

**Culminating Experience Action Research Projects,**

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**Edited by**

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## **Introduction**

As a part of the teacher licensure program at the graduate level at The University of Tennessee at Chattanooga (UTC), the M.Ed. Licensure candidate is required to complete an action research project during a 3-semester-hour course that coincides with the 9-semester-hour student teaching experience or with school employment. This course, Education 590 Culminating Experience, requires the student to implement an action research plan designed through (a) the Education 500 Introduction to Inquiry course, (b) one of the two learning assessments required during student teaching, or (c) a newly-designed project not used as one of the learning assessments.

With funding through a UTC Teaching, Learning, and Technology Faculty Fellows award, the Education 590 course is conducted through the use of an online, course management system (Blackboard), allowing for asynchronous discussion and use of the digital drop box feature for submitting required papers.

The action research projects from, fall semester 2009 (part 2), are presented below.

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**The Impact of Hands-On Activities and Labs in a Secondary Science Class**

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Education 590, Fall 2009

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*The Institutional Review Board of The University of Tennessee at Chattanooga (FWA00004149) has approved this research project # 09-174.*

### **Introduction to the Problem**

There seems to be a long term problem in schools with students and their comprehension of science. For years, many students have felt that science was too hard for them to understand or that it was boring. These thoughts are more prevalent in the upper grade levels. Recently, the researcher witnessed middle school science students overwhelmingly state that they did not want to have science-related jobs because they, either, did not like science or thought that it was too hard for them. This is a belief of too many students in America today. Many other countries, such as China and Japan, produce many more scientists than America does. Teachers need to do something here, in America, so that students will want to choose science as a career. Students should be encouraged to explore science in exciting ways throughout every grade level and they should be given measureless opportunities to see that science can be fun for them to learn.

Many teachers believe that using hands-on activities engage the students more and help students to learn better. Prior research has shown this is usually true. House (2002) found that students who performed experiments in science class more often enjoyed the subject learning than those who performed experiments less often. If this is true, experiments and other hands-on activities should be used more often in classes to stimulate the students. Advanced placement classes, usually, do more hands-on work than regular classes. However, all students should have the opportunity to perform fun and exciting activities in science. Science would, probably, be much more engaging to students if they did experiments more than once every few weeks, as some classes do. In addition to performing hands-on activities, these activities and labs need to be purposeful, and should require thinking and questioning on the part of the students.

Some researchers believe that traditional lab activities in science are not planned with the best practices for student learning. They argue that by having lab experiments that give step-by-

step procedures, students are not being led to inquire into scientific activities and procedures (Huber & Moore, 2001). Students learn more when they are performing a lab activity in which they explore, and when they decide what aspect of the lab activity they want to study. This type of lab activity may be harder for teachers to implement, but it may be well worth the effort of the teacher for his or her students.

In this study, the researcher wants to find a way for her students to get excited about science, and enjoy learning that subject. She plans to use hands-on lab activities or experiments to get her students interested and engaged. The purpose of this study is to measure the impact of hands-on activities on students in a secondary science class.

### **Research Questions**

The questions that the researcher seeks to answer are:

1. How does the incorporation of lab activities once each week affect student comprehension?
2. How does the incorporation of lab activities three times per week affect student comprehension?
3. How do students respond to increased hands-on lab activities?

### **Limitations**

There are a few limitations that may affect the results of this research. One possible limitation for this project would be if the groups being tested were not homogenous. This could lead to flawed results. If the groups are not homogenous, the plan of the project may need to be changed slightly. The students will need to be checked in both participating classes for their differing backgrounds. There will be possible limitations in the responses that the researcher will receive from the surveys that will be given to both students and parents or guardians.

## Review of literature

With American students falling behind the students of other countries in science and math, it is vital to find ways to encourage them to study science. Many teachers struggle to ignite a passion for science in their students. There have been many research projects performed to find what may cause students to learn science better and to enjoy this learning. House (2002) found that students in the study said that they enjoyed learning science more if they performed experiments in class, or if the teacher performed demonstrations for them. Lewis and Shaha (2003) found that students in lab and technology-integrated physics classes had much higher end-of-year test scores than students in a normal physics class without extra labs. Several other articles provided evidence that hands-on activities or labs may help students to learn science better, but not all hands-on activities are believed to be great at this. Backus (2005) states that traditional science projects with step-by-step procedures may not help student learning and may, possibly, stop students from using higher-level thinking. Research shows that there is, both, negative and positive information on the use of hands-on activities, and that there are several different types of activities that fall under this category.

Many traditional, hands-on activities in science are historically based on following specific steps in a process. Singer (2005) states,

Labs have the potential to help students master science subject matter, develop scientific reasoning skills, increase interest in science, and achieve other important science learning goals. (p. 10)

Unfortunately, the report reveals that these goals are not being achieved today. Singer (2005) says the reason for this is that labs do not always follow what is being taught in the class, and they often do not provide for subject mastery. Some researchers believe that labs should

focus on inquiry. Backus (2005) has provided information showing that inquiry is helpful for students in science, and has shown how to best implement it into activities. In the past, this has not been the focus of hands-on lab activities in science. The traditional, hands-on activities do not need to be omitted because they may be ineffective. They can be used effectively if they are modified to allow for student discovery and choice (Huber, 2001). Eick (2002) suggests that it would be easier to implement good, hands-on activities and labs for classroom use if more teachers collaborated by sharing what has worked well for them, with teachers who may be struggling to implement inquiry.

Unfortunately, not all schools have the same resources to allow their students the same opportunities. Schools that have high numbers of minority and impoverished students are less likely to have the resources and facilities to have lab time (Singer, 2005). She states, “Some students have no access to any type of laboratory experience” (p. 10). Lab experience is extremely important in learning science. Although there are some problems with the types of hands-on activities used by some teachers, hands-on activities are, generally, helpful for the learning of students in science. There has been some correlation that schools with lower state test scores use fewer hands-on activities in learning. This may be because the schools which need to raise scores often put pressure on teachers to teach information from the test, and this does not leave much time for activities (Eick, 2002).

Eick (2002) found that some of the schools with higher state test scores were performing many more hands-on activities per week. Lewis and Shaha (2003) found that students in an integrated physics and electronics class, which included hands-on labs, felt that they learned more for their futures. These students reported enjoying this type of learning. Students in these classes scored well in post-tests (Lewis & Shaba, 2003). Wallace (2004) found, in a study of the

roles of several learning activities, that student felt that they gained more knowledge when performing laboratory activities. In this same study, only one student felt that the text and class discussions were better sources of knowledge. One student commented that when you actually see something, then it is more permanent. These students performed experiments which explored scientific theories. These first-hand observations kept all levels of students active in the class (Wallace, 2004). The observation that Ediger (2001) writes about is an instance where a student brought a starfish to class. The teacher's plan was flexible and allowed the students to study and research starfish, while including hands-on activities to do so. The students said that they enjoyed the activities and the learning. Every student was engaged in learning and discipline problems were very low during the project (Ediger, 2001).

Some research has shown inquiry-based activities to be best for learning. As Huber (2001) discussed, this type of teaching may take more time, at first, but the results seem to be worth it. Backus (2005) found that eliminating procedures from experiments was less time-efficient and frustrating, at first, but the students seemed to enjoy learning more, through inquiry (Backus, 2005). In inquiry-based activities, the students get to explore and examine on their own without being told what the outcome of an experiment will be. Training teachers better on how to include and use labs and hands-on activities will help students to learn more in science classes (Singer, 2005). There may need to be more research into inquiry-based activity, and how they can best be implemented.

There can be several types of hands-on activities used in science classes. They do not all have to be lab experiments. Some other types of hands-on activities that may be included are: dramatizations, making things, art work, outdoor activities, and fieldtrips. Hildreth, Matthews, Hess, and Settle (2001) stated that the *National Science Education Standards* could be used

while having students act out scientific processes or by leading the class in making projects. They listed several ideas that could be used in the class and gave tips on encouraging students to be active in learning. Students created art projects to depict the life cycles of starfish (Ediger, 2001). Fieldtrips are another form of hands-on activity that could be used in science. They have a long history of use in school. Some people question if these trips are really beneficial to students. Pace and Tesi (2004) asked adults what they remembered and learned on fieldtrips they had taken, in the past. They found that the people remembered more and learned much more on the trips that included hands-on learning activities.

There is evidence, on both sides, that support and detract from the use of hands-on activities in classes. Activities seem to generate excitement in students (House, 2002), but there is, also, evidence that shows that not all activities are the best at helping students to learn (Backus, 2005). Some researchers have found mixed results. Oliver-Hoyo and Allen (2006) stress the importance of using triangulation methods in research, for this very reason. Some student data showed less positive results on surveys than what was found in interviews and in journal entries (Oliver-Hoyo, 2006). This shows that the researcher must acknowledge limitations and use the best data techniques possible to get an accurate representation of the facts regarding the use of hands-on activities in science.

## **Data Collection and Results**

### **Data Collection**

**Subjects.** The subjects for this study consisted of students from the researcher's first and second blocks, which were ninth-grade, physical science classes, at a Hamilton County high school in Tennessee. The scores on tests were, usually, consistent in both classes. Students

included in the study were 12 students in the first block class and 13 students in the second block class.

**Methodology.** The researcher sought to find how students were affected by the use of hands-on activities and lab experiments in a secondary science classroom. The second block class served as a control group, receiving normal teaching, with one hands-on activity each week. The first block class was the experimental group, doing a lab or hands-on activities three times per week.

**Instruments.** To answer the research questions, students were given a pre-test at the beginning of the first day of instruction on electrical circuits. At the end of the instructional unit, students were given an identical post-test (see Appendix A). The researcher acted as an active participant observer, taking field notes on the results of the activities (see Appendix B). The students were asked to respond to survey questions, which were on a Likert scale, to show how they felt about the increase in the use of labs (see Appendix C).

All activities used in this research project were meant to be meaningful to the science education of the students. The activities were contained in the student investigation manuals used by the Hamilton County schools.

## **Results**

For the first block class, which was the experimental group, pre-test scores had a mean of 3.17 answers correct, of the 15 items. The post-test scores of this group had a mean of 9.08 answers correct, of the 15 items, with an increase in mean of 5.91, after instruction and labs (see Figure 1).

The second block class, which was the control group, with only one lab per week, had a mean of 3.15 answers correct on the pre-test. This is only 0.02 less than the mean for the first

block class. The post-test scores had a mean of 7.77 answers correct, with an increase in mean of 4.62 (see Figure 1).

	1st block - 3 labs per week	Experimental group	
	Pre-test, number of correct answers	Post-test, number of correct answers	Improvement
Mean	3.17	9.08	5.91
	2nd block - 1 lab per week	Control group	
	Pre-test, number of correct answers	Post-test, number of correct answers	Improvement
Mean	3.15	7.77	4.62

*Figure 1.* Results of the student pre-test and post-test are presented.

All but three of the students in the experimental group remained on task during labs. The students all appeared to be having fun and were engaged, except for one student. All but one of the students in the control group stayed on task and were engaged during their one lab. During regular instruction days, the students in the control group were off task 10 times during the teacher observations.

Students in both classes responded that they overwhelmingly found the hands-on activities and labs to be helpful to their learning. They reported enjoying the activities that were used during this project; with the control group actually having a mode of 5 (really enjoyed the activities). The experimental group had a mode of 4, and said that they somewhat enjoyed the activities used in the class. In the experimental group, a larger number reported that they learned more or much more with the labs, than prior to the study. The control group had a slightly lower number on this item. Students reported between “no differences” to “learned more.” As to enjoyment of science, students in the experimental group had a higher number on the item, reporting that they enjoyed science more than that did, prior to the study, than did the control group (see Figure 2).

Experimental	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Total
Median	4.36	4.36	4.45	4.09	3.45	4.09	4.18	29.00
Control	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Total
Median	4.36	4.64	3.73	3.45	2.45	4.18	3.45	26.27

Figure 2. Student survey results are presented.

## Discussion

The results of this study follow what the researcher hypothesized. The students who had more labs and hands-on activities in the classroom did score higher on the post-test than the students in the class with one lab per week. However, the researcher was expecting a much wider range of difference in the scores. The students with more labs averaged about 1.3 more questions correct than the students with regular teaching. The researcher expected to see a larger number of students scoring higher in the experimental group.

It was not surprising that the students in the experimental group reported the activities to be helpful and that they enjoyed science more than the control group did. The experimental group, also, reported enjoying the learning more, which does coincide with the post-test score; that they did, actually, learn a little more than the control group did, in this project.

There were some extraneous variables that may have affected the results of the project. There have been behavioral problems in both of the classes, during the research project. Also, all of the students did not participate in the study. This led to more of the studious students in second block participating, which raised the scores for that group. Also, some of the students who responded to the survey questions may have been influenced by the Hawthorne effect. The researcher believes that the research has been skewed by some of these factors. However, most of the students in the experimental group did seem to like the use of the labs, and the researcher observed that they were more excited than students in the control group. In future research, these

problems may be avoided by more carefully choosing the groups for the project and having an outside party administer the student survey.

## **Conclusions and Recommendations**

### **Conclusions**

Based on the results of this study, one may decide that hands-on activities are helpful to students in their comprehension of material. The students in this study did learn more when they had more hands-on activities in class, and they were more engaged, overall, than those students who completed fewer activities. However, the students in the control group were not that far behind the experimental group, with regard to post-test score. There may be a place of balance between one and three activities per week that would better suit the students. A longer time period for a study may produce more accurate conclusions. At this point, the researcher has decided to keep at least one lab or hands-on activity per week in her classes and plans to do more research in this area.

### **Recommendations**

There is still much more room for improvement in the area of science teaching. More professional development in the area of labs would be beneficial to the teacher. The teacher could learn more about the lab equipment that has been provided by the school system and seek out more labs from teachers who have more experience in the discipline. The teacher could have more professional development and mentoring in the area of teaching strategies to better reach all intelligences in her classroom.

The National Science Teachers Association (NSTA) holds to the belief that appropriate science labs are very important and should be included in all science classes, but should be used in an appropriate manner. The NSTA encourages that all high school students should be in the

lab every week, but a specific number of days is not specified. Technology can be used in many ways, along with existing lab activities, to provide learning opportunities or virtual labs. There are countless ways that students can be led into inquiry and hands-on learning, and more research could be done in this area to find specific labs that would greatly increase student learning and enjoyment.

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**Appendix A****Electricity Unit Pre-test and Post-test****Electricity Unit      Circle the correct answer**

1. Electric \_\_\_\_\_ is what makes an electric motor turn or an electric stove heat up.  
a. circuit                      b. current                      c. switch                      d. resistor
2. An electrical device that uses the energy carried by electric current in a specific way is called a  
a. wire                      b. switch                      c. resistor                      d. circuit
3. Electric current is measured in units call \_\_\_\_\_.  
a. volts                      b. amperes                      c. watts                      d. meters
4. This is a measure of electric potential energy.  
a. voltage                      b. ampere                      c. multimeter                      d. ammeter
5. This object uses chemical energy to create a voltage difference between its two terminals.  
a. light bulb                      b. circuit board                      c. battery                      d. voltmeter
6. Electrical resistance is measured in units called \_\_\_\_\_.  
a. volts                      b. ohms                      c. amperes                      d. newtons
7. How many paths are there in a series circuit?  
a. two                      b. zero                      c. more than three                      d. one
8. A parallel path in a circuit with very low resistance is called a \_\_\_\_\_.  
a. series circuit                      b. short circuit                      c. long circuit                      d. battery

**On questions 9-15, use the equations you have learned to answer the questions.**

9. Find the electrical power (in watts) for a 12-volt battery connected to a light bulb in a circuit with a current of 3 amps.
  
  
  
  
  
  
  
  
  
  
10. The electrical system in your house uses this type of current \_\_\_\_\_.

11. A toaster oven has a resistance of 12 ohms and is plugged into a 120-volt outlet. How much current does it draw?

12. A laptop computer runs on a 24-volt battery. If the resistance of the circuit inside is 16 ohms, how much current does it use?

13. A motor in a toy car needs 2 amps of current to work properly. If the car runs on four 1.5-volt batteries, what is the motor's resistance?

14. A series circuit contains a 12-V battery and three bulbs with resistances of 1 ohm, 2 ohms, and 3 ohms. What is the current in the circuit?

15. The label on the back of a television states that it uses 300 watts of power. How much current does it draw when plugged into a 120-volt outlet?

## Appendix B

### Teacher Observations/Field Notes

Date \_\_\_\_\_

Student #	Stays on task	Engaged	Disengaged	Appears to be having fun	Appears to be bored	Talking about class activities	Talking about non-class activities
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							
21							
22							
23							

Other Observations:

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## Appendix C

### Student Survey

Directions: Answer all of the following questions truthfully. The scale is 1 to 5 for worst to best. Circle one number per question.

1. Do you feel that the use of hands-on activities and labs has been helpful to your learning?

**1-** not helpful at all, **2-** not very helpful, **3-** cannot tell a change,

**4-** somewhat helpful **5-** very helpful.

2. Did you enjoy the activities used in class?

**1-** really enjoyed them, **2-** enjoyed them, **3-** no difference from before

**4-** somewhat disliked them, **5-** did not like them at all

3. Do you feel that you learned more by doing the labs and activities?

**1-** I learned a lot, **2-** I learned some, **3-** no difference than without

**4-** I learned less, **5-** I learned much less

4. Did you enjoy learning science in this class during the research?

**1-** really enjoyed it, **2-** somewhat enjoyed it, **3-** no difference from before

**4-** somewhat disliked learning, **5-** did not enjoy learning at all

5. Do you feel that you would learn more if doing less labs and activities in class?

**1-** learn much less, **2-** learn some less, **3-** no difference

**4-** learn more, **5-** learn much more

6. Would you like to take more classes that are formatted in this way (with more labs)?

**1-** many more like this, **2-** some more like this, **3-** no difference,

**4-** less like this class, **5-** no more classes like this

7. Do you enjoy science more than you did before this project?

**1-** much more, **2-** a little more, **3-** no difference

**4-** a little less, **5-** much less

**Action Research Study of Group Work vs. Individual Work in High School Students**

Emily Mitchell

Education 590, Fall 2009

The University of Tennessee at Chattanooga

*The Institutional Review Board of The University of Tennessee at Chattanooga (FWA00004149) has approved this research project # 09-176.*

## **Introduction to the Problem**

I chose this problem to research by drawing on my own experience as a student. I remember, in high school, that each teacher had a different approach to group assignments. Sometimes, they worked well, but other times, they did not work well. I am fully aware that having students work in teams is a common practice, but common practices must, occasionally, be tested and questioned, in order to improve. There is no place in research for the status quo. In light of our increasingly interdependent and interconnected society, I want to determine whether or not there is a distinct advantage to be gained from group work versus individual work. The purpose of this study is to investigate the complexities of the relationship between these two working methodologies, and their relative successfulness in various situations. I intend to use the knowledge that I gather through this study to help form and support my own understanding on the matter of group versus individual work, in addition to enhancing the body of knowledge on the subject's importance in our current society.

My project is a mixed methods study involving information from both quantitative and qualitative sources. In my interpretation of the qualitative data, I will be employing elements of *Grounded Theory* and *Symbolic Interaction*. These approaches are significant to this study because the data generated will allow me to derive a supportable theory on the phenomenon of teamwork, and the grouping typologies I will be using are heavily dependent on cooperative learning and interaction.

## **Review of Literature**

In my search for sources relating to my topic of research, I found few publications that were more recent than 10 years old. This is most likely due to the fact that group projects are such a commonly-accepted classroom practice, and that using them as a teaching tool is,

generally, left to the teacher's own preference. I understand that this is a topic that does not change much over time, however; the times have changed around the topic. Society is growing increasingly interconnected, and the development of collaborative skills is becoming ever more important. Because of this, in order to determine their significance to the current classroom, I began by investigating the generally accepted concepts on group work. Kidshealth.org (2006), Kohn (1998), Penland and Fine (1974), and Wong and Wong (1998) all agree that the abilities involved in teamwork situations are essential skills for students to develop, and will aid them later in life. Slavin (1995) found that group learning can have a positive effect on student performance and attitude (as cited in Mahenthiran & Rouse, 2000). Postmes and Jetten (2006) go so far as to say that the very identity of the individual (their values, skills, and accepted norms) is largely determined by their involvement in social grouping situations. Some drawbacks that commonly interfere with the utilization of group learning practices, mentioned by Kohn (1998), were that it is often considered a "gimmick," does not ensure harmony, reduces predictability, and can be seen as a threat to individuality.

Next, I wanted to determine specifics on how I would implement the group projects. What size of group would be best? How long or often should the group meet? What would be a suitable content for each project? Wong and Wong (1998) claim that the number of members in the group should match the number of tasks in the project. Nixon's (1979) work indicates that increases in group size result in exponential increases in the number of possible group relationships, which may impede group interaction in cases where there are more than 20 members. In my class of 18 students, group size will be limited by the nature of the project.

The duration of the projects in this study must conform to block scheduling. Information on block schedule and group activities indicates a symbiotic relationship between the two.

Willis (1993) states that the block schedule allows more time for cooperative learning (as cited in Dougherty, 2004). I decided that these projects would serve as a break from the typical, lecture-driven lesson, and provide a valuable opportunity for students to connect personally with the material through inquiry-based projects. In groups, students will exercise cooperative and communication skills.

Quantitative measures of student productivity and successfulness, based on various performance task scores, comprise part of the data for this study. Hare, Blumberg, Davies, and Kent (1994) helpfully pointed out that, when doing research on individual versus group work, it is important to choose tasks that are possible for both groupings to perform. Because of this, I decided to use ChemQuest modules as the material for the four projects. According to Neil (2008), each ChemQuest is a self-contained worksheet that provides the student with information on a topic, examples, and opportunities for practice and self-assessment. It includes a summative assessment component called a Skill Practice. The Skill Practice is a separate sheet that contains problems for the student to complete using what they learned through completion of the ChemQuest activity. The individually-completed Skill Practices will provide data on student comprehension of each project's material.

Another part of the data that I am evaluating through this study will be qualitative and quantitative information on the student attitudes toward each project and throughout the study. Fcit.usf.edu (2004) provided information on the Likert style surveys that will be given to the students prior to and after research, in order to assess student attitude toward the project's variables. A statement made by Penland and Fine (1974), on the evaluative importance of measuring group members' positive and negative feelings, led me to create the student reflection

journals for use in collecting both quantitative and qualitative data on the student attitudes throughout the projects.

## **Data Collection and Results**

### **Description of Data Collection Methods**

The 18 students in the Academic Honors Chemistry class completed a series of four projects, one per class session, over a span of 3 weeks. The grouping typology varied from one project to the next. In the first project, the students worked individually; in the second project, the students worked in teacher-designated groups; in the third project, the students worked in groups that they selected; and in the fourth project, the students worked individually or in groups of their choice, on a voluntary basis.

Each project involved completion of a ChemQuest and a Skill Practice worksheet. The first project used ChemQuest 22 on Covalent Bonding, the second project used ChemQuest 23 on Lewis Structures, the third project used ChemQuest 28 on Chemical Reactions, and the fourth project used ChemQuest 29 on Balancing Equations. Each ChemQuest included introductory sections with information on the topic, critical thinking questions to help the student make connections, and practice problems to check for understanding. The Skill Practice worksheets offered the students the chance to apply what they had learned. The ChemQuest and Skill Practice, together, serve as assessment tools, formative and summative, respectively. These instruments provide the data for the quantitative evaluation of student productivity and successfulness and are cited in Appendix A.

Some of the quantitative data and most of the qualitative data were derived from the Likert-style survey given at the beginning and the end of the study, and a reflection journal where the students summarized their attitude during each project as positive or negative. These

instruments are contained in Appendix B and Appendix C, respectively. Other qualitative information was gathered through informal observations.

### Results of the Project

In this study, my objectives were to compare the relative successfulness and productivity observed, based on whether students worked individually or in groups. I, also, investigated the student attitude toward each project, toward whether groups were student formed or teacher formed, and throughout the study. Figure 1 presents the results of the ChemQuest and Skill Practice activities for the four projects.

	Project #1		Project #2		Project #3		Project #4	
	SP	CQ	SP	CQ	SP	CQ	SP	CQ
Average score	83	92	68	84	48	86	56	73

Figure 1. Skill Practice (SP) and ChemQuest (CQ) percentages are displayed for the four projects.

Figure 2 presents results for ChemQuest and Skill Practice activities, arranged by group. This is useful to note trends due to, both, group typology and individual group dynamics.

Project #2	SP	CQ	Project #3	SP	CQ	Project #4	SP	CQ
Group #1	59	83	Group #1	70	77	Group #1	68	58
Group #2	71	88	Group #2	40	88	Group #2	83	93
Group #3	38	70	Group #3	85	94	Group #3	57	85
Group #4	83	92	Group #4	45	94	Group #4	20	73
Group #5	75	91	Group #5	10	71	Group #5	73	81
Group #6	88	82	Group #6	30	86	Group #6	45	69
			Group #7	25	94	Group #7	45	59
			Group #8		88			

Figure 2. Skill Practice (SP) and ChemQuest (CQ) percentages for groups, across the projects, are displayed.

Figure 3 presents the information from the student reflection journals. This summarizes the attitude rank per student per project, and shows a trend through total values, and presents the findings as qualitative rankings, as well.

	Project #1	Project #2	Project #3	Project #4
Total	10	16	15	12
Ranking	Medium	High	High	Medium

*Figure 3.* Positive attitude ranks are tallied, and correspond to high (13-18), medium (7-12), or low (0-6).

The quantitative and qualitative results of the pre- and post-research attitude surveys are summarized in Figure 4. The quantitative information is presented as sums of particular questions on the survey that apply to the categories of student attitude toward individual or group projects.

Quantitative Totals*	Individual Work		Group Work		Change in Attitude		
	Pre-	Post-	Pre-	Post-	Individual	Group	
Positive		21	17	53	54	-4	1
Neutral		19	25	9	13	6	4
Negative		32	30	10	5	-2	-5

  

Qualitative Rank	Individual Work		Group Work		Change in Attitude	
	Pre-	Post-	Pre-	Post-	Individual	Group
Positive	Low	Low	High	High	None	None
Neutral	Low	Medium	Low	Low	Increase	None
Negative	Medium	Medium	Low	Low	None	None

*Figure 4.* A summary of quantitative and qualitative attitude survey data is presented. Individual work sums are taken from survey questions 1, 2, 6, and 7. Group work sums are taken from survey items 3, 4, 5, and 8. A total positive score was obtained from the sum of survey ranks 5 and 4. A total negative score was obtained from the sum of survey ranks 2 and 1. Ranks are classified as high (49-72), medium (25-48), or low (1-24).

## Analysis of Results

The trends in score observed through the projects are depicted in Figures 1 and 2, and the information is supported statistically through the mean and standard deviation values listed in Figure 5. Figure 1 shows that there was very little variation in mean for the ChemQuests given in the first three projects. Figure 5 shows that the mean of the ChemQuests from the first three projects varied little and shared a standard deviation of 9. There was a bit of a drop in the mean,

during the third project, and the standard deviation was higher, at 16. I believe that this drop was due to extraneous factors, rather than any of the variables being examined. There were a few interruptions to class that day, the project was fairly long, and the topic involved a lot of math. The Skill Practice scores varied more widely. This trend across the study can be seen in Figure 1, which shows the class average score per project, and in Figure 2, which shows the average score by group, for each project. The mean and standard deviation for the ChemQuest and Skill Practice for each project are listed in Figure 5. The mean Skill Practice score varies from 83 with a standard deviation of 12, in the first project, to 48 with a large, standard deviation of 30, in the third project. I believe this is, partially, due to the relative familiarities of the respective topics to the students. The first project was on a topic which the students had some prior knowledge and experience, but the third and fourth topics were wholly unfamiliar, and related to each other.

		Project #1	Project #2	Project #3	Project #4	
CQ	Mean	92	84	86	73	
	SD	9	9	9	16	
SP	Mean	83	68	48	56	
	SD	12	25	30	21	

*Figure 5.* The mean and standard deviation for the ChemQuest and Skill Practice for each project are presented.

The results of the attitude surveys and reflection journals were not entirely conclusive. A distinct difference can be observed in the positive attitude toward group versus individual work, but there is no distinct difference in attitude from the beginning to the end of the project. The information derived from the survey shows that the positive attitude rank for group projects is considerably higher than the positive attitude rank toward individual work, for both pre- and post-administrations. There is a slight decrease, of 4 points, in positive attitude toward individual work, and there is a 1-point increase in the positive rank toward group work, across

the study. The largest observable difference was the 6-point increase between the neutral ranks toward individual work, across the study. The results of the reflection journals were more telling. The lowest attitude was observed in the first project, which involved individual work, and the second and third projects involving group work were considerably higher. The attitude rank of the fourth project, involving voluntary group or individual work, was a bit lower than those of the second and third projects, but higher than the first project. My hypotheses were that there would be a gradual, observable increase in attitude throughout the projects, due to a learning effect, and that there would be a large increase between projects two and three, due to the difference in how the groups were formed. None of my hypotheses were supported by the data. I believe that the decrease in attitude rank, observed between the second and third projects was due to several factors:

- The project was given the Monday following Thanksgiving break and two students were absent.
- The students were not in learning mode after the long break.
- The ChemQuest and Skill Practice sheets were longer and less familiar than the previous one had been.
- Several students took their work home because they were unable to finish, and did not return it the following day.

### **Conclusions and Recommendations**

Inquiry-based learning activities are best utilized in concert with direct teaching methods as enrichment, but not as a replacement for lecture and standard assessments. It is true that the ChemQuests are designed to be self-contained, but it was unreasonable to expect the students to be able to finish them, regardless of length, in a single class period. I can confidently generalize

that students consistently have a more positive attitude toward group projects than individual projects. Because of this, group activities can be a powerful tool for the teacher to use, if used properly. These claims are supported by the designer of the ChemQuest Modules (Neil, 2008). Teachers would do well to get involved in any professional development activities available that could enhance their ability to use inquiry, and action research style assessments. Both have the potential to be quite useful as tools to improve the classroom learning environment. Technology could have played a larger role in this study. I think results could have been improved if a short PowerPoint presentation or video on each topic could have been shown, prior to completion of student activities. This would be a way to insure all the students were beginning with the same basis of information.

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## Appendix A

### Summary of ChemQuest Modules

The students will be completing 4 different ChemQuest modules as part of this project. These are self-contained formative and evaluative tools. Each one consists of information on a certain topic, examples, and critical thinking questions. The modules are fairly uniform in difficulty. The number of questions in each varies, but since some questions have multiple parts they all have an average of 30 items to be answered.

#### The Four ChemQuest Modules Utilized in the Study Include:

- Project #1: Individual Work
  - ChemQuest #22 [Covalent Bonding]
    - Total Score out of [19]
  - Skill Practice#22 [Covalent Formula Practice]
    - Total Score out of [22]
  
- Project #2: Teacher Designated Group Work
  - ChemQuest #23 [Lewis Structures]
    - Total Score out of [22]
  - Skill Practice#23 [Structure Practice]
    - Total Score out of [8]
  
- Project #3: Student Designated Group Work
  - ChemQuest #28 [Chemical Reactions]
    - Total Score out of [32]
  - Skill Practice#28 [Reactions Practice]
    - Total Score out of [10]
  
- Project #4: Voluntary Individual or Group Work
  - ChemQuest #29 [Balancing Equations]
    - Total Score out of [29]
  - Skill Practice#29 [Balancing Practice]
    - Total Score out of [20]

## Appendix B

### Student Survey

Please circle the number response that most closely matches your opinion on each topic.  
(1)= strongly disagree, (2)= disagree, (3)= no opinion, (4)= agree, (5)= strongly agree.

Also, write in opinions or explanations are quite welcome in the space provided beneath each statement.

1. I work best individually. 1 2 3 4 5
2. I enjoy working individually more than in groups. 1 2 3 4 5
3. I work best in groups. 1 2 3 4 5
4. I enjoy working in groups more than individually. 1 2 3 4 5
5. I think groups are good because they encourage teamwork. 1 2 3 4 5
6. I think groups are bad because some people can be lazy. 1 2 3 4 5
7. When I hear that we have to work in groups, I get worried. 1 2 3 4 5
8. When I hear that we have to work in groups, I get excited. 1 2 3 4 5
9. I like it better when groups are assigned by the teacher. 1 2 3 4 5
10. I like it better when we get to choose our own groups. 1 2 3 4 5

## Appendix C

### Student Reflection Journal

**Instructions:** This sheet is a summary of your attitude toward each project. Please fill it out so that I can see what you think of everything. How you feel about the projects is important to me! I will use this information to improve the way I teach.

Consider what kinds of things you worked on individually or in your groups each day and, in the “How I feel” box, just write a + sign for positive feelings, or a – sign for negative feelings...I know some days you feel neither...but try to pick one...

Also, if you would like to explain your choice, I left a space for that, too. You don't *have* to do this, but it would help me understand things better if you did ^\_^.

Please turn this in with your other materials at the end of all 4 projects.

Project	How I feel about my work today (+ / -)	Explain why if you'd like...
#1		
#2		
#3		
#4		

**Parental Involvement**

James Pierce

Education 590, Fall 2009

The University of Tennessee at Chattanooga

*The Institutional Review Board of The University of Tennessee at Chattanooga (FWA00004149) has approved this research project # 09-140.*

### **Introduction to the Problem**

The middle grades represent a significant turning point in students' lives. During the middle grades, students solidify ideas about themselves as learners. They arrive at these conclusions about their competence in academics, their attitudes, their interests, and their motivation. These ideas will influence how they approach their academic studies in later years, which, in turn, will affect their later career and personal opportunities.

### **Statement of Problem**

Many schools at the middle school level have a lack of consistent parental involvement throughout the school year. There seems to be different levels of parental involvement. Some parents are active participants in their child's education. They are the ones that are there for every extracurricular or nonextracurricular event, to show support or volunteer their time in classrooms or fundraisers. Some parents have fluctuating involvement. These parents show up only when there is a particular problem, whether that problem is academic or when they think that there has been some social injustice. There are those parents that never show any interest in their child's academic progress, except in extreme cases. These parents show up at the last minute when their child is in jeopardy of not being promoted or is in serious trouble.

It is important to remember that, during these middle school years, there are changes in adolescent development and cognitive growth. During these times of change, there is a decline in academic performance. It is this important fact that makes it crucial to have parental support to insure adolescents reach their full potential. Therefore, it is imperative to identify the extent to which parental involvement in education is positively related to achievement for middle school students and which types of involvement are most effective (Hill & Tyson, 2009). Identifying the programs that will have the most positive effect on achievement and the best relationship for

parental involvement will determine the best avenue to attack the issue of parental involvement in schools. Improving parental involvement is one of the most challenging tasks facing educators today (Vandegrift & Greene, 1992).

### **Area of Focus**

The purpose of this study is to determine how much effect parental involvement has on student behavior and test results. Ideally, the research will outline the most effective program to reach the goals of proficient and advanced test scores. Research will, also, investigate if parental involvement will have any unintentional effects on student test scores or the school community.

### **Limitations**

Possible limitations to the research will be the willingness of parents to participate in the study. There are parents that work two or more jobs to provide for their families and it will be understandable that they may not be able to participate. Other factors that may affect the study would be the low educational background of some of the parents.

### **Research Questions**

The following questions will guide the research project:

- Does parental involvement have a direct correlation with test scores?
- Can parental involvement have a negative effect on a student's test scores?
- Are there any unintentional results of parental involvement?
- Can parental involvement affect a school in ways other than test scores?

### **Review of Literature**

There seems to be a general consensus that student test scores and schools, themselves, improve with parental involvement. Research, over the years, has shown that there is a positive correlation between student achievement and parental involvement. The most important element

in this positive correlation is the team work between teachers and parents. Lonigan and Whitehurst (1998) support the idea that teamwork between teachers and parents facilitates learning for children. In their study, they discovered that, when parents and teachers collaborate in shared reading intervention for preschool, African American children, from low income backgrounds, with below age-level oral language skills, produced the most significant main effect compared to the treatment group. Additionally, the collaborative ventures between families and schools can result in children being successful, both, academically and in life (Henderson & Berla, 1994; Jackson & Davis, 2000; Mapp, 1997).

Although research has shown that collaboration between teachers and parents has resulted in improved test scores, there are some teachers and parents that do not work together well. It is important to remember that the family unit has changed and will continue to do so. Clevenson (1999) reported that families commented that they receive little information about school and what is occurring at school. Munk, Bursuck, Epstein, Jayanthi, Nelson, and Polloway (2001) state that causes of communication problems include the lack of convenient opportunities to communicate, differing attitudes of parents and teachers toward homework, and teachers' scant knowledge regarding student strengths and needs.

Since family patterns have changed, a variety of communication approaches must be used (Moore & Littlejohn, 1992). Moore and Littlejohn identified four models that can be effective in communication with parents:

1. Administration must be enthusiastic about the prospect.
2. Schools should act on the changing roles of families.
3. Schools should use all their technological communication skills to stay in touch with families.

#### 4. Schools should not expect perfect starts.

Some parents are reluctant to get involved in their children's education. The reasons vary, but include the parents own lack of education, or a bad school experience of their own.

Sasser (1991) found that, among the factors that affect parental involvement in public schools, parents are deterred from participation by a feeling of inadequacy about themselves, prior negative association, perception of school administrators, and teacher attitude toward parents.

There are those teachers that consider uninvolved parents as those who are disinterested in their child's education. Finders and Lewis (1994) think that, instead of assuming that absence means non-caring, educators must understand the barriers that hinder parents from participating in their child's education.

There is an encouraging report in which France and Hager (1993) found that schools can recruit and retain parents to provide a support system for their children's literacy development. This report is encouraging and important because of the fact that evidence suggests that parental involvement is very important for the middle school student's school success, and, also, for later academic success (Catsambis 2001). Parents must remain involved in the lives of their early adolescent children, given the complexity of modern life (Simmons-Morton & Crump, 2003). When parents are proactive with school work, the student's behavior and social adjustment improve drastically (Cordry & Wilson, 2004). Additional reports state that parents tend to be less involved with their children during middle school than during elementary school (Downs, 2001; Johnston, 1998, cited in Lonigan & Whitehurst, 1998). Some research has indicated that the strength of the relationship between parental involvement and achievement declines between elementary and middle school (Singh, Bickley, Trivette, Keith, Keith, & Anderson, 1995). This

is unfortunate, with all the changes in adolescent development that occurs during middle school years. These changes include biological and cognitive growth, and social development, not to mention the change in the parent-adolescent relationship. With this evidence, it is very important to determine which programs can identify the most effective strategies. In light of the research reviewed, the most successful predictors of student achievement are an encouraging home environment, high expectations from parents, and parental involvement (Epstein, 2001; Zellman & Waterman, 1998).

## **Data Collection and Results**

### **Data Collection**

This research will involve the parents and students of a seventh-grade math class, at a suburban school located in the Hamilton County school district, in Tennessee. The parents of this school are middle class to upper class. The student population is 67% white, 32% African-American, and 1% Hispanic. The following method was used to collect data for research:

- Evaluate Experimental group math scores and Think Link scores.
- Evaluate control group math scores and Think Link scores.
- The experimental group will receive intense parental involvement efforts.
- Compare experimental group and control group scores.

Instruction in each class was identical, with the use of differentiated instruction when appropriate. Math scores, from publisher-provided skills tests were used to determine achievement. There was an attempt at an appropriate level of parental involvement in each class, with the exception of the experimental class. The experimental class received accelerated efforts to increase parental involvement. A parent survey (see Appendix A) was used to determine past and present parental involvement, and to identify methods of parental involvement.

## Results

The parent survey asked a variety of questions to try to determine the amount of parental involvement that existed. When parents were asked about how regularly they attended parent-teacher conferences or open houses, 38% attended 0 to 1 times per year and 62% attended 4 to 5 times per year.

When asked about their diligence in questioning their child, regarding school activities, 50% asked their children daily, 37% asked weekly, and 13% said they asked every 10 days.

Parents were asked how often their children received assistance with their homework. The survey revealed 25% received help 1 to 3 days per week, 38% received help daily, and 37% received help only on occasion. Parents checked for homework on a daily basis 25% of the time, every 1 to 3 days 62% of the time, and occasionally 13% of the time.

When asked about rules regarding television viewing, the parents reported that 50% had rules in place, 25% had no rules, and 25% had occasional restrictions on television viewing. When asked if too much parental involvement could discourage their child from performing well academically, 75% responded that it did not and 25% responded that it was possible.

Of the parents surveyed, 50% of the parents expected their child to earn a grade of A or B, while 25% expect a grade of B and C, and 25% hoped that their child would receive the best grade that they were capable of earning. When parents were asked how often they communicated with their child's teacher, regarding a test or quiz, only 13% reported that they did so when they were aware of a test or quiz. Fifty percent of parents reported that they communicate with teachers only when there is a poor grade involved, and 37% reported no contact with teachers, at all, regarding test grades.

An encouraging revelation from the study revealed that parents are supportive of teachers, when dealing with behavior problems. Sixty-two percent said that they would thank the teacher and deal with the problem at home while 38% felt it was the responsibility of the teacher and school administrator to deal with the problem at school. When attending a parent-teacher conference, parents reported that 62% felt the school personnel made them feel comfortable and 38% believed the school personnel made them feel somewhat comfortable.

The control group received as much attention as usual in connecting with parents and asking for their involvement in their child's education. The experimental group experienced an increased effort of connecting with parents to establish parental involvement. In the experimental group, parents signed completed homework and tests, there was an increase in progress reports sent to parents, and there was an effort to contact parents, personally, by the teacher.

The result of these efforts revealed no significant improvement in student grades. On the assessment used, the control group had a 57% passing rate while the experimental group had a 58% passing rate. Although the results of the research show no difference in passing rate, there is a result that cannot be measured. That result was the goodwill that was created between teacher and parent. The majority of parents want to be informed of their child's academic success or lack thereof. For the most part, parents want to know, in advance, of any behavioral problems, before they become a serious threat to academic progress.

### **Conclusion**

There is no doubt that parental involvement is a huge benefit to student academic success. The evidence is in numerous research studies, which have shown the benefits of parental involvement in student academic achievement. When parents and teachers participate

equally in a student's academic program, the depth and quality of learning increases (Hatch, 1998). It is up to all educators to try to foster a parent-teacher relationship that will ensure the success of all children.

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## Appendix A

### Parental Survey

- 1) How many parent teacher conferences or school open houses have you attended in the last year?
  - A) 0-1
  - B) 2-3
  - C) 4-5
- 2) How often do you question your child about school activities?
  - A) Daily
  - B) Weekly
  - C) Every 10 days
- 3) How often do you assist or have someone assist your child with homework?
  - A) 1-3 days per week
  - B) daily
  - C) occasionally
- 4) How often do you check to see if your child has completed their homework?
  - A) Daily
  - B) 1-3 days per week
  - C) occasionally
- 5) Do you have established rules regarding television?
  - A) Yes
  - B) No
  - C) Occasionally
- 6) Do you believe that too much parental involvement may discourage your child from successful academic performance?
  - A) Yes
  - B) No
  - C) Possible
- 7) What are your academic expectations for your child? Measure by letter grade.
  - A) A-B
  - B) B-C
  - C) Do the best they can
- 8) How often have you communicated with your child's teacher regarding a test or quiz grade?
  - A) Every time I am made aware of a test or quiz.
  - B) Only when the test or quiz reveals a poor grade.
  - C) Never
- 9) How do you respond to communication from your child's teacher or school administrator regarding behavior problems?
  - A) Thanks for contacting me; I will deal with the issue.
  - B) I deal with the issues at home the teacher or administrator can deal with the issue at school.
- 10) When attending a parent teacher conference, how does your child's school make you feel?
  - A) Comfortable
  - B) Somewhat comfortable
  - C) Uneasy

**Numeracy Across the Middle School Curriculum**

LaShelle M. Smith

Education 590, Fall 2009

The University of Tennessee at Chattanooga

*The Institutional Review Board of The University of Tennessee at Chattanooga (FWA00004149) has approved this research project # 09-181.*

### **Introduction to the Problem**

As a current math teacher in the middle school, I realize the importance of teaching mathematical skills and concepts. However, with the rise of the focus being given to mathematics instruction, one begins to wonder if all can be accomplished in a math class alone. Is it only the responsibility of the math teacher to teach math concepts? Isn't math used in other subjects, too?

Math skills are important, but a shift of focus on numeracy has begun to occur in our school society. So what is numeracy? Numeracy has many different definitions but the main concept is the same. Numeracy is using mathematics and mathematical skills in real life situations. In school subjects, it refers to the ability to teach math subject-wide in ways that will be effective to students, later in life. I use numeracy in the math class room. It is the main instrument with which I teach, every day. Understanding all this and feeling the pressures of success for my students, I became curious of how other teachers in other subjects dealt with the rise of numeracy accountability in our schools. Is it important to use and teach numeracy in all the subjects? Do the teachers of the other subjects understand the importance of numeracy? Can numeracy be incorporated into all the subjects?

The purpose of this research is to determine to what effect numeracy is being taught or used in middle schools, and what the level of knowledge of numeracy teachers may have.

Guiding questions include the following:

1. Do teachers in other subjects know and understand the definition of numeracy?
2. How often are teachers in all subject areas using numeracy in their classrooms?
3. How important is numeracy to teachers in all subject areas?

4. How are the teachers in all subject areas using and/or teaching numeracy in their classrooms?

### **Review of Literature**

Steen (2001) wants schools to focus on numeracy as much as they focus on literacy. In his article, he focuses on the importance of numeracy. Numeracy is not the same as mathematics, nor is it an alternative to mathematics. The idea he stresses is that students and math teachers don't need to do more work. The curriculum should, instead, support greater math usage. Since math can be used and seen everywhere, it needs to be taught everywhere. This can be done by relating math to real concepts. This, in part, allows the student to see the importance of learning the skills and the usefulness of applying them. Math should be presented in a way that makes sense for the learner. It should be related to real-life experiences so students can see how each subject can use the skills they have learned. Each school subject should support each other's different subjects, relating them together for one joint learning experience for the student. Being able to take the skills students are taught in math, and teaching students to apply them in various other contexts, including other subjects, allows for deeper knowledge. The more they know and understand, the better they will be in dealing with unfamiliar situations in real life.

Another article related to numeracy research shows that numeracy has become more important over the past few years. Hurst (2007) found that most people had the same ideas about numeracy. Numeracy always seems to encompass one's ability to use his or her mathematical knowledge. Therefore, numeracy not only involves the math concept, but the use of that concept in various situations. The use of the teacher as the facilitator is also very important. Most students do not use their skills unless prompted to or encouraged to do so. If students used numeracy wherever it was needed, there probably would not be a need to focus on numeracy.

The teacher must be knowledgeable of the importance of deepening the skills around the curriculum. Numeracy should encompass all aspects of education. Hurst concludes his research by stressing the importance of teaching and using learning strategies to help broaden the students' abilities to apply their mathematical knowledge to various different situations.

Much research has been done in the U.S., as well as in Australia (Muir, 2008) and the United Kingdom (Askew, Brown, Rhodes, & William, 1997). There is a strong focus on numeracy in these countries. In each of these countries, the outcomes remain similar to those in the U.S. The focus should not be in the math classroom, but distributed to each of the subjects in the curriculum. Teachers are the main focus in each set of data in these studies. Teachers need to take responsibility for the development of numeracy across the curriculum (Groves, 2001). Some teachers go through specialized training to learn how to effectively teach and implement numeracy in their subjects (Watson, Caney, Beswick, & Skalicky, 2005/2006). When training is completed, many teachers find that they re-evaluate and adjust their teaching practices accordingly to adapt the new numeracy focus. Strong evidence supported the idea to teach numeracy in all subject areas.

In all the supporting literature, one idea runs throughout: Only a small portion of the numeracy debate can be put on the shoulders of the math teacher. Numeracy and mathematics should go hand in hand, and be incorporated into each aspect of the school curriculum. Numeracy is not the same as mathematics, nor is it an alternative to mathematics. Rather, it is an equal and supporting partner in helping students learn to cope with the quantitative demands of modern society. Whereas mathematics is a well-established discipline, numeracy is necessarily interdisciplinary. As with writing, numeracy must permeate the curriculum. When it does, also

like writing, it will enhance students' understanding of all subjects and their capacity to lead informed lives (Steen, 2001).

## **Data Collection and Results**

### **Data Collection**

**Subjects.** The subjects for this study were middle school teachers in an urban middle school in Hamilton County, Tennessee. The teachers were from sixth-, seventh-, and/or eighth-grade classrooms. Their subject areas were math, science, social studies, or language arts.

**Instruments used.** A short survey was given to the middle school teachers. It was composed of five multiple-choice and two short-answer questions (see Appendix A). The results of the survey are presented in Appendix B.

**Procedures.** All teachers at this middle school have grade-level planning once every 2 weeks. The surveys were given to each of the teachers during this planning time. Teachers were briefed on the purpose of this survey for the research project. Of the 25 surveys distributed, only 15 were returned. Among the grade levels, four were returned from sixth-grade teachers, four were returned from seventh-grade teachers, and seven were returned from eighth-grade teachers. With regard to subject area, science teachers returned three surveys, math teachers returned two surveys, social studies teachers returned three surveys, and language arts teachers returned seven surveys.

### **Results**

**Science.** Of the three science teachers who returned the survey, 100% of them gave an accurate definition of numeracy. Daily use of numeracy is done by 66% of the teachers, while 33% use numeracy once in a while. The importance of numeracy was deemed important by 100% of the science teachers. The ways the teachers use numeracy were listed as looking at data

and scientific methods, weather concepts, using scientific formulas, solving problems, using charts and graphs, communicating results of data, and quantitative assessments.

**Mathematics.** Of the two math teachers who returned the survey, one teacher gave a complete and accurate definition of numeracy, while the other teacher gave a definition as it related only to the subject of mathematics. Daily use of numeracy and importance of use of numeracy was cited by 100% of the teachers surveyed. The math teachers used numeracy in the curriculum taught, to show how mathematical concepts are used in everyday life situations and to show how numeracy can enhance and improve student understanding of the world.

**Social studies.** Of the three social studies teachers surveyed, 100% of the teachers gave an accurate account of the meaning of numeracy. Daily use of numeracy is done by 33% of the teachers, while 66% use numeracy once in a while. While 66% of the teachers agreed numeracy was important, 33% had no comment on the topic. Social studies teachers cited creating, reading, and using statistics on graphs and charts; using maps; and grading as ways they use numeracy in their subject area.

**Language arts.** Of the seven language arts teachers surveyed, 100% of the teachers gave an accurate account of the meaning of numeracy. All 100% of the teachers used numeracy once in a while. Numeracy was deemed as not important by 14%, and important by 43%, while 43% had no comment on its importance. The language arts teachers cited warm-ups, word problem break down, analyzing items and statistical information in texts, timelines, determining averages and grade-point averages, and scoring essays as uses for numeracy in their subject area. See Figure 1.

Content areas	Response	Science (3)	Mathematics(2)	Language Arts (7)	Social Studies (3)
Define Numeracy	Correct	3	1	7	3
	Incorrect	0	1	0	0
Use of Numeracy	Daily	2	2	0	1
	Once in a while	1	0	7	2
	Never	0	0	0	0
Importance of Numeracy	Not needed	0	0	1	0
	Important	3	2	3	2
	No comment	0	0	3	1

*Figure 1.* Educator responses on the numeracy survey are presented. The total number of respondents was 15.

## **Conclusions and Recommendations**

### **Conclusions**

The purpose of this research paper was two-fold: (a) to determine to what effect numeracy is being taught or used in middle schools, and (b) to determine what the level of knowledge of numeracy teachers have. The literature reviewed emphasized the importance of this topic in our schools. The survey indicated that the teachers are, in fact, teaching numeracy, and showed the understanding of the definition of numeracy across the curriculum.

Teachers in each of the subject areas gave several important and useful ways in which to use numeracy in the given subject. Most subject teachers agreed with the uses of graphing and data collection as ways to use numeracy in their classrooms. Students are able to figure their grades in each classroom subject, and determine grade-point average, with the use of numeracy.

A majority of the teachers agreed on the importance of numeracy, and they used numeracy most of the time. Numeracy is important and is a focus in most schools, in this area and around the world. More attention is being given to the subject, and the focus is not, solely, on math teachers. School personnel, as a whole, should work as a team to make numeracy important in all subjects and to all students.

### **Recommendations**

Recommendations are focused on collaboration. Allowing all subject area teachers to plan collaboratively, focusing on numeracy and ways numeracy can be used in cross-curricular learning, would be useful. Teacher training could be an effective way to stress the importance of numeracy and teach appropriate ways to incorporate numeracy into each subject. Working as a team, with the responsibility of educating and preparing students for the future, would benefit all persons involved.

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## Appendix B

### Survey Results

Results of science teachers (two, sixth-grade teachers, and one, eighth-grade teacher)

Question 4: What does the word numeracy mean to you (in just a few words)

1. Mathematics awareness
2. Working with numbers, able to solve problems
3. Using numbers that make sense to the students, with the appropriate definitions

Question 5: I use numeracy in my subject area

1. Daily: 66%
2. Once in a while: 33%
3. Never: 0%

Question 6: I feel that the use of numeracy in each subject is

1. Not needed: 0%
2. Important: 100%
3. No comment: 0%

Question 7: The best way to use numeracy in my subject area is...

1. Data from scientific methods
2. Weather
3. Degrees for latitude and longitude
4. Charts/graphs
5. Formulas
6. Looking at data
7. Solving problems
8. Communicate results
9. Quantitative assessment

Results of math teachers (one, sixth-grade teacher, and one, eighth-grade teacher)

Question 4: What does the word numeracy mean to you (in just a few words)

1. Understanding concepts in math
2. Numeracy is the ability to understand and use mathematical concepts and techniques

Question 5: I use numeracy in my subject area

1. Daily: 100%
2. Once in a while: 0%
3. Never: 0%

Question 6: I feel that the use of numeracy in each subject is

1. Not needed: 0%
2. Important: 100%
3. No comment: 0%

Question 7: The best way to use numeracy in my subject area is...

1. Used in the curriculum I teach
2. Show student how mathematical concepts are used in everyday life situations
3. Show how numeracy can enhance and improve one's understanding of the world around them.

Results of social studies teachers (one, seventh-grade teacher, and two, eighth-grade teachers)

Question 4: What does the word numeracy mean to you (in just a few words)

1. Math in every subject
2. Working with math skills
3. Using numbers while I teacher

Question 5: I use numeracy in my subject area

1. Daily: 33%
2. Once in a while: 66%
3. Never: 0%

Question 6: I feel that the use of numeracy in each subject is

1. Not needed: 0%
2. Important: 66%
3. No comment: 33%

Question 7: The best way to use numeracy in my subject area is...

1. Statistics on charts/graphs
2. Maps (measuring distance, interpretation...)
3. Grading (finding percentages)

4. Creating charts and graphs
5. Population graph work
6. World population situation
7. Any type of graph and/or chart
8. Graphs
9. Charts
10. Maps

Results of language arts teachers (one, sixth-grade teacher, three, seventh-grade teachers, and three, eighth-grade teachers)

Question 4: What does the word numeracy mean to you (in just a few words)

1. Using math in all content areas
2. Numeracy is the knowledge of how numbers work in everyday life, as well as academically.
3. Incorporating math into everyday life
4. Using some sort of math in class
5. Numeracy is about math in all situations
6. Incorporating the use of numeric information into curriculum
7. The student's ability to communicate mathematically

Question 5: I use numeracy in my subject area

1. Daily: 0%
2. Once in a while: 100%
3. Never: 0%

Question 6: I feel that the use of numeracy in each subject is

1. Not needed: 14%
2. Important: 43%
3. No comment: 43%

Question 7: The best way to use numeracy in my subject area is...

1. Warm-ups
2. Word problem break down
3. Charts and graphs

4. Analyzing items in non-fiction
5. Statistical information in text
6. Timelines in writing
7. Teaching grade-point average
8. Averaging grades/teaching and understanding weighting
9. Percentages of students understanding
10. Scoring essays
11. Charts (non-fiction)
12. Graphs (non-fiction)
13. As an alternative way to communicate
14. Students' use of math skills in grading
15. Score keeping during games
16. Relate to life skills
17. Charts
18. Kids can average grades
19. Looking for patterns in everything
20. Logic