ACTION RESEARCH

USING KINESTHETIC TEACHING STRATEGIES: THE JOURNEY OF A SEVENTH GRADE CLASS

by

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Abstract

This study focuses on data gathered in a seventh grade math class. The study was designed to examine the relationship between learning styles and student learning. The question of whether teaching students using strategies that are consistent with their learning styles fosters student learning is explored. Specifically, the kinesthetic learner is addressed and lessons are planned and carried out that use kinesthetic/tactile strategies such as games, group activities and the use of manipulatives. Students' behavior was observed, artifacts of their work were gathered and student interviews were conducted. The student teacher also reflected on lessons and student behavior. The combination of these data sets suggests that student learning is enhanced when strategies are used to match student learning styles.
Being a math student has been an uphill climb for me at times, while at other times I have experienced that mountaintop feeling of understanding and exhilaration.

One of my earliest recollections of being a math student is from middle school. I was initially placed in the lower math class. However, within the first few weeks of my placement, my teacher realized that this was a mismatch for me and bumped me to the next level for math.

When I look back, I think this simple placement change cemented my love for math. My math confidence soared and, although it has taken a beating a few times since then, for the most part I have not lost that confidence. What is remarkable to me is that the only actual memories I have while in middle school of learning math are from an activity that I remember doing in the seventh grade in which we discovered prime numbers by using the Sieve of Eratosthenes.

Probably the uphill struggles that I have faced with math have been those times that a concept has been introduced and I have faced that feeling of disequilibrium that learning new concepts can bring. Unfortunately, teachers do not always teach or re-teach a concept with varied approaches to give students who are struggling more time to process or learn the new concept with an alternative approach.

As an adult, I have experienced what it is like to be one of the few in a room who did not understand the concept that is being introduced as quickly as others did. I recently was a student in a class designed to teach methods of mathematics teaching. In this class, we were not to rely on our algebraic thinking or skills. Instead, we were challenged to use manipulatives and think more spatially. I found some students in my class, usually the male students, were quick to see the spatial relationships that were
represented by the manipulatives. I felt foolish at times. However, if given enough time to explore, I, too, was able to see the spatial relationships and deepen my understanding of concepts that I considered myself to have mastery over. I found this experience to be instrumental in how I approached teaching during my student teaching.

I did my student teaching in a small rural community middle school with seventh and eighth grade students. The school district had a small percentage of minorities attending its schools. Yet, there were a significant number of economically disadvantaged students attending the middle school.

The group of students that I chose to conduct my inquiry with was considered the lower math group of the two seventh grade classes. The students were well aware of the distinction between the two classes. The class was large at 29 students. The majority of these students were female. I also had several students on an Individualized Education Plan (IEP). These plans are put into place for students who have special needs. Most of my students’ special needs were for learning disabilities.

Students learn and forget math concepts, sometimes rather quickly. I posed the question to my seventh grade students on several occasions, “Who remembers learning about ....?” Usually, no one responds. I know that because of the curriculum requirements set by our state’s education department these students have been taught the concept that I am inquiring about, but their retention is minimal.

For instance, I gave a pre-assessment on a unit that I was to teach. I was to prepare 5 70-minute lesson plans on Number Theory and wanted to make sure that I planned these lessons appropriately. The scores on the pre-assessment were dismal.
However, I am confident that this material had been taught in the sixth grade. The level of difficulty is what changes, not the concept. This serious situation coupled with the fact that my seventh grade students were in my math class for 70 minutes made me start to wonder what I, as a student teacher, could do to not only facilitate their learning, but to make it meaningful as well.

The saying that “You learn best by doing” seemed to fit this situation. In realizing this fact, I also saw that, for some reason, we stop teaching math with the tactile/kinesthetic learner in mind during the middle school years. Students are expected to sit at their desks sometimes for as long as 70 minutes (as was the case with my class of seventh grade students) with only visual or auditory presentations. I started to wonder if teaching math concepts that included tactile/kinesthetic activities would make a difference for my seventh grade students as they constructed knowledge instead of just being told or shown information.

Due to the ability grouping for math in this school, I often heard students make statements like, “We can’t do this. We are in the dumb math class.” As a person who has not had those feelings about math, these statements motivated me even more to create a positive learning environment. I realized that the students did not believe in themselves. I felt that adding a third dimension to my teaching plans by using strategies that incorporated not only visual and auditory learning styles but also kinesthetic learning styles would greatly benefit these students.

At times, I feel students have been conditioned to sit and listen and wait for the bell of clarification to go off in their heads as the teacher lectures. These students have
become too accustomed for the bell not to go off and, therefore, have accepted just not getting a concept.

Kinesthetic activities give these students the practice they need in grappling with a concept and manipulating it until they can make the concept personally meaningful. I thought that I would have a healthy percentage of kinesthetic learners in my class, but the actual number of kinesthetic learners surprised me. It was much higher than I anticipated. I administered a modified learning style inventory to my students. I discovered that 86 percent of my students either had a kinesthetic learning style for their first or second learning modality. These results baited me to try to answer this very important question, “Will teaching math concepts to my seventh grade students with tactile presentations/activities have a positive effect on their learning?”

Were my students more successful? I believe so. I saw improvements in their behavior due to being engaged with the activities. I saw improvements in quiz and test scores. I also witnessed students whose confidence grew. I heard statements like, “This is easy,” and “It makes sense.” I believe this growth in confidence was the most positive effect of all.
What I’ve learned from Distant Colleagues

As a pre-service teacher in a seventh grade mathematics class, I have noticed how one-dimensional teaching can be at this level. I have also observed how quickly students are learning and forgetting math concepts. But, the one observation that has stood out to me is that for some reason, we stop teaching math with the tactile/kinesthetic learner in mind during the middle school and later years. Students are expected to sit at their desks sometimes for as long as 70 minutes with only visual or auditory presentations. I want to know if teaching math concepts to my seventh grade students with methods that include tactile/kinesthetic activities or presentations will make a difference for my students and decrease this pattern of learning and then forgetting.

My experience at the elementary level as a parent volunteer gave me an interesting comparison. An elementary teacher would not expect her students to sit and listen and work for 70 minutes. Yet, at the middle school level that is exactly what is expected. Do student learning styles change that dramatically from elementary to middle school? This comparison led me to wonder if teaching math concepts to my seventh grade students with tactile presentations/activities included in the learning process might have a positive effect on their learning.

Where do the Learning Styles Overlap?
There are three distinct approaches or areas of research focusing on how information should be taught in the classroom. Multiple intelligences suggests that intelligence does not involve a single quantifiable cognitive ability but a number of different cognitive abilities that each has its own developmental process (Gardner, 1983). Learning styles focus on understanding how each student learns in order to create a more effective learning experience (Sarasin, 1998). Finally, brain-based education emphasizes the physiological basis for attention and strategies for refocusing attention on learning (Jensen, 1998).

Although these approaches have different theoretical underpinnings, there are a numbers of areas in which they overlap (Guild, 1997). For instance, each approach is learning and learner-centered. Therefore, the learner and the process of learning are the focus of the educational system. Each approach views students as reflective practitioners who are actively engaged in exploring, experimenting with, creating, applying, and evaluating the ways in which they learn.

By incorporating aspects from the students’ cultural, physical, social, and emotional lives, each of the three approaches produces a personalized education that interconnects learning with everyday life. Each approach also encourages curriculum substance, depth, and quality within the context of application instead of standardization. Lastly, each approach promotes diversity in that each emphasizes the uniqueness of each student. Given these areas of overlap, perhaps it is not surprising that, despite the theoretical differences between these approaches, the practical outcomes of their use are the same (Guild, 1997).
Although there are a number of different models of learning styles because of the emphasis of various researchers, each model stresses three important points (Dunn, 1990). First, learning styles acknowledge and honor diversity. Second, learning styles stress adapting instruction to individuals instead of groups. Finally, learning styles suggest that students do not fail because they cannot grasp the material being taught. Instead, students fail because they are not being taught in a way that makes sense to them. Dunn (1990) clearly echoes this point with her statement that “when students cannot learn the way we teach them, we must teach them the way that they learn” (p. 18). Models of learning styles are typically designed around one or two characteristics on a continuum with extremes on both ends. Unfortunately, the amount and quality of supporting research varies across models (Dunn, 1990).

Numerous benefits from using instruction tailored to learning styles in the classroom have been reported. Student achievement improves when teaching styles match learning styles (Dunn, Deckinger, Withers, & Katzenstein, 1990). Learning styles-based education has also produced gains in self-esteem in addition to achievement, thereby building self confidence and reducing the risk of dropout (Perrin, 1990).

Additionally, focusing on learning styles helps students develop respect for individual difference in others (Marshall, 1990). Finally, addressing learning styles can serve as a common bond that unites the efforts of students, teachers, and parents in the educational process (Sykes, Jones, & Phillips, 1990).

Learning style advocates, similar to brain-based education advocates, suggest that approximately 60 percent of learning styles are due to biological predisposition (cf., Restak, 1979). As a result, learning styles are not always evident from observation.
alone. Therefore, learning styles inventories are required (Dunn, 1990). DeBello (1990) summarized results comparing several different models of learning styles and found that the measures used to assess learning styles were valid measures suitable for use with students.

Learning styles, however, have received some criticism. One problem in particular is that of practicality. How practical is it for a teacher to assess each student in regard to learning styles and then tailor an educational strategy for each student? O’Neil (1990) notes that the time-intensiveness of assessing and tailoring educational plans can contribute to teacher burnout. He suggests that more of a group approach to learning styles may be warranted.

**Teaching Strategies**

Campbell, Campbell and Dickinson (1999) suggest several teaching strategies for the kinesthetic learner, including the use of manipulatives and classroom games, and the use of technology. The use of manipulatives is one strategy that can be adapted to meet varying learning style needs while allowing students to explore concepts in a group setting.

In fact, Stein and Bovalino (2001) comment that manipulatives provide a method to present abstract information in a concrete way by linking information with personally meaningful networks of knowledge. Therefore, manipulatives allow students to explore concepts, discover knowledge themselves, and understand how to apply that knowledge. Bennett and Nelson (2002), for instance, demonstrate that decomposing math problems into base ten units can facilitate learning of multiplication and division.
Their approach can be adapted for paper and pencil exercises as well as exercises in which blocks are used to solve problems.

The use of technology can also be a powerful teaching and learning tool. Available to us on the World Wide Web are tools referred to as “virtual manipulatives” (Moyer, Bolyard, and Spikell, 2002). These virtual manipulatives are dynamic visual representations of concrete manipulatives. These tools are interactive and allow the learner to manipulate the virtual object as you would a concrete manipulative. You can turn or flip the virtual objects and therefore make meaning for oneself and see relationships as a result of manipulating the visual objects.

Conclusion

As suggested by Teresa Benzwie (1988) in *A Moving Experience*, the more we know about learning and how the brain works, the more evident it is that movement is important to the learning process. Why then, if all of the evidence directs us as educators to incorporate kinesthetic teaching strategies into our classroom, do our students spend so much time in their desks?

Sarasin (1998) recommends educators to take a learning style inventory to identify their own learning style. According to Sarasin (1998), as educators we naturally tend to use teaching strategies that are in line with our own learning style. Could it be that the majority of educators are not kinesthetic learners and therefore have undervalued the kinesthetic learning process? Since our ultimate goal is the success of all of our students, we must recognize our biases and change our teaching strategies.
The three main learning theories of multiple intelligences, learning styles, and brain-based education have four common underlying assumptions. First, education should focus on the learner and the learning process. Second, learning should be active and incorporate aspects of everyday life. Third, the curriculum should emphasize substance, depth, and quality over standardization. Finally, learning should promote diversity.

Since teaching strategies that involve manipulatives tap kinesthetic intelligence (i.e., multiple intelligences) and address the particular learning styles of individual students (i.e., learning styles) as well as focusing on the learning process, creating an active learning environment and establishing greater depth and quality within the math curriculum, manipulative-based teaching strategies should improve mathematics learning in middle school-aged students.

Therefore, the goal of my action research was to evaluate the effectiveness of a variety of kinesthetic activities such as the use of manipulatives. Specifically, I was interested in whether or not students liked the activities and found the exercises and demonstrations with manipulatives valuable. I also tested students to see how well they learned math concepts when I used kinesthetic activities such as the use of manipulatives as a teaching strategy.
Clarifying my Action Research Project

Math classes at the middle school level are typically oriented toward the visual and auditory. The teacher describes a problem and how to solve it (auditory) while showing how to solve the problem on the board (visual). Homework problems and worksheets (both visual) are used to help reinforce concepts and develop skills.

Unfortunately, student retention of mathematical concepts in middle school is not very high. A learning styles survey of a seventh grade math class at a rural middle school revealed that 86 percent of the students had tactile/kinesthetic as a primary or secondary learning style. This school is located in a farm town of about 790 people. There were 29 students in this seventh grade math class. Of these 29 students, ten were male and 19 were female.

The above finding of 86 percent of the students favoring a tactile/kinesthetic learning style suggests that a major avenue of student learning is being ignored in typical middle school math instruction. Therefore, I examined the impact of tactile/kinesthetic teaching strategies on student learning.

During my work sample and primary teaching duties, which commenced November 5\textsuperscript{th} and were completed by February 27\textsuperscript{th}, I taught three separate units. Each unit was planned to include visual, auditory and tactile/kinesthetic teaching strategies. I examined chapter tests, lab worksheets, and art posters as well as other artifacts to assess student learning. I also included personal reflections and student evaluations (surveys) of tactile/kinesthetic activities for each unit. The personal reflections on the activities were combined with student evaluations to determine what aspects of the tactile/kinesthetic activities were most engaging to the students.
The chapter tests, lab worksheets, and art posters were used to assess student understanding of the concepts covered. Together, these different assessment measures provided the necessary information to evaluate the effectiveness of the teaching strategies and to determine how these strategies could be modified in the future to optimize student learning.
Roadmap to my Action Research Project

Procedure

The participants for my action research were seventh grade students at a rural middle school. I conducted my research in a basic math class. Twenty-six of the 29 students returned the parental consent form (Appendix A). Of these 26 participants, 8 students are male and 18 students are female.

I started my inquiry by administering a modified learning style inventory (Appendix B) to my seventh grade students. The learning styles inventory that I used classified students into three types of learners: auditory, visual and kinesthetic. The students answered questions using a three-point rating scale with 3 being often, 2 being sometimes, and 1 being seldom or never. The ratings for each section were totaled to determine each student’s strength in the learning modality. The highest score indicates the primary learning modality. The second highest score represents the secondary modality, which enhances the primary strength.

During my pre-service teaching, I taught three units: Number Theory, Algebraic Equations, and Integers. I collected a data set during each of these units. The first data set was collected Monday, November 3rd through Monday, November 24th. During this data set, I planned tactile/kinesthetic activities that were connected to the unit goals. Students worked in the computer lab with an Excel macro to derive their own rules for divisibility (Appendix C and D). Students used colored tiles to explore numbers and their factors, prime and composite (Appendix E). They played the game Buzz, in which students stood up and had to say the word “Buzz” on a number’s factors.

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worked on an activity called the Sieve of Eratosthenes in which they discovered which numbers from 1 to 100 are prime. Students also completed a 3-D art project demonstrating their mastery of the concepts they had learned (Appendix L).

During each of these activities, I observed students (Appendix F) and took field notes regarding student engagement. I used a chart with students’ names on it and marked “OT” to indicate a student was on-task or “OF” to indicate a student was off-task. I observed student behavior for on-task and off-task behavior usually every 10 minutes.

On the days that these activities were included in the lesson plan, I kept a research diary to track my own feelings about teaching with learning styles in mind. I also collected artifacts of student learning during this first data collection. Artifacts for data set one were the divisibility pattern worksheet (Appendix D), the worksheet from the visual math lesson with colored tiles (Appendix E), two quizzes, and the 3-D posters that students created. The final part of my data collection involved giving students an attitude survey (Appendix G) about the activities and which ones helped them learn the concepts.

My second data set was collected from January 13th through January 26th. During this data set, I again planned tactile/kinesthetic activities that matched the unit goals. This unit was on algebraic equations. The activities that I planned included two labs using cups and beans as manipulatives, a game using algebraic equations and an index card activity. The first lab involved solving equations using cups, which represented variables and beans, which represented numbers. The second lab also used cups as
variables and beans as the numbers in the equation, but required solving a two-step equation.

For the game, students were divided into pairs. Each student was given 10 cards with algebraic equations on them. The students were each to turn a card over at the same time and solve the equation on it. The student with the highest solution would received a point.

The index card activity required students to translate a word phrase into an algebraic expression. Each student received 10 index cards. On one side they were given a word phrase. On the other side students were to write the equivalent math phrase. After the students completed their index cards, they were paired together in twos and shared their cards with each other.

During each of these activities, I again observed students for on-task and off-task behavior every 5 or 10 minutes. On the days that students did these activities, I kept a research diary to track my experiences and feelings about teaching and including tactile/kinesthetic activities in my teaching strategy. I also collected artifacts of student learning during this second data collection, which included lab worksheets from both labs when we worked with beans and cups, the index cards that students completed, and the chapter test. At the conclusion of this data set, I again administered an attitude survey (Appendix I). However, I changed the attitude survey design from the first attitude survey design. This survey gave students a place to explain why a specific activity did or did not help them.

My third and final data set was collected February 5th through February 23rd. Again, for this data set, I planned tactile/kinesthetic activities that were connected to the
unit goals. This unit was on integers and required students to add, subtract, multiply and divide integers for the first time. The activities that I planned included a lab using red and black tiles. Red tiles represented negative numbers and black tiles represented positive numbers. Students manipulated the tiles to discover how to add positive and negative numbers (Appendix J).

The second activity was a game in which each student had a stack of cards. Students were put in groups of 3, and each student flipped over a card at the same time. The students had to compare numbers and figure out which number was greater, thus ordering the integers. The third activity was also a lab using red and black tiles. This time students used the tiles to discover how to subtract positive and negative numbers.

My final planned activity was also a game in which each student was given 15 cards with multiplication or division equations on them that involved integers. Students worked in groups of 2 or 3. Students solved their own equation and then compared them with other students’ answers. The student with the highest value of their solution received a point. Students tallied their points during the game.

On each of the days that students did these activities I kept a research diary to reflect on the experience and reflect on my feelings about teaching with tactile/kinesthetic activities. The artifacts that I collected during this data set are the worksheet on adding and subtracting integers students used during both labs, a focus activity that students completed after the first lab, the papers that students did their work on to figure out their answers to equations during the game, and a chapter test. I again
gave an attitude survey (Appendix K) at the end of this data set to determine student opinion. This survey was modeled after the survey given in Data Set Two.

Data Analysis

I began by categorizing students in a table according to their learning style (Appendix H). At the end of each data set, I compiled the data: the observations, interviews and artifacts. I reviewed the information that I was looking for and reflected on how my hunches may have informed or misinformed me. As I read and reread the data, I kept a record of my impressions, questions and speculations. I also looked for events that seemed to repeat themselves. I categorized students according to their success rates and attitudes toward instruction using learning styles.

After breaking my research into understandable units in the analysis, I put the pieces back together by asking how my data related to my overall question of “Will teaching math concepts with tactile presentations/activities have a positive effect on student learning?” I looked for patterns as to when the tactile presentations/activities were effective, which students seemed to thrive through the teaching with these type of activities, which students consistently had difficulty, and how did the teaching strategies affected students’ attitudes about math. I also made sure to look for data that disconfirmed how teaching with tactile presentations/activities increased learning in math. Did some students seem to be distracted by the various activities?

When I came to “conclusions,” I went back and looked at the assumptions behind the “conclusions.” I double-checked my assumptions about particular students and teaching situations by getting input from my cooperating teacher and a colleague. I
applied what I learned in the literature to my emerging theories to see how my conclusions meshed with the literature. I placed my “conclusions” in the context of my school and classroom.
The Story of my Action Research Project

The gender breakdown in my classroom of those students that took the Learning Styles Modality Preference Inventory was 18 girls and 8 boys (Figure 1).

![Gender Makeup of Class](image)

Figure 1. Gender breakdown of class.

Of these students, there was not a significant difference between boys and girls who were primary kinesthetic learners. There were more girls that were kinesthetic learners, only because there were more girls in the class. However, the percentage of girl kinesthetic learners (44.44%) to total girls in the class was very close to the percentage of boy kinesthetic learners (50.00%) in the class.
The significance of Figure 2 is that almost half of the students in my class were primary kinesthetic learners. When one considers how little of the teaching in this classroom was geared to the kinesthetic learner prior to my pre-service teaching, this is very significant. We were ignoring half of our class.

This result becomes even more glaring when we consider students who are secondary kinesthetic learners. The second highest modality boosts the primary strength and therefore is a key component to learning for those students with a secondary strength in the kinesthetic modality. By putting students that have a primary strength or a secondary strength in kinesthetic learning together, we see that the number of students in my class who were included in the survey greatly increases.

Figure 3 shows that when girls and boys who are primary or secondary kinesthetic learners are combined, the total increases to 85 percent of the class. Were my students high in the modality of the kinesthetic learning style? Absolutely. The...
results indicated to me that to ignore kinesthetic/tactile activities would be to ignore the primary learning modality of most of the students in my classroom.

These results confirmed my decision to create lesson plans that included kinesthetic/tactile activities. The first unit that I examined in my action research dealt with number theory. I included a computer activity, a game that required students to stand up and sit down that involved factors, a group activity using colored tiles, an activity with prime numbers (the Sieve of Eratosthenes), and creating colored posters.

One example of student behavior is the amount of time they remain on-task. In assessing the computer assignment, I recorded the number of students who were on task at 10-minute intervals. Generally, I found students to be on-task during this activity.
As seen in Figure 4, students were engaged during the computer activity and doing the activity as assigned. As time passed, a few students did go off-task, but as I noticed in my reflection of that lesson, those students who were off-task were exploring the Excel program, not just being disruptive or doing something unrelated to the task. What is interesting about this activity is that when students were interviewed, 6 students stated that this activity was not helpful to them in understanding the concept of divisibility rules. In fact, one female student stated on her survey that this assignment created confusion for her. Due to her confusion, other students made her feel badly, because she did not understand it right away.

Another activity that students responded negatively to on the survey for Data Set One was the Visual Math Lesson working with colored tiles and exploring factors and primes. Again, this was a surprise to me due to my observations of students and my
reflection on how this lesson went. Figure 5 shows student behavior during this activity to be highly on-task.

My reflections from this class period also indicated a high degree of student engagement. In fact, a third party supported my observations. My cooperating teacher was present throughout this period and activity. He commented how successful he felt the activity was and how engaged students were in learning.

What was the common thread through both the computer activity and the visual math with colored tiles activity that caused student discomfort? Upon reflection of this data set, I felt these two activities required students to construct information for themselves. Usually, we are just told that the number one is not prime. However, with the visual math lesson, students had to construct this information with the colored tiles and derive the understanding for themselves.
Also, it is typical to be given a list of rules about divisibility that must be memorized. The computer activity was designed to have students construct their own divisibility rules instead of just memorizing them. This type of learning is “doing mathematics” as described by the QUASAR Project (The Math Learning Center, 1998). It is by far the highest form of learning and therefore the most demanding for learners. Because it was so demanding, this type of learning made students the most uncomfortable, which may be why they reported the activity as not being “fun.”

Did student learning during data set one support the use of kinesthetic/tactile activities? Students designed their own posters (Appendix L) and displayed their knowledge pictorially. Most posters were well-constructed and demonstrated genuine understanding. A variety of quizzes were also given and, as a whole, students performed well on these quizzes. Students were not only engaged in the learning, but the artifacts collected support that students were also learning the concepts.

My second unit was an introduction to algebraic equations. Again, during this unit, especially since the subject matter was so abstract, I wanted to include kinesthetic/tactile activities that would help students learn. I implemented two labs using beans and cups. Students used the beans and cups to represent models of algebraic equations. In the first lab, students modeled one-step equations and solved them using the models. In the second lab, students modeled two-step equations and solved them using the beans and cups as a model.

In my reflections during the one-step equation lab, I noted that during this activity there was a 20-minute disruption due to head checks for lice. This is quite a lengthy disruption and students were not nearly as focused after the checks as they were before
the lice checks. So, even though observations do not show that students were greatly off-task, the climate of the activity was drastically changed and hurried due to the interruption. I feel that this accounts in part for the tremendous dissatisfaction that students expressed about this activity on the student interview (Figure 6). Also, the survey gives a picture of student feelings during this lab. Comments like, “It was very confusing to me and I did not know what to do half the time,” “It made you feel like a little kid,” and “It was hard to understand the getting rid of the beans.”

![Figure 6: Results from Student Survey](image)

Students were equally dissatisfied with the lab using beans and cups to solve a two-step algebraic equation. My personal reflection from this day also reveals my dissatisfaction of how this activity went:

“When the last bean was put away today, I was thankful I had done another activity similar to the first solving equation lab…Having done this activity the second time I realized that it was not the activity, but the delivery. I expected students to follow the book and questions in the lab. However, what I
experienced was that the lab was too wordy. I needed to break down the activity step by step and not direct student learning, but facilitate it...I have gotten to watch this artistry in my EDUG 550 class, “Teaching Mathematics.” There would be times the instructor would introduce a concept through the use of a manipulative. At first I would feel a little foggy on what I was to accomplish...And then...I would see the concept so much clearer and with better understanding than I had...It was a kind of art knowing how much to say or how much to give students as to facilitate learning, but not spoon-feed learning.”

Teaching with manipulatives is an art. I am still a novice at this style of teaching since it is not congruent with my own learning style. I believe that student satisfaction will go up as my experience increases. Although my own teaching using manipulatives needs to grow, the activity still was useful to students in learning.

How did student learning fare during the unit on Algebraic Equations? The Index Card Activity artifacts showed deep student understanding of translating verbal phrases into algebraic expressions. This activity was done in place of a quiz, and students were placed in groups to teach the concept on their index cards to another student. The lowest score received on this activity was an 8 out of 10.

The chapter test also demonstrated solid student learning. Including all students, the average grade for the chapter test was 82%. One student was absent for the majority of the school days prior to the test. Without her score, the average was 84%.

These numbers are exciting to me because of the low level of the math students in this class and the amount of student dissatisfaction with the kinesthetic activities using the beans and cups as manipulatives. These students, for the most part, are not used to scoring well on math tests. Probably even more exciting than this data is the data on my students who are on an IEPs. The average test score for these students
was 84%, with one student on an IEP earning a perfect score on the test. Algebra is a very abstract concept, and students in my class showed above-average proficiency.

My third data set was collected during a unit on integers. Again, the concept of negative numbers is abstract. Although there are a few real-life examples of negative numbers, such as temperatures below zero and overdrawing on a checking account, students find manipulating negative numbers a difficult concept to master.

Overall student satisfaction with the kinesthetic/tactile activities was much higher than in data set two (Figure 7). During this data set, I planned activities that included an adding integers lab with red and black tiles, a game comparing positive and negative numbers, a subtracting integers lab with red and black tiles, and a game with partners solving multiplication problems with integers.

Figure 7: Results from Student Survey
The majority of students during this data set found the activities helpful and felt the activities were valuable to their learning. The interesting part of this data set is the prior experience I have had teaching with the labs. During my course on mathematics instruction, my instructor conducted these labs with us. Also, I had the opportunity to teach these labs in a case study and to a different seventh grade math class. Therefore, my experience with these labs was greater than with the previous labs, and my students were more positive about these activities. During these activities, I saw more confidence among students in working with manipulatives. Students seemed eager to figure out what the manipulatives represented.

The artifacts for this unit of study substantiate how the students felt. The lab worksheets that corresponded to the Adding Integers Lab demonstrate that students were on-task and completed the information. The Focus Activity at the end of the lab was an extension activity. Students were also able to complete this activity. The few times I have taught integers with this lab, I have been disturbed by the speed at which I have to go to complete the lab within one class period. And I have to wonder if that might be why one of the negative comments I received from a student about this lab was, “I forgot what I learned the next day.”

I also felt this time crunch during the subtracting integer lab. My reflections from that day state that I did more prompting than I would have preferred to do. Preferably, these labs would involve student construction of the rules of adding and subtracting integers.

Observations tell me that student engagement was high during the kinesthetic/tactile activities. Figure 8 is an example of on/off task behavior during the
Adding Integers Lab with red and black tiles. Students enjoyed touching and playing with the red and black tiles. There did not seem to be negative feelings about using the tiles, as there had been with the beans. Students did not write any negative feedback about the tiles themselves on the attitude survey.
Lastly, the chapter test also indicated a good understanding of the concept of integers by students. The average grade for the chapter test was 80%. IEP students averaged 84%. Three of the 5 students on an IEP worked with a Learning Resource Assistant while taking their test. Part of my reflection on this unit was about the pressure I felt in teaching this unit. A solid understanding of integers is vital to future success in Algebra. I really wanted these students to do well. I believe that student understanding was positively influenced by the kinesthetic/tactile activities that we did in class.
Final Reflection and Questions about my Action Research Journey

At the start of my action research, I was pretty confident that students would experience more success when I used teaching strategies that were compatible with their learning styles. After all, this is what the experts in education told me: “Student achievement improves when teaching styles match learning styles” (Dunn, Deckinger, Withers, & Katzenstein, 1990). However, my journey was so much more complex than this statement. As a pre-service teacher, I faced many bumps and curves in the road, partly because of my inexperience and partly because of the individuality of the students in the class and the school itself.

Incorporating kinesthetic/tactile strategies in my classroom took on many forms. I did both small-group activities and large-group ones, and I used different types manipulatives, both physical and virtual ones. All of these activities seemed to require a certain degree of practice and classroom management that I have not yet fully developed as a pre-service teacher. I found that the activities were more successful the more I was prepared and the more I prepared my students for the activities.

One way I prepared for a class using manipulatives involved going into the classroom early and setting up desks in groups for group work and putting manipulatives into individual containers with lids. I prepared my students by explaining in detail my expectations for their behavior with the manipulatives. I also explained the activity in detail and divided students into pre-planned groups. I found that each time I did an activity I walked away from that lesson with more ideas on how to make it more successful the next time. I wrote those ideas in my reflections.
For instance, after one particular lab that did not go as well as I had hoped, I reflected, “Student groups were sitting too close together and therefore distracting each other. I need to help them organize themselves into pairs better.” I believe that the positive results my students had with these activities will increase even more as my classroom management and organization skills improve.

Another aspect that I would change is constructing lessons that give students enough time to work through the problems presented. Stein and Bovalino (2001) noted, that for successful manipulative use, you must “give students the time and latitude to think through and make sense of the manipulative activity on their own.”

As a pre-service teacher, I felt pressure to teach a specific amount of content within a specific amount of time. As a teacher, I hopefully will have more latitude in scheduling the time it takes to enable students to grapple with a lesson and construct meaning for themselves.

Many times I finished a lesson that involved manipulatives and felt that I really needed a few days to cover the material. I think my least successful lessons were my most rushed. On one occasion this was out of my hands as a portion of my classroom time was taken up with lice checks. If this had been my own class, I would have come back to the lab the next day.

Another factor that can cause unsuccessful manipulative activity is “when teachers leave students too much to their own devices, resulting in unsystematic and nonproductive exploration” (Stein & Bovalino 2001). I feel that this happened with the two equation labs that I did with the students. I found the labs in the textbook. I thought they were valuable, but I personally have not seen them applied in a classroom. In my
reflections I wrote, “I think more direction on how to start this lab may have been needed than I gave them.”

I feel this is an area that I will grow and develop in as a teacher. These times when the activity does not go as well as the teacher anticipated could cause a teacher to decide that the difficulties and the work it takes to teach with manipulatives may not be worth it. Having seen the positive results from my teaching with manipulatives and other kinesthetic activities, I am convinced of their value. In fact, if there were such a positive outcome with manipulatives and I am still learning how to teach with manipulatives, how much better will my students perform as I get better at teaching with manipulatives?

I honestly do not believe that I would have learned all of this information about teaching with kinesthetic activities if I had not conducted action research in my classroom. I may have just tossed out an activity without realizing that it might not be the activity—but something in my practice—that needs to be adjusted. There were days after I did a lesson with beans that I thought to myself: “Am I crazy giving middle school-aged students beans?” However, having seen the results of their success, I am not crazy but bold and daring, and the risks were well worth it.

This study on teaching students according to their learning styles has enabled me to become the type of practitioner that I have always wanted to be. I have dreamed of being a teacher that can reach all of her students. What my action research has proven to me is that all students can learn the content and that I will not be content with anything less.
References


APPENDICES

APPENDIX A:

PARENTAL CONSENT FORM

October 27, 2003

Dear Parent and/or Guardian,

Greetings from ______ Grade School Seventh Grade Math class. I am writing to introduce myself. My name is Julie XXX and I am a student teacher from the University in Mr. C’s classroom. It is my joy and privilege to have a teacher as experienced and wise as Mr. C as my mentor and to be able to teach and learn mathematics with your child. We have already had a productive month and a half together!

Beginning on November 6, I’ll be starting a math unit on “Numbers and their Relationships” that will emphasize divisibility rules, prime and composite numbers, and prime factorization. The students will take part in a variety of learning approaches that will teach this unit, such as virtual manipulatives (using Excel in the computer lab), hands-on manipulatives, demonstrations, group activities, and a 3-D project. To enhance your child’s learning experience you can ask your child to re-tell how the specific activities of the day helped and/or hurt their understanding of the math topic we studied that day. Also, it will be very important that your child complete any assignments or projects he or she was unable to complete in class, so please keep them accountable for their progress.

During this unit and the remainder of my student teaching, I’ll be studying my own practice of becoming a teacher of mathematics by conducting a teaching/learning project. I will be looking specifically at how to teach students who have different learning styles. To evaluate the effectiveness of using various teaching strategies, I will carefully analyze students’ responses through surveys, observations and a close look at their finished work. All of this will be done during the regular teaching/learning process. After my student teaching, I will write a report about what I have learned. This report will be presented to University faculty and my colleagues. Pseudonyms will be used for the community, school and any reference to students. Please sign the form on the bottom to indicate whether I may or may not use your child’s work and responses in our math lessons as a part of my teaching/learning project.

If you have any questions, please be sure and give Mr. C or me a call. Again, I look forward to this learning experience and the opportunity to work with your child!
Sincerely,

Julie XXXXX
Student Teacher
Phone Number

☐ Yes, my child’s responses and sample work may be used for Mrs. K’s teaching/learning project. I understand that the data is being used to assist Mrs. K in becoming a better teacher of middle school students and to enhance my child’s knowledge of mathematics. I also understand that pseudonyms will be used in the final report and that I may request a final copy of the report.

☐ No, I would rather not have my child’s responses and work used in this analysis.

________________________________                      ________________
Signature of Parent and/or Guardian                         Date
APPENDIX B:

LEARNING STYLE INVENTORY

(Julie used a purchased learning style inventory from her school)
APPENDIX C:
KINESTHETIC ACTIVITY – EXCEL MACRO

(Worksheet purchased by school and used here by Julie)
APPENDIX D:
KINESTHETIC ACTIVITY – DIVISIBILITY

Divisibility Patterns

Name:

Your rule for dividing by the number:

2

Test your rule: __________ Does it work? yes/no

3

Test your rule: __________ Does it work? yes/no

4

Test your rule: __________ Does it work? yes/no

5

Test your rule: __________ Does it work? yes/no

6

Test your rule: __________ Does it work? yes/no

9

Test your rule: __________ Does it work? yes/no

10
Test your rule: ______ Does it work? yes/no
## APPENDIX E:

### KINESTHETIC ACTIVITY – COLORED TILES

Focus Student Activity 7.1

Name: ______________________

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<th>Factors of the Number</th>
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# APPENDIX F:

## STUDENT OBSERVATIONS

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Observations
OT – On Task
OF – Off Task

Activity:
APPENDIX G:

ATTITUDE SURVEY

Survey - What worked for you?

Were the following activities helpful in your understanding of the math concept?

1) The Computer Activity using Excel. Did it help you understand the rules of divisibility better?
   Yes    No

2) The game - “Buzz.” Did playing this game help you understand the rules of divisibility better?
   Yes    No

3) The FACTOR Activity. Did doing this activity help you understand factors are better?
   Yes    No

4) Visual Math - Using the linear pieces and tiles to explore prime numbers. Did this activity help you understand prime and composite numbers better?
   Yes    No

5) The Sieve of Eratosthenes. Did doing this activity help you understand prime numbers better?
   Yes    No

6) Did I lecture enough about the rules of divisibility, factors, prime and composite numbers for you to understand these concepts?
   Yes    No

7) Did doing the final project help you understand the rules of divisibility, factors, prime and composite numbers, and prime factorization?
   Yes    No
## APPENDIX H:

### CHART – LEARNING STYLES

Data Set 2 (Learning Styles Broken Down)

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<th>KINESTHETIC</th>
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*Teaching with Manipulatives*
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APPENDIX I:

ATTITUDE SURVEY (DATA SET TWO)

Survey - What worked for you?

Were the following activities helpful in your understanding of the math concept?

1) The Solving Equations Lab using beans and cups. Did this lab help you understand how to solve an equation better by getting rid of the beans?

   Yes    No

   Why or why not?______________________________________________________
   ___________________________________________________________________

2) The Solving Two-Step Equations Lab using beans and cups. Did this lab help you understand how to solve a two-step equation better by getting rid of the beans first and then figuring out how many beans should go in each cup?

   Yes    No

   Why or why not?______________________________________________________
   ___________________________________________________________________

1) Solving Equations Game: Did playing this game with a partner help you get better at solving algebraic equations?

   Yes    No

   Why or why not?______________________________________________________
   ___________________________________________________________________

2) Index Card Activity: Did using the index cards to translate words into algebraic expressions and sharing them with a partner help you understand how to do translate words into algebraic expressions better?

   Yes    No

   Why or why not?______________________________________________________
   ___________________________________________________________________
APPENDIX J:

KINESTHETIC ACTIVITY – USING RED/BLACK TILES

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APPENDIX K:

ATTITUDE SURVEY (DATA SET THREE)

Survey - What worked for you?

Were the following activities helpful in your understanding of the math concept?

1. Did the Adding Integers Lab using red and black tiles help you understand how to add integers better?
   
   Yes  No

   Why or why not? __________________________________________________________
   _______________________________________________________________________

2. The activity where you compared numbers (positive and negative) and got a point for having the high card: Did this game help you to learn about positive and negative numbers better?

   Yes  No

   Why or why not? __________________________________________________________
   _______________________________________________________________________

3. Did the Subtracting Integers Lab using red and black tiles help you understand how to subtract integers better?

   Yes  No

   Why or why not? __________________________________________________________
   _______________________________________________________________________

4. The game where you had to solve a multiplication problem with integers and compare your answer with your partner’s answers and the highest person scored a point: Did this game help you to understand multiplying integers better?

   Yes  No

   Why or why not? __________________________________________________________
   _______________________________________________________________________
APPENDIX L:

SAMPLE OF STUDENT POSTER
**Divisibility Rules**

2: any divisible by two is even

3: the sum adds up to a number divisible by 3, 6, 9, 12, 15...

5: any number divisible by 5 and number ends with 0 or a 5.

7: if all the digits add up to a number divisible by 7 then it is divisible by 7.

9: if all the digits add up to a number divisible by 9 then it is divisible by 9.

10: a number divisible by 10 if ones place is a zero.

**Prime:** any number divisible by itself

**Composite:** any number having more than 2 factors