Teaching Study Skills in the Chemistry Classroom

by

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Abstract

This study traces my current journey in becoming a teacher as I tried to answer the question: “How can students acquire study skills in the context of the science classroom?”

Many students at the high school level have never been taught strategies for developing study skills and positive study habits. As a result, the goal of this project was to discover ways in which study skills activities could be integrated into lessons in an accelerated chemistry classroom in order to help students learn to study more efficiently and effectively.

This was accomplished by making use of activities in each of the following categories: reading comprehension, note-taking skills, and review activities. Students participated in a variety of study skills activities in the science classroom on a daily and weekly basis and were asked to provide feedback on the effectiveness of various strategies in helping them learn and remember the concepts being addressed in the curriculum. Detailed data, which included artifacts, observations, and interviews, was collected and analyzed during the course of the project. It was determined that this study did not necessarily help students acquire the anticipated study skills, but provided them with invaluable lessons as they truly learned how to learn.
**Introduction**

My journey to becoming a teacher began nearly seven years ago when I encountered Accelerated Chemistry during my sophomore year in high school. It was then that I fell in love with science and made the decision that I was going to pursue a career in teaching. I carried this goal through four years of college and now the time had almost come to meet my first group of students!

I was overjoyed to learn that I would be teaching a chemistry course nearly identical to the one I had taken as a student. And I looked forward to the experience, expecting to find a classroom full of students similar to myself. Perhaps this assumption was rooted in the fact that I had been a student in a high school in the same district just two miles down the road from Hillcrest High. Despite being located in a fairly diverse community with a growing Asian and Hispanic population, I knew that my class roster would consist mainly of white, middle-class students who had grown up in a suburban community where school spirit and pride run deep.

The nature of the course told me that, academically speaking, these students were at the top of their class. With this in mind, I anticipated I would find myself teaching a room full of highly motivated, self-sufficient, highly trained studying machines who, after years of practice, had figured out how to successfully navigate the system. Although I hadn’t completely missed the mark when it came to sizing up my student population, it was here that I encountered the first of many surprises, all of which are helping to shape the teacher I am becoming.

Here is a taste of what I witnessed during my first week—things that caused me to discard my unrealistic expectations. The day quickly approached when the
students were to take their first weekly quiz and my CT took a moment during her lesson to remind everyone of the format of a quiz as well as the content that would be included. To me, the notion of a ten-point weekly quiz seemed non-threatening; however, the response from the students was much more than I expected. The students proceeded to panic and ask dozens of questions about what they should study, how long the quiz would be, if the material was difficult, etc. Many even begged to be allowed to use their class notes during the quiz. It was at this point that I began wondering if the students’ anxiety came from a lack of understanding of the concepts that had been covered or if it was a result of their inability to effectively prepare for assessments such as tests or quizzes.

Several nights later, I witnessed my own brother, an eighth grader, attempting to study for an algebra test that would take place the following day. Rather than looking back over past assignments and class notes, or working practice problems, he was content to spend a few minutes flipping through the pages in his textbook while watching television. Needless to say, the test grade reflected his lack of effort in studying. Why is it that today’s students are less apt to study? Is it simply because they do not know how? These curiosities lead to the birth of an action research project that focused on teaching study skills to students in the classroom.

With the start of the second trimester, and the inception of my full-time teaching experience, I began implementing various study skills strategies into my daily lessons with the hope that I could change students’ attitude toward science by teaching them how to review material, use their textbooks and class notes as a resource, and increase their mastery of the content we were learning in the *Becoming a Teacher Through Action Research, Second Edition* © 2010 Routledge / Taylor & Francis Group, LLC.
classroom. In doing so, I desired to appeal to a wide range of learning styles and reach students with varying intelligences. Worksheet reviews, concept test questions, review games, note-taking skills, flashcards, collaborative studying, review days, and mind-mapping are just a few of the methods I implemented in order to develop students’ study skills and habits.

As a result, I anticipated an improvement in students’ test and quiz scores as well as the quality of their daily work, including laboratory reports. I hoped to see that students were better able to demonstrate their knowledge simply because they truly understood what it is they were studying. Finally, I wanted to create a classroom environment that was more conducive to learning—one in which students could thrive and be able to enjoy the content being covered as they learn. While the data I collected may not have shown an increase in test and quiz scores as I had initially anticipated, more valuable learning was taking place in my classroom as I attempted to answer my critical question: “How can students acquire study skills in the context of the science classroom?”

What I learned from Distant Colleagues

Once I had directed my interest toward exploring ways in which students can acquire study skills in my chemistry classroom, I began to seriously consider what kinds of strategies I should use in order to turn this idea into a reality. In doing so, I thought about the study skills that I had relied on over the years and pondered where and how I had learned these techniques. I could recall several courses in high
school in which teachers had encouraged my classmates and I to “study hard” and “take good notes.” But what did that really mean?

I imagined that my students had heard this same empty advice, and I knew that I didn’t want to subscribe to that same mentality in my teaching. Instead, I wanted to provide them with resources and opportunities to develop study skills and habits that would serve them today and in the future. I had several ideas of kinds of strategies I could use, but these were based on my own experiences as a student and I was unsure whether or not they would be successful among my student population. It was at this point that I directed my focus toward the literature available on my topic and pointed my eyes and ears toward the voices of distant teachers who I hoped would help me assemble a study skills bag of tricks to carry me through this project.

As I began to turn to the literature in order to gain some background information, I came across the following:

One misconception among students about their studying is that they just have to do more of it. However, studying more while using ineffective study strategies is unlikely to produce better learning. Students need to learn that the key to effective studying might be to change some of the study methods they use (Hartman & Glasgow, 2002, p. 93).

Is it possible, I wondered, for a teacher to teach students how to study? As I thought about this question, I decided that I could certainly try. In turn, my critical question became, “How can students acquire study skills in the context of the science classroom?” and I decided to incorporate activities that would help build students’ study skills into my lessons. From here, my journey began and I looked,
once again, to the literature in search of suggestions and strategies for teaching study skills in a content area classroom.

Prior to planning and executing lessons that involve study skills, it was important to determine exactly what a “study skill” is and how they aid students in being successful in the classroom. In Teaching Study Skills, Thomas Devine (1987) provides an answer. He notes, “They are those competencies associated with acquiring, recording, organizing, synthesizing, remembering, and using information and ideas found in school. Many should be valuable in nonacademic settings, but all seem more or less indispensable for school success” (p. 5).

Most authors and educators agree that study skills can be taught in the classroom. In Hartman and Glasgow’s (2002) Tips for the Science Teacher, the authors have a great deal of practical knowledge to share. They note that study skill approaches must be appropriate for the learning environment. This may require the classroom teacher to analyze the skill levels and types of learners present in the classroom in order to determine the best methods. Students must be encouraged to think and talk about how they read and study, especially if one of the goals is to help students acquire study skills that are best suited to their personality and learning style.

In order to uncover information about students’ study habits, Devine (1987) suggests providing the opportunity for students to complete a study habits inventory. The example he provides asks students to determine what sorts of methods they use to study (i.e., reading the textbook, note-taking skills, organization methods,
reading techniques) as well as to rate how effective they perceive their tactics to be.

He also encourages teachers to take time to get to know their students better so they are able to plan instruction that is more meaningful and meets the needs of the student population. Hartman and Glasgow (2002) note that part of the process of teaching study skills requires the teacher to help students acquire self-regulatory processes; this may come in the way of goal-setting or creating a personalized study plan. Either way, students must take on some responsibility for improving their study habits and oftentimes teachers must provide the motivation for them to do so. Hartman and Glasgow also note that a component of study skills instruction includes attempting to build and raise students’ science self-concept, which will in turn aid in their success in the classroom.

There are literally hundreds of resource books written on teaching study skills in the content areas; however, one that I found particularly useful, perhaps due to its fairly recent publication, was written by M. Carroll Tama (1998) and is titled *Guiding Reading and Writing in the Content Areas*. This book, written specifically for teachers by an education professor at a local university, contains chapters focused on study skill techniques, as well as comprehension, writing, vocabulary, and discussion strategies. Tama’s provision of practical techniques that teachers can put to use in the classroom is exceptional, especially those focused on real-world literacy techniques such as using computers and technology, as well as current events from newspapers and journals, to encourage students to read.
Hartman and Glasgow (2002) also provide useful strategies that can be employed when teaching students how to read science textbooks. Rather than simply giving students the assignment of “read section 10-1 in your textbook tonight,” they suggest using guided notes in order to help students focus on the important points in a chapter. Notes of this type may include basic fill-in, application, and analysis type questions in order to get students thinking about what they have read. To teach students how to read and think, Hartman and Glasgow also suggest modeling these skills for the students by reading to the class and thinking aloud about the text that was just read.

Reading strategies are constantly being developed and practiced in the education community. To prepare students such as ourselves, the university sees the value in teaching us to teach students reading and comprehension skills. In doing so, I gleaned a great deal of techniques that can easily be put to use in the classroom from our class textbook, *Teaching Content Reading and Writing*, written by Martha Ruddell (2004). Ruddell details dozens of strategies such as a Directed Reading-Thinking Activity (DR-TA), which is adaptable to many different text styles and guides students through text by asking them to make predictions, then examine these as they read. Semantic or concept-mapping is also a commonly used reading strategy that asks students to make visual connections between vocabulary and concepts by detailing these relationships on paper. Students make meaning of what they have read, then have the opportunity to share their map with the class.

A list-group-label activity operates along similar premises, as it gets students thinking about and categorizing vocabulary words in order to determine the
relationships between them. Other suggestions include using anticipation guides, as well as teaching students how to take notes on, flag, and underline important elements in the text as they read.

In continuing my search for reading strategies specific to the discipline of science I also encountered Marlene Thier’s book, *The New Science Literacy* (2002). As I read I was immediately drawn to the following quote from Paulo Friere:

“Textbooks focus on only one form of literacy: reading content. Therefore, teachers in textbook centered programs usually must make a concerted effort to find (or create) and include a wider range of literacy opportunities for their students” (p. 99). Knowing that the curriculum taught in my classroom was built around a ten-year-old textbook made these words especially meaningful and important, but since I am expected to make use of this text, how can I do so in a way that promotes learning? Thier noted that if a textbook is the primary source of understanding, the sole objective cannot be the memorization of facts. Instead, she suggests engaging students in pre-reading, active reading, and post-reading activities. She also encourages teachers to ask open-ended versus fact-based questions regarding the information students are reading in order to challenge students to expand their comprehension and conceptual understanding.

Additionally, the use of reflective questions entices students to synthesize ideas rather than repeat information. A suggested pre-reading strategy asks students to write a list of questions after previewing a selection of text and asking themselves what they already know, similar to a KWL (What do you know about this topic, What do you want to learn about this topic, and What have you learned about this topic?)

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Requiring students to write in a journalistic form as they read, by jotting down key concepts, words, and passages that can later be shared in a group setting, also helps to develop their literacy skills.

Thier emphasizes the use of multiple strategies and provides a variety of practical examples. Reading about issues in the news helps to make the information being read relevant to the world students are living in. Graphic organizers are suggested to help students construct a visual depiction of what they are reading. Additionally, laboratory activities can be turned into an opportunity for improving science literacy by requiring students to write down the procedures they will follow in a procedural narrative.

Although there are multiple strategies and mounds of literature available on the topic of teaching reading comprehension, is it possible for students to actually find value in reading a textbook? In Improving Textbook Reading in a Middle School Science Classroom the process is carried out by a middle school science teacher in order to get his students to read and comprehend their science textbook and the answer is “yes.”

A Texas middle school teacher, under the mentorship of four university faculty members, implemented a program called PLAN over the course of a nine-month study and found that with proper guided instruction and a great deal of practice, students were able to read and understand the information being presented in their textbooks, as well as produce conceptual diagrams of the information in their texts. They also began to see their science textbook as a

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valuable resource, which is no small task at the middle school level (Radcliffe, 2004). If this is the case, there is hope for high school students as well.

In the planning stages of this project, I relied heavily on the advice of my colleague and mentor, Marcy Martone, who carried out an action research project similar to mine during the 1998 school year titled *Reading Comprehension and Writing in Science*. Although her project focus was slightly different and less involved than my design, I have found valuable information by examining her method of execution and looking at the outcomes of her research as she too focused on teaching study skills and improving reading comprehension.

Specific methods used included goal-setting, personal evaluation and reflection on individual study habits, and the implementation of study skills and reading comprehension lessons. In order to measure the success of her project, this teacher focused on students’ perceptions of their study habits and attitude toward science, analyzing students’ responses at various stages during a school term. In the end, she saw little change in her students based on the data collected; however, she did feel that a project such as hers was valuable in helping students develop and practice skills that will serve them in their high school and college careers. It is my hope that my students will benefit from my project as well.

**Clarifying my Action Research Project**

Students today, though taking more advanced courses than ever, are lacking in effective study skills and habits. As a result, they are overwhelmed and anxious when it comes time to have their knowledge tested in the form of a quiz or exam.
My goal with this project was to help build my students’ confidence in their science abilities while helping them to better learn and apply the concepts they encountered in my chemistry class.

This project was designed specifically for the twenty-five students (ten males and fifteen females) in my second period accelerated chemistry classroom at Hillcrest High. Ethnically speaking, these students are a fairly homogeneous group: eighty percent are white and the remaining five students are either Hispanic or Asian. However, they represent a diverse group of learners with varying study skills and science abilities. Overall, this group of students is a seemingly representative cross section of the 1,200 plus students who attend this suburban high school.

The action research project called for the integration of study skills into the accelerated chemistry curriculum during the time period between December 7th and February 28th. Students were exposed to a variety of study skills techniques designed to reach a variety of learning styles with evaluation based on a collection of observations, student interviews, and artifacts which seem to be indicative of student learning and acquisition of study skills. While a variety of study skills activities were modeled and utilized in the classroom, the following were exercised consistently over the course of the research project: review games/activities, warm-up questions, concept test questions, note-taking activities, collaborative work time, and weekly quizzes.

These study skills components were built into lessons accordingly for each topical chapter with the overarching goals of improving students’ learning and
understanding of chemistry while answering the following question: “How can study
skills be acquired in the context of the science classroom?”

My study is limited by my own lack of experience in teaching and time in this
classroom as a student teacher. This study is a snapshot of my own learning and
journey in becoming a teacher.

Roadmap for my Action Research Project

Data was collected during the four-month period between December and
early March as I was completing my student teaching in an accelerated chemistry
classroom with twenty-five students at the freshman and sophomore levels at
suburban Hillcrest High. In the course of this project, five data sets were collected
in conjunction with five different topical chapters. Each data set was generally
comprised of a combination of three components: artifacts (samples of student
work) completed during study skill activities, interviews in which students gauged
the effectiveness of the methods employed, and observations of students taking part
in study skills activities. (See Appendix A for a detailed data collection plan.)

Each data set resulted from the compilation of a variety of study skills
activities that were developed in order to help students better learn, understand,
apply and practice the concepts being covered in the course, while also striving to
achieve the underlying goals of increasing students’ confidence in their science
abilities and discovering teaching strategies that helped accomplish both of these
purposes.
Prior to the inception of the project and data collection three initial steps were followed in order to obtain the permission necessary to utilize data collected, determine the types of learners present in the classroom, and determine a baseline of students’ current study skills. A parental consent form was sent home and returned by every student, thus allowing the use of all data and photographs or video clips obtained during the action research project (Appendix B).

Additionally, a learning styles/multiple intelligences inventory was given to each student in an attempt to determine the types of learners present in the classroom so that the study skills strategies selected would be tailored to the types of learners while allowing for diverse teaching techniques to be employed (Appendix C).

Finally, a preliminary study skills survey was given to each student containing questions that would help me determine their current study habits and preferences for learning (Appendix D). As a part of this survey, students were asked to provide a pre-assessment ranking of their current attitude toward science as well as how successful they perceived their current study skills to be. Immediately following the completion of this survey the responses were compiled onto one form and the results read and analyzed. It quickly became obvious that these surveys would provide a great deal of insight into the types of students and studiers present in my classroom—data that should be considered when making decisions about the types of strategies I used and the context in which they were taught.

From this point on, data was collected in sets that were divided by the five topical chapters that I taught during my primary teacher duties including: Becoming a Teacher Through Action Research, Second Edition © 2010 Routledge / Taylor & Francis Group, LLC.
Stoichiometry, Causes of Change, Gases and Condensation, Solutions, and Chemical Equilibrium. An unofficial set of observations, though not formally documented, was conducted during a chapter on Acids and Bases.

Data set one was carried out in correlation with my work sample unit on the topic of stoichiometry. This data set proved to be an experiment of sorts in which I believed nearly any instructional technique or assignment, including laboratory reports, to be a study skill activity. I began the chapter with an exercise in collaborative reading, a strategy suggested in several pieces of literature I had consulted. Students were divided into groups and given a selection of text from their chemistry textbook to read.

Nearly every day thereafter, students entered the classroom to find a warm-up question or problem on the overhead that they were to complete. Warm-ups were worked out in class with students providing the answers and the strategy used to reach their answer. These were kept on one sheet of paper and turned in at the end of the unit. Copies were made of the students’ warm-up questions and kept as an artifact in my researcher’s notebook (Appendix E).

Prior to taking a weekly quiz, the students participated in a wall graffiti activity, which was really a type of butcher paper review. Students were divided into groups and each group was assigned a particular colored marker to use throughout the activity. They then moved about the room from paper to paper, working through a variety of review problems in their group.

An observation of students participating in the graffiti activity was made by simply recording what I saw each student doing during the course of the activity.
observed, I had several questions in mind: Is the student engaged? On-task? Participating actively? Using the language of science? These observations were recorded in a simple data table following the activity. Photographs of the finished products were also taken to be used as an artifact (Appendix F).

Because it was the first activity of its type, I asked students to provide feedback on the wall graffiti by writing a few sentences on whether it was effective in helping them review concepts for their test. This feedback was compiled in a table and considered as I later made the decision whether to use the strategy again.

Early in the unit, a problem set was assigned as homework in order to provide students with a review opportunity to be done on their own time. This problem set was turned in at the end of the chapter. The final pieces of data collected during this first data set included each student’s quiz and test scores. Although the data collected was broad, I did begin to introduce students to several strategies that carried through the course of the entire project and remaining data sets. As I analyzed the first set of data, I realized that my definition of a study skill activity wasn’t clear. The scope needed to be narrowed and redefined before further strategies could be implemented and data collection could proceed.

Following analysis of the first data set, the remaining sets were entered into with a renewed focus. After reviewing the literature and evaluating the needs of the students in my classroom, I decided that the study skills strategies used would focus on three specific areas: note-taking skills, reading strategies, and review opportunities. As mentioned, several strategies introduced during data set one were carried through the remaining four data collection periods. Students continued to

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complete warm-ups at least twice per week, weekly quizzes were still utilized because they provided students with immediate feedback on their progress, problem sets continued to be assigned, and the day preceding a test was always designated a review day in which students participated in some sort of review activity including a butcher paper review.

A new strategy, only used in this data set was a goal-setting activity in which students were asked to formulate personal and academic goals for the trimester, including something regarding chemistry class and their study habits (Appendix G). These goal sheets were photocopied to be kept as an artifact and the original copies were returned to the students to be referred to later in the term.

Introduced during data set two was the use of concept test questions. After introducing a topic during a lecture I would pause and pose a multiple-choice question for the students to ponder. Each student possessed a concept test card with colored coded letters, A through D, that they held up to designate their answer (Appendix H). Each time a concept test question was offered and students responded, their answers were recorded on a seating chart and later transferred to an Excel spreadsheet for analysis.

On one occasion I chose to replace a warm-up question with a kinesthetic pop quiz. A series of questions were put up on the overhead and students stood up if they knew the answer to the question. From those standing, I chose a student to give the answer and a rationale. Students were asked to give feedback on this strategy, along with several others, on a study skills feedback form (Appendix I). This form was handed out at the end of the unit and students were given the

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opportunity to rank the effectiveness of the strategies used throughout the chapter on a scale of one to five, as well as give additional suggestions and input. These scores and input were compiled onto a single form and analyzed to determine which strategies seemed to be working.

The final new strategy introduced during data set two was the use of a chapter review worksheet. This was given to students two days prior to their test, turned in as an assignment, graded, and recorded as part of each student’s final grade. It provided practice problems that closely mirrored those on their chapter test.

With the start of the third data set, I felt that the set of strategies I had selected to use consistently were working effectively but focused mainly on the review activities piece of the study skills picture. Therefore, in addition to warm-ups, concept test questions, a weekly quiz, review worksheet, and test review day, I added a reading and note-taking strategy. Students began a chapter on gases by completing a group KWL. Initial responses and questions were written on a piece of butcher paper on the white board. We revisited this activity at the end of the unit to determine if students’ questions had been answered and to see what they had learned. In addition, students were given the opportunity to prepare one 4” x 6” note card of notes to be used on their chapter test. During the test review day, I provided the students with a sort of outline that gave them a general guideline for taking notes on their note card. Samples of these note cards were kept as artifacts in the researcher’s binder.
Once again, data set four employed the same set of “core strategies” as used in the previous two data collection periods. In addition, students were provided with a vocabulary sheet and were given two or three words of the day to add and define as part of their warm-up. The vocabulary sheet was referred to several times throughout the course of the chapter, and students were encouraged to use it as they studied at home for their chapter test. A culminating butcher paper review was turned into an opportunity to expose students to concept-mapping using the chapter vocabulary.

Students were observed, and the observations were recorded, as they participated in the activity with special attention being paid to the use of science vocabulary. Photographs of students presenting their work to the class were taken as artifacts (Appendix J).

Because this chapter fell at the midpoint of a trimester and parent conferences were approaching, I made use of the opportunity to employ another one-time use strategy. Students were asked to provide narrative feedback about the course, teacher, activities, etc. via a letter to their parents (Appendix K). This served as an interview piece and was photocopied as data. These letters were read by myself and my CT then later passed on to the students’ parents when they visited me at conferences. The students certainly made use of this opportunity to tell me what they felt was working and what was not. Along with the letter, students provided a mid-assessment ranking of the perceived effectiveness of their study skills and current attitude toward science. These rankings were compiled along with the initial rankings for later analysis.
The final piece of data collected was another study skills feedback form where students were asked, once again, to rank the effectiveness of the strategies being used as well as provide comments on specific activities. Again, these responses were compiled and examined during a critical analysis point. This feedback, in combination with the artifacts collected and observations made, helped me to make the determination that continuity was paying off and that I should continue on my current path of strategies used.

The final formal data set collected introduced only one new strategy. Rather than use a butcher paper review activity, I followed the advice of the students and planned a review game. The game used was called Review Basketball and students worked in pairs to answer questions. The team that answered most quickly and accurately was given the opportunity to shoot a basket with their review paper for extra points. Observations were made of the students’ level of participation and engagement as they took part in the game. They were asked to provide two or three sentences of feedback regarding the review game the following day in order to help me determine its effectiveness.

Once the final data set had been collected, I made the decision to try an experiment during a chapter on acids and bases. I set aside all of the strategies used until this point and launched the use of chalkboards as a learning and study tool (Appendix L). This method was gleaned from a workshop I attended half-way through my action research data collection period and I was curious to see if students would embrace this strategy more than the others.
Informal observations were made as I witnessed the ways in which students used the chalkboards, their attitude toward the use of a new method, and their perceived effectiveness in helping students learn and practice the concepts being covered. This data was recorded in journal form. During this time, I also began wrapping up my data collection and asked students to once again complete a study skills inventory as a post-assessment (Appendix M). They carried out a final evaluation of the strategies used, identified which they believed to be most and least effective, and determined whether they discovered a method that answered questions similar to those on the initial inventory with the purpose of helping me determine if the project I carried out had reached its intended goal. Additionally, students ranked themselves one final time regarding the perceived effectiveness of their study skills and attitude toward science. These two rankings were compiled and compared to their pre- and mid-assessment rankings to see if there had been any change throughout the duration of the project.

The process of collecting, compiling, and organizing data was just the beginning. Really, the true analysis began when I took a step back in order to look at the entire picture through varying lenses. This process was truly invaluable as I tried to determine if I had successfully taught my students study skills that they will carry with them throughout their career as students and into the future. This will be discussed further in the section that follows.

The story of my Action Research Project

Framing the Study

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When I began this project, I believed the most important data I collected was that which would show me my students were learning valuable study skills. I assumed I could measure this seemingly intangible thing by looking for improvements in their formal assessment scores. In addition, I hoped that the acquisition of these skills would become evident in my students’ level of confidence regarding their science abilities as well as their attitude toward the subject. What I initially overlooked was the importance of the context in which this project was being carried out and the silent hand it had in the results I was observing. Therefore, let me begin my data interpretation by first introducing you to my classroom and students, and then I’ll deconstruct the assumptions I carried with me from the start of this action research project.

From the time of my first classroom observation, it became obvious that I had been placed in a classroom of excellent students lead by a wonderful and seasoned teacher who had a passion for science. The environment was cohesive and on the verge of becoming a community, although this was not a priority at the start of the school year.

I quickly discovered that instruction was delivered with a focus on notes and textbook-based learning. Because of the college preparatory nature of the class, this was not surprising, especially since this is what students must become accustomed to when they reach the university level. The classroom lacked technology and few efforts were made to integrate this pivotal learning tool into the curriculum. Although students did engage in numerous labs and activities that certainly were
meant to provide meaningful hands-on learning experiences, this classroom was not focused on inquiry and exploration.

Really what I witnessed—and am guilty at times of perpetuating—was passive learning. Rather than allowing students to question, struggle, become frustrated, experiment, and discover, they—like many advanced students—were accustomed to being spoon-fed information and regurgitating it on a test. They were comfortable with this method; it had worked for them in the past.

I also noted, much to my dismay, that these students did not seem motivated by the sheer joy of learning and experiencing science; they were what I will refer to as “grade grubbers.” The motivation to succeed did not come from an intrinsic source but resulted from the desire to earn a prized “A” on their report card. Now looking back to the start of the year when I witnessed my students’ anxiety about their first weekly quiz, I believe I can attribute this stress not to the fact that they did not know how to study and prepare for this type of formal assessment but instead to the personalities of the students seated in my classroom and the context of the learning environment. In short, it soon became evident that my students were continually anxious to know exactly what to study, not how to go about studying it.

Though not consciously at first, I began to form my own assumptions of what the data would look like and how this project would affect my students. Obviously, I did so without taking into account the context and varying perspectives involved in interpreting what I saw. I was seeing things through one set of lenses, wearing rose-colored glasses of sorts, and forgetting that my own beliefs and ideologies would deeply affect the strategies used and outcomes viewed.
Many of these assumptions began to form in my mind the moment I knew where and what I would be teaching. I imagined that this class would be nearly identical to the one I took as a sophomore at a neighboring high school. I pictured the students as being highly motivated, bright, meticulous individuals who already liked science and would appreciate all that this course had to offer them. I anticipated that my students would be exactly like myself and my fellow students and friends when we were in high school. To further idealize the process, I was confident that I could, and would, teach these students how to study!

There is certainly some degree of truth rooted in my suppositions; however, what applied to one student did not necessarily hold true for all of the others. Additionally, this meant that I could not make generalizations about my data or put it in a box without considering all of the contributing factors. Fortunately, in allowing the context of the project to be viewed as data in its own right, I was better able to interpret and make meaning from what I was seeing take shape as a result of my efforts to teach students study skills in my science classroom.

As I tried to decide on study skills activities to implement in my lessons, I wanted to reach the various learning styles represented among my students so that the activities they were participating in were helping create a meaningful learning opportunity. In order to do so, I administered a multiple intelligences survey to my chemistry students. I wasn’t surprised to find that nearly half of my students found themselves to have strong logical-mathematical and interpersonal abilities. (See Figure 1.)
The accelerated nature of this course dictated the type of students that are enrolled in the course; they are generally high achievers in mathematics as well as in their previous science classes. In addition, my students have proven themselves to be incredibly social and thrived in my classroom where they were often required to work in pairs or groups, especially in the lab. Nearly one-third of the students were also identified as having strong interpersonal abilities. These results reinforced the importance of planning study skills activities that provided opportunities for collaboration as well as activities that stretched their problem-solving and logic skills.

Figure 1: Results of Multiple Intelligences Survey, Primary Intelligences
Because the main goal of this action research project was to determine ways in which study skills can be taught in the context of the science classroom, I found that it was necessary to provide the students with a study skills survey that gave me a great deal of insight about the study habits of my students. This survey supplied information that served as a baseline regarding the students’ study habits, the environment in which they studied and did homework, review techniques that worked for them, and ways that teachers have helped them develop study skills. I was surprised to discover that most students, despite being quite a social group, preferred to study on their own.
I was also surprised that many students did not make use of their textbook and/or did not complete assigned readings. As the trimester progressed, it became obvious that, because of the heavy reliance on notes and lecture as a teaching strategy, students did not feel they needed to use the textbook unless they were working on homework problems.

While my CT encouraged students to leave their textbooks at home and rely on their notes, I felt that the students should be viewing their textbook as a tool and was determined to find a way to make that happen. At the time of this survey, approximately half of my students were satisfied with their current study habits; however, many were willing to try something new. When polled again in the final week of the project, four students indicated they had adopted new study skills strategies as a result of participating in this project while eighteen continued to make use of the same study techniques they had subscribed to prior to the start of the project, thus cementing one of my theories.

From day one I wondered whether this project would affect the way the students studied at home. While the data does not provide an answer to this specific question, I believe that it does show this project still benefited the students. The first study skills survey asked students to provide an initial ranking of the success of their current study skills. They performed this same ranking again at the midpoint and once more when the study concluded. (See Figure 2.)

**Figure 2: Initial, mid, and final rankings of students’ perceived success of their study skills**

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Of the twenty-five students who participated in the study, the data showed nine students saw an increase in the effectiveness of their study skills, seven students reported seeing no change, and six noted that the effectiveness of their study skills decreased over the course of the study. (See Figure 3.)

Figure 3: Overall change in students’ perceived effectiveness of their study skills
Examining this overall data caused me to believe that it is reflective of much more than whether students were able to acquire study skills and learn the material they were encountering. I believe it also suggests that the data was affected by what seemed to be less obvious factors such as the students’ personalities, the nature of the study skills strategies used, the classroom environment, and students’ connection/relationship with the teacher conducting the research. With this in mind, the following will explore what the data says about the individual strategies used during the course of the action research while considering the aforementioned factors. It will also take into account the varying perspectives present in the *Becoming a Teacher Through Action Research, Second Edition* © 2010 Routledge / Taylor & Francis Group, LLC.
classroom and the criteria used for determining the success or failure of the variety of strategies implemented during this project.

Data Analysis and Interpretation

The first interactive study skill activity I used was wall graffiti where students worked together to work through problems and answer questions on butcher paper. I chose to have my CT help me carry out an observation while my students participated in this activity. Prior to introducing the activity, I hoped that the students would find it both fun and useful in reviewing for their upcoming quiz. Although the room was a bit noisier and chaotic than I was used to, I walked away from this activity feeling that it had successfully accomplished the goal at hand.

My CT and I witnessed students who were working well together and who were engaged for the entire duration of the activity. This observation was confirmed by my university supervisor as he was present in the classroom for a formal observation. After the period had ended, I felt a sense of satisfaction that the activity had fulfilled its potential and served its purpose for helping students practice and review.

Surprisingly, my CT agreed but noted that she would probably not repeat the activity because of the set-up and maintenance time involved for the activity to run smoothly. As an afterthought, I had my entire class take a few minutes to give feedback on the activity after they had taken the quiz for which it was meant to prepare them. I asked them whether they felt the graffiti activity was useful in preparing them for their quiz and to explain why or why not.
Having watched them closely as they worked on the activity and finding them seemingly engaged and excited, I was surprised to find that the class was split 50/50. About half thought the activity was great and a very useful review. One student noted, “…It gave me practice (something I normally don’t do much) and it was kind of cool.”

On the other hand, many students didn’t find the activity as useful as I had hoped, and another student wrote, “The project confused me beyond belief. No one helped me clarify our answers and we were second-guessing ourselves.” The students’ comments indicated that they lacked confidence in their conceptual knowledge, something I was hoping to build by using activities such as this.

Later I realized that part of the students’ anxiety came from the fact that they were used to focusing on arriving at the correct answer; I was asking them to look beyond being right and learn from the process while making use of their problem-solving and critical-thinking skills. This experience was pivotal in beginning the unraveling of my assumptions and seeing the importance of context. These students had already had twelve weeks of formal learning that had not been student-centered. I knew I was going to have to work diligently, but carefully, if they were going to embrace and find value in the study skills activities I presented them with from this point on.

The second strategy introduced during the first data set, which was used consistently throughout the entire project, was the use of warm-up questions at the start of nearly every class period. Typically a warm-up question required some sort of calculation and reviewed something the students had learned during the previous
day. These involved the students by asking them first to try the problem on their own, drawing on just their knowledge; then, after several minutes, students were called upon to share their answers and problem-solving process. At the end of each chapter, these warm-ups were turned in and counted as a homework assignment.

Although I did not record formal observations as students worked on these problems at the start of class, I saw that students tended to work diligently to complete their warm-up, often returning to their notes or asking for assistance from another student if they did not understand how to proceed. When polled, 20 out of 25 students found these to be highly effective. When surveyed again later in the project, I found that 17 out of 21 students who responded still believed that these were an effective study skill by assigning warm-ups a score of 3, 4, or 5.

Because of the rapid pace of the trimester and rate at which we proceeded through content (usually one chapter every week and a half), it became increasingly difficult to make a large number of assignments. It was more efficient to make use of a review worksheet in order to give closure to each chapter. This was generally given to the students two days prior to their chapter test and they were provided with a limited amount of in-class work time during which they were permitted to work with their peers and ask questions of the teacher.

Initially, these review worksheets were collected on the day of the test and the students had no knowledge of whether or not their answers were correct. A system was devised to increase their effectiveness in that I would provide the students with answers to all of the even-numbered problems during class on the day before the test and then grade the odd problems when they turned in the review worksheet.
sheets. Of the review opportunities provided, I have found this to be one that the students ranked highly. Over 90% of the class felt that this was one of the best review tools because it gave them the opportunity to practice everything that they had learned over the course of the chapter, especially if the chapter was heavy on calculations.

While I initially concurred that these review worksheets were one of the most valuable strategies I was using, I was forced to reconsider this idea after talking with one of my colleagues who was also student teaching in a chemistry classroom at the time. He noted that just because students could memorize how to do the types of problems that would be on the chapter test by using a review worksheet that did not necessarily mean they were truly learning anything.

At first I was shocked to hear this, but after some consideration had to agree. The more I thought about this, the more I realized that I was perpetuating the passive learning that I was striving to move away from by doing this project. It became clear that the reason my students loved these review worksheets so much was because they helped them to memorize the way to get the right answer on their test and therefore put them on the path to earning a high grade. Despite this revelation, I decided for continuity’s sake to continue using the review worksheets and found assurance in the fact that this was not the only strategy I was relying on.

My desire to see if my students truly understood the material I was presenting to them as they took notes and absorbed new content resulted in the introduction of concept test questions. In my college chemistry course, I was introduced to “Concept Test Cards” to check for understanding as the teacher proceeded through
a lecture. Each student picked up a card as they entered the classroom, and as the lesson progressed, one or more concept test question was asked. Students responded by using their card and holding up a letter corresponding to one of the multiple-choice answers to the question. Because each of the letters was a different color, the professor could almost immediately determine whether or not a majority of the students were grasping the concept and re-teach as necessary. This method was used in data sets two through five. Every time a concept test question was offered, each student’s answer was recorded by my CT or me. I found that approximately 85% of the time my students answered correctly, indicating that they had some sort of understanding of the concept immediately after it was presented to them.

In many cases, all but one or two students provided correct answers and when called upon could give a reason for choosing the answer they had selected. While this served as a valuable source of feedback, I questioned the validity of this data in showing long-term retention of concepts. Because students have their notes in front of them and answered these questions no more than ten minutes after learning about a concept, it should be relatively easy to recall the information being asked for because it is fresh in their minds.

I also found it interesting that such a large majority of students could answer nearly every single question correctly, and I tried to adjust by changing the types of questions asked and integrating calculation type questions as well.

I polled the students on the effectiveness of the concept test questions at the end of my second data set and again at the end of the fourth data set. I found that 18 of my 25 students ranked this method as being effective to very effective.
(indicated by a score of 3, 4, or 5) after the first two weeks of use. During the second polling, 11 of the 21 students who responded ranked this strategy as effective in helping them learn and review the concepts after eight weeks of use.

As time passed, I began to see a small occurrence of students who either chose not to answer or simply cheated off of their peers, thereby diminishing the effectiveness of the method. They failed to see the purpose in using this strategy as a quiz and check for understanding and started asking if they were receiving points for participation. The notion that everything must have points associated with it and contribute to the course grade became a constant battle with this group of students. As a result of these observations, combined with student feedback, I decided to make a change in the way that I checked for understanding in an unofficial sixth data set.

After attending a workshop sponsored by the Bureau of Education and Research that focused on strengthening the teaching of chemistry concepts in the science classroom, I was inspired to replace concept test questions with a more interactive strategy during the last chapter that I taught (informally data set six).

Al Guenther, a veteran chemistry teacher and our workshop presenter, introduced us to the use of chalkboards. Rather than answer multiple-choice questions, students are more involved in the process and are asked to problem-solve. Each student receives a small chalkboard on which they DO, DRAW, SOLVE, SHOW WORK, QUESTION, BRAINSTORM, etc. In the resource handbook given to each workshop attendee Guenther notes, “The effectiveness of this approach derives from the fact that students must prove to the teacher that they understand each.
step in a lesson before proceeding to the next.” He adds, “This method greatly
decreases frustration and builds confidence—the student knows he/she
understands…” (p. 15).

Although there was not an easy way to record each student’s answer and
thought process as I had been recording their multiple-choice responses, I witnessed
a difference in my students when they used the chalkboards. Rather than glance
around the room to see if their answer matched that of their peers, they discussed
questions with their neighbors, offered assistance to each other, and explained their
own processes.

I should note that the first use of chalkboards wasn’t quite this productive as
my students found it especially entertaining to draw and color, rather than problem-
solve. Although this still occurred occasionally, they finally began to utilize their
chalkboards as a learning tool and less for artistic expression. Based on my own
observations and the verbal feedback from students, replacing the old strategy with
a new one was a positive choice.

When I left my chemistry classroom behind at the end of my student-teaching
experience, I surrendered my supply of vinyl chalkboards to a very happy CT who
plans to implement their use in her teaching practice. The students’ acceptance of
this particular strategy was incredibly encouraging as it marked a change in their
perspective on study skills. Rather than seeing the use of chalkboards as arduous and
extra, they embraced them. Little did they know that they were accepting a more
authentic method of learning than they had used before.
With the practice makes perfect mentality in mind, I also chose to make use of additional review opportunities. The first came in the way of a kinesthetic pop quiz. I simply put several different questions on the overhead and asked students to “stand up if you know the answer.” I found that 75% to 80% of my students were able to stand up each time, and when called upon were able to give a correct explanation of the concept or question being asked. For many, however, this game quickly got old and they resorted to raising their hands after the first three or four questions instead of standing up. One student noted on her feedback form that although this unofficial pop quiz of sorts was helpful in reviewing material that was a few days old, it was “embarrassing if you didn’t know the answer.” Rather than quizzes of this type, the students noted they would like to play more trivia type games to test their knowledge.

At the conclusion of one chapter I took the suggestion made by my critical colleague—also a science teacher—and planned a review game termed Review Basketball. I used a series of questions similar to those that would be on the final test. I thought the idea of having each student solve the problem given to them on paper was an excellent way for them to practice what they had been learning.

While a majority of the students participated, they unanimously commented that they disliked this particular game. Perhaps the fact that I did not offer extra credit for correct answers made the game seem unnecessary to students since they seemed to value only activities with a point value attached or that was somehow coupled to a reward.
Surprisingly, my fourth-period class thoroughly enjoyed this review game and was much more engaged, which seemed to indicate that the personality of the student group and classroom dynamics probably have much to do with the success or failure of many of the study skills strategies I have enlisted over the past months. I believe that this also ties back in to the types of learners that I have in my classroom. While 21% of the students were labeled as kinesthetic learners, which this activity catered to, that is certainly not the majority of the students in the room. When asked, students suggested that they would have been more interested in a game like Jeopardy, where they could work in large, competitive teams.

In an attempt to remove some of the pressure the students were facing when it came to test day, as well as to encourage them to take notes, I allowed the students to use a single note card for their chapter ten test. They could record equations, examples, and notes on the card. I provided the students with a list of items that they might find useful to include, and allowed them freedom to fill in whatever else they liked.

This idea had really come about as a result of a discussion during the summer semester in a learning theory class. We were discussing classic vs. official theories of learning, and it was stated that as teachers our goal was to help students actually learn material rather than just memorize and regurgitate information. My instructor suggested that we try implementing various means of assessment rather than relying simply on tests. She also noted that it was acceptable to allow students to use their resources when testing including another student, the textbook, or class notes. Not surprisingly, the average test score increased by three points. I suppose the rise in
the test scores from the previous test could be attributed solely to the use of a note
card, however, I also believe that other factors may have contributed including, but
not limited to: student interest in the material, nature of the material, number of
review opportunities offered, and learning that resulted from re-writing class notes
onto the note card. Even my CT embraced this strategy, although felt that it was not
appropriate to allow students to use some form of notes on all formal assessments.

When my students encountered a chapter on solutions and solubility, they
began to understand how important it was to learn the language of science simply
because they were encountering literally dozens of new words. To help them keep
all of the terminology straight, they were given a vocabulary log sheet (“Words to
Know”). Each day of the chapter at least three new words of the day were on the
board and they added these to their list. They also looked up the definitions of these
words on their own time.

I encouraged students to refer to this list as we proceeded throughout the
chapter, as well as use it to study for their chapter test. While this was a seemingly
useful activity, the students gave it mixed reviews. Just a few more than half of the
students (13 out of 21) found that keeping a vocabulary log was an effective study
skill and only 5 out of 21 students actually used their vocabulary list to study for
their test. This quickly became evident when only 3 of my 25 students were able to
perfectly match a list of twelve words to their definitions on the chapter test,
despite being encouraged over and over to study and use their vocabulary lists.

In the future, I believe that I would begin this practice at the beginning of the
year and ask students to reserve a section in a spiral notebook for a chemistry

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dictionary. With each chapter they could then add new terminology to this section to refer to later. In essence, they would be constructing their own mini-textbook in language that makes sense to them as they learn the language of science.

Following suit with the vocabulary list, I also asked the students to take the vocabulary they had learned and make connections between all of the concepts we had studied regarding solutions and solubility. In their small groups the students made a sort of graphic organizer, which they later presented to their classmates. I was doubtful that the students would “buy in” to this activity; however, as I walked around the classroom and observed the students working, I was pleasantly surprised at what I saw. Although there were about four students who were consistently off task, I found that everyone else was actively engaged in this project. The students were grouping the words I had provided them, coming up with definitions, noting examples, and using the language of science as they did it!

One student noted, “This activity showed how each concept can relate to another and we had to help each other out to understand things better.” Not all students found this activity useful. But despite some negative feedback from students, I believe that something like this is successful. When I stopped to observe a group of students working on their concept map and overheard one young man who rarely participates engaged in a conversation with another member in his group about saturated and unsaturated solutions, I counted that as a success.

This is what I saw: Dan is holding the word “saturated” in his hand, trying to decide where to put it. He comments, “Something is saturated when it can’t dissolve any more of the substance and you can tell it’s saturated because there will be some
undissolved stuff left on the bottom.” He glues down his word and draws a quick picture beneath it of a beaker containing a solution with particles at the bottom.

Another group member asks, “Can’t you also look up whether something is saturated or unsaturated on a solubility graph?”

Dan answers, “Yeah, just like on the ones we made in the lab this week.” They agree to draw a solubility graph on their poster as well and label the solubility curve. It seemed that, once again, a more authentic strategy was proving to be a useful tool for allowing students to review concepts while giving them an opportunity to showcase what they really know.

From the beginning of this project I had been trying to encourage students to use their textbooks as a study tool. I decided to also employ the use of guided notes. This strategy focuses a student’s reading. This particular assignment guided students through the application part of a chapter. Overall, the students understood that the purpose of guided notes was to point them to the important pieces of information; however, several disliked the strategy, feeling that it was busywork.

Twelve out of 21 students felt that guided notes were an effective study tool as they gave them a score of 3, 4, or 5. Others noted that the review worksheets were sufficient.

Perhaps this strategy would have been more beneficial if I had asked the students to complete this assignment during the first part of the class period, then used the end of the period for students to share with the entire class or a small group the information they had found in the chapter that helped them answer the questions.
I am still concerned that the students do not feel the need to make use of their textbooks, relying solely on the notes given by the teacher in the form of lecture or a lab activity to learn the material sufficiently. Yet, this is an indentured habit and it did not surprise me that I was not able to “sell” them on the importance of using the textbook.

Overall, throughout the project I became truly curious to know whether or not incorporating study skills and review activities into my daily lessons was really making a difference in improving students’ study habits and increasing student learning. Although I do not believe that test and quiz scores alone can provide an answer, I did witness a very slight increase in students’ test and quiz scores. (See Figures 6 and 7.)

Figure 6: Students’ quiz scores throughout the duration of the AR project
Figure 7: Students’ test scores throughout the duration of the AR project
One student in particular was consistently receiving scores of 2/10 on quizzes and had scored 9/50 on the first chapter test. Over the course of three months, I saw her scores dramatically improve to 9/10 on the last three quizzes and 37/50 on the most recent test. I continued to listen for students’ ability to talk with other students using the language of science, to assist each other and work cooperatively, to make use of the problem-solving skills they were most certainly acquiring, and to demonstrate that their knowledge base was continually growing as we progressed through the trimester.

When I first decided upon my action research topic several months ago, I thought I was merely carrying on with an idea passed on to me by a colleague and Becoming a Teacher Through Action Research, Second Edition © 2010 Routledge / Taylor & Francis Group, LLC.
friend, but this project turned into much more than I initially set out to accomplish. What started out as a ploy to get students to study became a study in the process of teaching and learning in the science classroom. I reached a pivotal point in this project when I had the opportunity to sit down with my cohort leader to discuss my final data analysis.

As we began trying to sort out and make sense of all of the scratches, scribbles, notes, and ideas that had been thrown onto paper, she noted that what I had done wasn’t necessarily teach students how to study. I believe that I probably entered an inward state of panic as I considered the notion that I had somewhere missed the mark.

Fortunately, this feeling quickly passed as I discovered that what I had accomplished instead was much greater: I had been able to introduce a style of teaching and learning different than the students had experienced before, a style focused on more than just getting the right answer.

Further Reflection and Questions on my Action Research Journey

Now that my action research project has been wrapped up, I cannot help but look forward to my next adventure in teaching when I will have the opportunity to challenge myself to better my practices and reconsider my currently held theories about teaching and learning. Although I thoroughly enjoyed exploring ways to teach students how to learn and study chemistry, I must admit that before this project came to an end I had already compiled a mental laundry list of things I would do differently next time and topics I would like to explore further.
In a perfect world, I would have been able to start with a blank slate, an empty classroom that I could decorate and situate as I pleased. The first day of school would roll around and entering my classroom would be a group of fresh, energetic students who had not yet had their young minds filled with the idea that the only thing that matters is the grade. (Then again, maybe that isn’t really possible.)

I would begin the process of providing the scaffolding necessary to create an inquiry-based classroom where students truly learn by exploring. (This was one of the greatest challenges I faced in my action research project setting.) Included as part of this process would be time set aside for helping students determine how they learn best and identifying their interests; perhaps this would come in the way of a workshop-style class period that includes multiple intelligences.

Because I am still interested in study skills, I also feel that it would be important to build a mini-lesson each week, each focusing on a different topic, into my lessons. If I indeed chose to continue with this focus, I believe that I would choose one specific strategy, such as the use of chalkboards for developing students’ ability to think abstractly and construct conceptual models, and follow this through an entire course.

I am also interested in the idea of having students make meaning by constructing their own chemistry textbook of sorts in a notebook which would include a section for vocabulary, models, warm-ups and problem-solving, lab data, and other similar things. This would perhaps take the emphasis off of lecture-based teaching and create a more student-centered approach for learning.
Additionally, teaching such as this decreases the need for heavy emphasis on formal assessments such as tests and opens up the possibilities for implementing more meaningful authentic assessment strategies such as projects and portfolios. Truly, I anticipate implementing a project incorporating several of the above ideas during my first year of teaching.

Looking back, questions surrounding my current action research project still remain. What other methods could I have used that may have been more successful? What would a project like this look like if my student population was different (i.e., non-advanced students or students from more diverse backgrounds)? How would my results look different if I had conducted this project over a longer period of time? Would it have been more effective to select a single strategy and use it consistently over a long period of time? What should I do when my students and I disagree on the effectiveness of a strategy?

This project has certainly been a journey. I mentioned at the conclusion of my data analysis and results that this project really stemmed from something similar carried out by a good friend of mine several years ago. After reading through the details of her project, I anticipated that the results would be cut-and-dried, but instead discovered the importance of considering context and perspective before making superficial statements and generalizations about what I believed was true.

The more I learned about the students, considered the context of “advanced classes,” the school building and staff, the educational philosophies of my CT, and my own ideas about teaching, the more I discovered that the entire process is similar to viewing something through several different filters or lenses. For example,
if I am to look at the data I collected with my own assumptions and ideas in mind, I am seeing it through essentially rose-colored glasses; perhaps viewing the data from the perspective of my CT is like seeing it through a yellow filter; and if I am to take into account the students’ point of view I am looking through a set of blue lenses.

Each perspective holds merit, but lacks clarity and validity until I take the time and make an effort to look through all three sets of eyes simultaneously. When this occurs, the three overlapping colors blend together to produce white, or a clear image of what the data is really saying. While it may seem amazing that the product of combining red, blue, and yellow light is pure white light, it is truly fantastic what I began to uncover when I moved beyond myself and my assumptions. This has really shown me how dynamic and powerful the action research process can be. In addition, I can truly attest to the fact that the action research process is permanently embedded in the process of good teaching.
Works Cited


## Appendices

### Appendix A

### Data Collection Plan

<table>
<thead>
<tr>
<th>Proposed Date of Action</th>
<th>Action (Strategy, intervention, evaluation, etc. to be implemented)</th>
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| Week of December 6<sup>th</sup> | Interview:  
- Learning Style/Multiple Intelligences Inventory  
- Conduct preliminary survey of students’ study habits |
| December 7<sup>th</sup>-15<sup>th</sup> | Work Sample: Chapter 8, Reaction Stoichiometry  
Study skills built into lessons:  
- Chapter anticipation guide/pre-assessment (December 7<sup>th</sup>)  
- Collaborative reading (Dec. 7<sup>th</sup>)  
- Warm-up questions (Daily use during WS)  
- Wall graffiti (Dec. 9<sup>th</sup>)  
- Weekly quiz (Dec. 10<sup>th</sup>)  
- Problem sets (Assigned Dec. 7<sup>th</sup> and Dec. 9<sup>th</sup>)  
- Test review day (Dec. 14<sup>th</sup>)  
- Chapter test (Dec. 15<sup>th</sup>)  
Artifacts:  
- Warm-up questions  
- Wall graffiti posters  
- Lab reports  
  - Mass-mass lab  
  - S’mores lab  
  - Glass lab  
- Problem set/Chapter HW problems  
- Quiz scores  
- Chapter test scores  
Observations:  
- Observations of group collaboration and study skills during wall graffiti activity  
- Individual student observations of laboratory technique during glass lab |
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<tr>
<th>December 20th - January 2nd</th>
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<td>January 3rd - 11th</td>
<td>Ch. 9, Causes of Change</td>
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<td>- Chapter test</td>
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<td>- Warm-up questions</td>
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<tr>
<td></td>
<td>- Quiz scores</td>
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<td></td>
<td>- Review note card</td>
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<tr>
<td></td>
<td>- Chapter test scores</td>
</tr>
<tr>
<td></td>
<td>Observations:</td>
</tr>
<tr>
<td></td>
<td>- Concept test question answers recorded for each student</td>
</tr>
<tr>
<td></td>
<td>Interviews:</td>
</tr>
<tr>
<td></td>
<td>- TBD?</td>
</tr>
<tr>
<td>January 25th - February 1st</td>
<td>Ch. 11, Solutions</td>
</tr>
<tr>
<td>----------------------------</td>
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</tr>
<tr>
<td>Study skills built into lessons:</td>
<td></td>
</tr>
<tr>
<td>▪ Guided notes</td>
<td></td>
</tr>
<tr>
<td>▪ Warm-up questions</td>
<td></td>
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<tr>
<td>▪ Concept test questions</td>
<td></td>
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<tr>
<td>▪ Weekly quiz</td>
<td></td>
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<tr>
<td>▪ Problem sets</td>
<td></td>
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<tr>
<td>▪ Review worksheet</td>
<td></td>
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<tr>
<td>▪ Test review day</td>
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<tr>
<td>▪ Chapter test</td>
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<tr>
<td>▪ Conference letter to parents</td>
<td></td>
</tr>
<tr>
<td>▪ Concept mapping with chapter vocabulary</td>
<td></td>
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<tr>
<td>Artifacts:</td>
<td></td>
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<tr>
<td>▪ Guided notes</td>
<td></td>
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<tr>
<td>▪ Warm-up questions</td>
<td></td>
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<tr>
<td>▪ Quiz scores</td>
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<tr>
<td>▪ Chapter test scores</td>
<td></td>
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<tr>
<td>▪ Vocab-mapping posters</td>
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<tr>
<td>Observations:</td>
<td></td>
</tr>
<tr>
<td>▪ Concept test question answers recorded for each student.</td>
<td></td>
</tr>
<tr>
<td>▪ Students will be observed during the concept-mapping activity for participation and level of engagement.</td>
<td></td>
</tr>
<tr>
<td>Interviews:</td>
<td></td>
</tr>
<tr>
<td>▪ Conference letter to parents detailing the grade the student is receiving and why they are receiving it, as well as feedback and comments about the class and teacher.</td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>February 2nd - 9th</th>
<th>Ch. 12, Chemical Equilibrium</th>
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</thead>
<tbody>
<tr>
<td>Ch. 11, Solutions</td>
<td></td>
</tr>
<tr>
<td>Study skills built into lessons:</td>
<td></td>
</tr>
<tr>
<td>▪ Warm-up questions</td>
<td></td>
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<tr>
<td>▪ Concept test questions</td>
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<tr>
<td>▪ Weekly quiz</td>
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<tr>
<td>▪ Problem sets</td>
<td></td>
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<tr>
<td>▪ Review worksheet</td>
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<tr>
<td>▪ Test review day</td>
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<tr>
<td>▪ Chapter test</td>
<td></td>
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<tr>
<td>▪ Basketball Review</td>
<td></td>
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<tr>
<td>Artifacts:</td>
<td></td>
</tr>
<tr>
<td>▪ Warm-up questions</td>
<td></td>
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<tr>
<td>▪ Quiz scores</td>
<td></td>
</tr>
<tr>
<td>▪ Chapter test scores</td>
<td></td>
</tr>
<tr>
<td>▪ Basketball Review Work</td>
<td></td>
</tr>
<tr>
<td>Observations:</td>
<td></td>
</tr>
<tr>
<td>▪ Concept test question answers recorded for each student.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>February 10th - 18th</th>
<th>Ch. 13, Acids and Bases</th>
</tr>
</thead>
<tbody>
<tr>
<td>▪ Introduce Chalkboards</td>
<td></td>
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<tr>
<td>Informal Observation:</td>
<td></td>
</tr>
<tr>
<td>▪ Chalkboard use and effectiveness</td>
<td></td>
</tr>
<tr>
<td>Week of February 28th</td>
<td>Interview:</td>
</tr>
<tr>
<td>----------------------</td>
<td>------------</td>
</tr>
<tr>
<td></td>
<td>• Collect final study skills/habits questionnaire from each student (to include student evaluation of study skills methods—which were most/least effective, did they discover a method that best fits their learning style, etc.)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Week of March 6th</th>
<th>Interview/Artifact:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• Chemistry Legacy—students give advice to the next group of students, tell what they liked/didn’t like, and give feedback to the teacher in a comical manner</td>
</tr>
</tbody>
</table>

Appendix B

Parental Consent Form

December 7, 2004

Dear Parent and/or Guardian:

Hello! My name is Colleen XXXX and I will be student-teaching this trimester in Mrs. R’s chemistry classroom. I am delighted to have this opportunity to learn with Mrs. R and your student.

The first unit I will be teaching is on Reaction Stoichiometry. This is such an important chemistry topic and I am excited to begin exploring it with your student. As students learn about stoichiometry, they will be encountering and practicing new conversions and calculations, experiencing chemistry hands-on through various lab activities, and working collaboratively with their peers.

During my student-teaching, I will also be studying my own practice of becoming a teacher through an action research project. Specifically, I want to learn more about ways students can develop study skills in the science classroom. In doing so, I plan to implement a number of study skills and review activities in my daily lessons.

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During this project, I will survey students about their study habits, help them determine ways in which they learn and study best, monitor homework and in-class assignments, analyze test and quiz scores, and observe class activities involving study skills to better understand this issue. This data will be collected during the normal course of class routine and work between December 1st and March 5th. I will present this project to the faculty and my peers at the University on April 28th.

To maintain confidentiality, pseudonyms for the community, school, and all students will be used throughout the report I write. Data generated by students will be part of the teaching-learning process and will help me become a better teacher and provide a better education to your child. There is no risk in participation, and your student’s grade will be in no way affected.

Please sign the permission slip below, indicating whether I may or may not use the data generated during the normal school day from your child’s work.

During the course of this project I would like to take digital photos and video-clips of the students participating in study skills activities. These will be used to enhance my research project presentation. Please indicate below if I have permission to use these photos and video-clips of your child in my report.

Becoming a teacher has been a lifetime goal of mine. I know I will learn much from not only my action research project and formal teaching experiences, but also from daily life in the classroom and my interactions with children like yours. If you have any questions, please do not hesitate to contact Mrs. R or myself.

Sincerely,
Colleen XXXXX
Email of student teacher
Email of Mentor Teacher
School Phone Number

Please sign this slip and return it with your student. Thank you!

- Yes. You may use data generated by my child to be used in your research project.
- No. Please do not use data generated by my child in your research project.
- Yes. You may use video-clips and/or digital photos of my child in your research presentation.
- No. Please do not use video-clips and/or digital photos of my child in your research presentation.

Student’s Name _____________________________________________ Date _____________

Signature of Parent and/or Guardian ____________________________________________
Appendix C

Multiple Intelligences Inventory

(Colleen used an MI inventory purchased by her school.)
Appendix D

Preliminary Study Skills Survey

Name ____________________
Period ___________

**Study Skills Survey**

<table>
<thead>
<tr>
<th>Question</th>
<th>Hardly Ever</th>
<th>Sometimes</th>
<th>Frequently</th>
<th>Most Always</th>
</tr>
</thead>
<tbody>
<tr>
<td>Do you have a regular place to do homework and study?</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Do you keep track of assignments in a planner?</td>
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</tr>
<tr>
<td>Do you keep a calendar of tests, projects, etc.?</td>
<td></td>
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</tr>
<tr>
<td>Do you take notes in class?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Do you use your notes to study?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Do you study with friends?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Do you review material weekly?</td>
<td></td>
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</tr>
<tr>
<td>Do you study for tests or quizzes at the last minute?</td>
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</tr>
<tr>
<td>Do you listen well in class?</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Do you feel that you learn at school?</td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>Do you read from your textbook?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Do you take notes as you read?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Do you study effectively?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Do you try to improve your study habits?</td>
<td></td>
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</tr>
</tbody>
</table>

1. How many hours per week do you spend studying for tests and quizzes? Working on homework? Reading?
2. Describe your optimal study environment. (Is it a quiet room? Do you have music playing or the TV on? Do you study at a desk or table?)

3. How do you go about studying for a quiz or test? List all of the techniques you use (i.e., flashcards, study from class notes, do practice problems, study groups, etc.).

4. What study habits have always worked best for you?

5. What study habits, if any, usually don’t work?

6. Have you ever been taught how to study? If so, where and how?

7. What kinds of teaching techniques have your previous teachers used that helped you to be successful? Why were they helpful?

8. What kinds of teaching techniques have your previous teachers used that just did not work for you or that you found annoying? Please explain why.
9. Are you willing to try new study skills techniques to improve your learning, or are you satisfied with how you currently operate?

Place yourself on this continuum on how successful you perceive your current study skills to be. 1=least successful and 5=most successful.

Study Skills

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
</table>

Rank your current attitude toward science. 1=negative and 5=very positive

Attitude Toward Science

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
</table>
Appendix E

Researcher’s Notebook
Appendix F

Photo of Student Work: Wall Graffiti

[Image of a photo of student work on a wall with mathematical and scientific notation.]
This Year I’m Going to “Stick” to It…
Use the space below to jot down a few goals for the year and trimester in each of the following categories.

Personal

School

This Class
Study Habits

Anything Else!

Appendix H
Concept Test Cards

Appendix I
Study Skills Feedback Form
Name __________________________

Study Skills Feedback Form

Now it’s your turn to give feedback! Rate the effectiveness of the in-class review activities in helping you learn and practice concepts we have covered in Chapter 9. 1=not effective 5=very effective

- Homework Problems
- Warm-ups
- Concept Test Questions
- “Stand Up If You Know the Answer” Review
- Review Worksheet
- Butcher Paper Review Problems

What other types of review activities would be helpful for you? (games, pop quizzes, etc.)

Do you think there were enough opportunities available during class to review and practice material? 1=too few 5=too many

How did you prepare for the quizzes and chapter test?

On a scale of 1 to 5, how prepared did you feel for the quizzes and chapter test? 1=not prepared 5=very prepared
Other feedback/comments:

Appendix J

Photos of Student Work: Vocabulary Mapping

Appendix K

Mid-Trimester Letter

Directions: Type a letter to your parent(s), or guardian, answering and explaining the following questions. Please feel free to be honest! This letter will be given to your parents/guardian when they visit me at conferences on Wednesday, February 2nd.

Use this paper as a checklist. Be specific. No particular order is necessary; be creative!!

___ what class this is for,
___ what your progress report grade is,
___ why you received that grade,
___ things you have enjoyed about the teacher and the class,
___ things you haven’t liked about the teacher or the class,
___ any changes you would like to make during the rest of the trimester,
___ any changes you would like me to make in the remainder of the trimester,
___ concepts you found interesting,

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___ concepts you found boring or a waste of time,
___ and any additional comments.

Place yourself on this continuum on how successful you perceive your current study skills to be. 1=least successful and 5=most successful.

Study Skills

1  2  3  4  5

Rank your current attitude toward science. 1=negative and 5=very positive

Attitude toward Science

1  2  3  4  5

Would you like to make any additional comments?

---

*Turn this sheet in with your typed letter. Don’t forget to sign your name.*

*Thank you for your input!*

---

Appendix L

Chalkboards

---

Appendix M

Study Skills Post-Assessment

---

Name __________________

Study Skills Post Assessment Survey
**Directions:** Please answer the following questions in the space provided. If you need more space, attach a separate piece of paper. These responses will not be shared with the class; they are just for me to read.

1. What overall grade do you expect to earn in this class? Are you satisfied with this grade? Explain why or why not.

2. What is your opinion of the science textbook we used this year? Did you read it? How often did you read it? How much time did you spend reading it at night? Did you ever re-read?

3. How did you go about studying for a quiz or exam? Please list all techniques.

4. What study habits worked best for you?

5. What study habits didn’t work for you?

6. Did your study habits change as a result of the study skills activities we did in class?

7. What kinds of teaching techniques did I use that helped you to be successful? Why were they helpful?

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8. What kinds of teaching techniques did I use that just did not work for you or that you found annoying? Please explain why.

9. Of the concepts that you will remember from this science class, do you remember how you learned them?

10. Place yourself on this continuum on how you successful you perceive your current study skills to be. 1 (least successful) to 5 (most successful).

   Study Skills
   
   Rank your current attitude toward science on the following continuum. 1 (low—“I really don’t like science at all”) to 5 (high—“Science is great!”)

   Attitude toward science

Would you like to make any additional comments?

Thank you for your input!
Appendix N
Chemistry Legacy

Chemistry Legacy

TEACHER:

DESCRIPTION:

THINGS THAT MAKE THIS TEACHER ACT...

HAPPY

MAD

CRAZY

FUNNY
GENERAL ADVICE ON...

HOMEWORK

STUDYING

TESTS

LABS

FAVORITE

WORST

MEMORABLE MOMENTS

WORST MOMENT

HELPFUL HINTS
DESCRIBE THE YEAR OVERALL

OTHER COMMENTS OR ADVICE YOU WOULD LIKE TO OFFER: