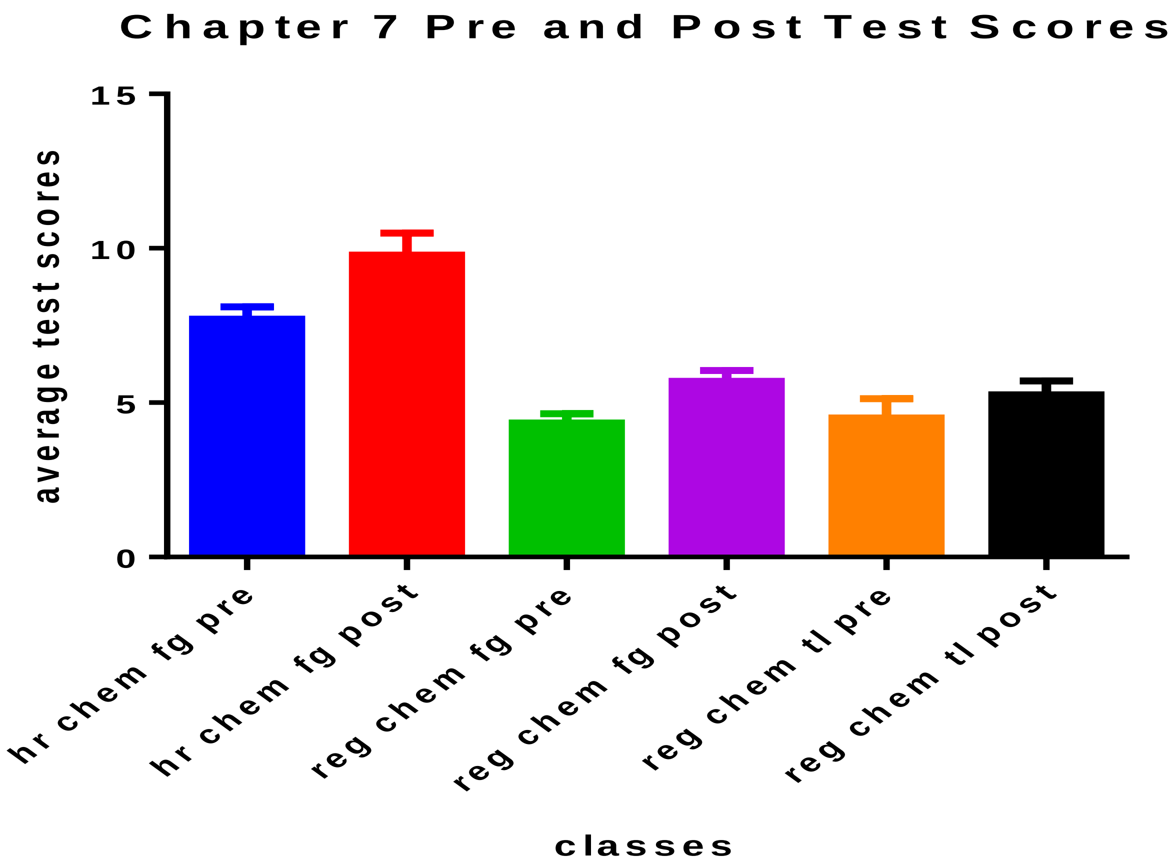

Figure A-7. The pretest and posttest scores for chapter 7.

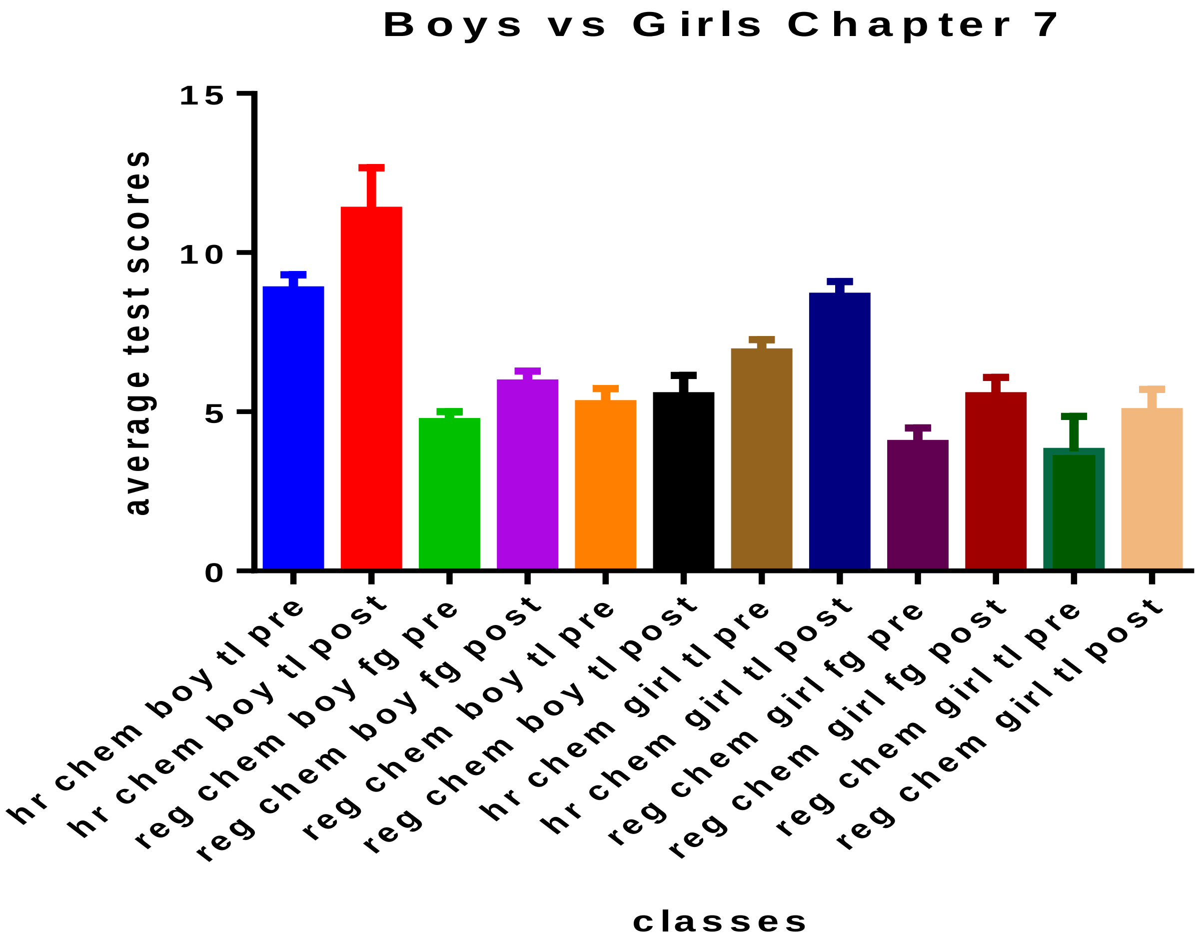

Figure A-8. Comparison of Boys Vs Girls in Chapter 7.

APPENDIX B: IRB FORMS

Application for Exemption from Institutional Oversight

Unless qualified as meeting the specific criteria for exemption from Institutional Review Board (IRB) oversight, ALL LSU research/projects using living humans as subjects, or samples, or data obtained from humans, directly or indirectly, with or without their consent, must be approved or exempted in advance by the LSU IRB. This Form helps the PI determine if a project may be exempted, and is used to request an exemption.

LSU
Institutional Review Board
Dr. Robert Mathews, Chair
131 David Boyd Hall
Baton Rouge, LA 70803
P: 225.578.8692
F: 225.578.6792
irb@lsu.edu
lsu.edu/irb

– Applicant,Please fill out the application in its entirety and include the completed application as well as parts A-E, listed below, when submitting to the IRB. Once the application is completed, please submit two copies of the completed application to the IRB Office or to a member of the Human Subjects Screening Committee. Members of this committee can be found at http://research.lsu.edu/CompliancePoliciesProcedures/InstitutionalReviewBoard%28IRB%29/item24737.html

– A Complete Application Includes All of the Following:
- **(A)** Two copies of this completed form and two copies of part B thru E.
- **(B)** A brief project description (adequate to evaluate risks to subjects and to explain your responses to Parts 1&2)
- **(C)** Copies of all instruments to be used.
  - *If this proposal is part of a grant proposal, include a copy of the proposal and all recruitment material.
- **(D)** The consent form that you will use in the study (see part 3 for more information.)
- **(E)** Certificate of Completion of Human Subjects Protection Training for all personnel involved in the project, including students who are involved with testing or handling data, unless already on file with the IRB. Training link: (http://phrp.nihtraining.com/users/login.php)
- **(F)** IRB Security of Data Agreement: (http://research.lsu.edu/files/item26774.pdf)

1) Principal Investigator: James V. Moroney **Rank:** Professor

Dept: Biological Sciences **Ph:** 578-8561 **E-mail:** btmoro@lsu.edu

2) Co Investigator(s): please include department, rank, phone and e-mail for each
*If student, please identify and name supervising professor in this space

Brian Joseph Carter
Biological Sciences LaMSTI student, bcarter@stjohn.k12.la.us (504) 451-9356(cell)

IRB# E6000 LSU Proposal #_______
✓ Complete Application
✓ Human Subjects Training

3) Project Title: Louisiana Math and Science Teacher Institute
Does Flexible Grouping Increase Science Retention To Increase Test Scores

Study Exempted By:
Dr. Robert C. Mathews, Chairman
Institutional Review Board
Louisiana State University
203 B-1 David Boyd Hall
225-578-8692 | www.lsu.edu/irb
Exemption Expires: 6/24/2015

4) Proposal? (yes or no) No **If Yes, LSU Proposal Number** ______

Also, if YES, either ◯ **This application completely matches the scope of work in the grant**
OR ◯ **More IRB Applications will be filed later**

5) Subject pool (e.g. Psychology students) Middle school and ~~high school~~ students

*Circle any "**vulnerable populations" to be used**: (children <18; the mentally impaired, pregnant women, the ages, other). Projects with incarcerated persons cannot be exempted.

6) PI Signature Brian J Carter **Date** 5/28/2012 6/1/2012 (no per signatures)

** **I certify my responses are accurate and complete.** If the project scope or design is later changes, I will resubmit for review. I will obtain written approval from the Authorized Representative of all non-LSU institutions in which the study is conducted. I also understand that it is my responsibility to maintain copies of all consent forms at LSU for three years after completion of the study. If I leave LSU before that time the consent forms should be preserved in the Departmental Office.

Screening Committee Action: Exempted √ Not Exempted ____ Category/Paragraph 1

Reviewer Mathews **Signature** Robert C Mathews **Date** 6/25/12

Parental Permission Form

Project Title: Does Flexible Grouping Increase Science Retention to Increase Test Scores

Performance Site: West St. John High School

Investigator: I will be available for any questions related to the project,

M-F, 6:50 a.m. -3:00 p.m.

Brian Joseph Carter, M.Ed.

Louisiana Math and Science Teaching Institute, LSU

(504) 451-9356 (cell)

Purpose of the Study: The purpose of this research project is to test a peer instruction technique, flexible grouping, as to whether it will increase science retention better than traditional lecture in improving test scores.

All students taking science in the fall semester will be used. Only students who parents refuse to allow their children to participate in the test will be excluded.

Description of the study: Over a period of one year, for five days a week, the investigator will give students a pre and post test for each chapter discussed. All chapters will have traditional lectures and every other chapter, flexible grouping will be incorporated. The pre and post test scores will be analyzed using both techniques. The scores will not affect your child's overall grade in the class.

Benefits: Subjects will have the opportunity to earn "awards" for their performance on the pre and post tests. The study will allow to teacher to identify techniques to provide a classroom that will become more conducive to learning.

Risks: There are no risks in this project. Students overall grade in the class will not be affected by their pre and post test scores and your child's name will not appear in the research paper.

Right to Refuse: Participation in this research project is voluntary. Your child will become a part of the research project only if you and your child agree on his or her participation. You or your child may withdraw at any time without penalty or loss of any benefit entitled to your child.

Privacy: The test scores will only be reviewed by the investigator. The results from the research will be published, but no student's name will appear on the publication. Subject identity will remain confidential unless disclosure is required by law.

There is no cost for participation in the study, nor will anyone be compensated for participating in the study.

Signatures: The study has been discussed and reviewed with me and the investigator has answered all questions related to the survey. If I have any more questions related to my child's rights, I will contact Robert C. Matthews, Chairman, Institutional Review Board at (225) 578-8692 or email him at irb@lsu.edu. **I will allow my child to participate in the study described above and acknowledge that the investigator will provide me with a signed copy of the consent form.**

Parent's Signature: ________________________________ Date: __________

Child's Signature: ________________________________ Date: __________

I do not give my child permission to participate in the study.

Parent's Signature: __________________________ Date: ___________

Child's Signature: ___________________________ Date: __________

Study Exempted By:
Dr. Robert C. Mathews, Chairman
Institutional Review Board
Louisiana State University
203 B-1 David Boyd Hall
225-578-8692 | www.lsu.edu/irb
Exemption Expires: 6/24/2015

Child Assent Form

I,______________________________, agree to be in a study to test whether peer instruction has a positive effect on retention in science. I will only have to do take pre and post tests and participate in flexible grouping activities. I have to follow all the classroom rules, related to flexible grouping. I can decide to stop being in the study at any time without getting in trouble.

Child's Signature:____________________________ Age:_____ Date:_________________

Witness* _________________________________ Date:_________________

* (N.B. Witness must be present for the assent process, not just the signature by the minor.)

Institutional Review Board

Dr. Robert Mathews, Chair

203 B-1 David Boyd Hall

Baton Rouge, LA 70803

P: 225.578.8692

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irb@lsu.edu | lsu.edu/irb

VITA

Brian Joseph Carter was born in Lafayette, Louisiana on March 1970. He attended elementary, middle and high school in Lake Charles, Louisiana. He graduated from Washington Marion Magnet High School in 1988. After high school, he attended Louisiana State University for two years, but graduated from Southern University at New Orleans with a B.S. in chemistry. He became a certified science and math educator through Southern University at New Orleans alternative certification program. He graduated from Southeastern University with a Masters in Educational Leadership. He entered graduate school at LSU in June 2011 and is a candidate for a Masters of Natural Science. He has taught high school science and math in Orleans and Baton Rouge parish. He has taught for 18 years and now he is entering West St. John High in St. John Parish where he has been currently teaching for the past eight years.