EDUCATIONAL SERVICE DISTRICT 112

THE SUSTAINABLE CLASSROOM PROJECT

Middle School Case Study: Dianne

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About Dianne

Dianne has been teaching elementary level students for 16 years. She has an undergraduate Bachelor of Science degree in elementary education from George Fox University and a Master's Degree from City University in Educational Technology. Dianne has set a goal to complete a National Teacher Certification Program within the next two years.

Dianne was an early adopter of technology in her own classroom and a regional leader in thinking about the best strategies for using technology to enhance student learning. She began using technology to enhance her teaching in the early 1980's. Dianne wrote:

> *I had the privilege of being introduced to computers with the Apple IIe in the early 1980s. It was love at first sight. I spent hours of my personal time learning everything possible about how it worked and learning how to use the instructional software purchased by our district. In the beginning, I was frustrated with drill and practice software. It seemed to take a powerful tool and make it powerless. I searched for something better and found word processing, databases, and the LOGO programming language and began to imagine that computers would be a valuable learning tool.*

While she was teaching at the primary level, her classroom technology included four computers with Internet access. Her students took virtual fieldtrips on the Internet to places like Betsy Ross's house, took Accelerated Reader Tests on the computers, used Kidspiration to retell stories with words and pictures for reading practice, created geometric shapes with LOGO, and learned keyboarding.

Early in her career, Dianne taught Title I students with computers supplied to her classroom by an Educational Service District that serviced the school in which she taught. "Most of the software," she said, "was drill and practice and the data we collected showed this intervention to be ineffective." Later, Dianne worked as a computer consultant with an Educational Service District in Oregon. Her duties included maintaining a software library, working with districts that were struggling with how to use technology in classrooms, and training teachers to use software. About that experience, she wrote: "It was rewarding to participate in the debate regarding meaningful use of technology in classrooms and bring a vision that went beyond drilling students to engaging students."

For the past 4 years, Dianne has taught 6-8th grade mathematics, science, and geography in a tiny, K-8 school district located in heavily forested mountains near Mt. Saint Helens in southwest Washington. Before becoming a participant in the Sustainable Classroom Project, Dianne's classroom technology included a laptop computer, projector, document camera, inkjet printers, and eight desktop computer stations. In addition to word processing most of their writing projects and using the computer software that came with science FOSS kits, her students created PowerPoint presentations to demonstrate and share learning; kept track of their grades with Excel; and, researched topics, took virtual fieldtrips, studied math with virtual manipulatives and learned skills via tutorials on the Internet.

Dianne reported she likes to learn to use technology by "trial and error." She wrote, "When I learn new software, I like to try every menu choice and see what it does." Over the years, she said she has learned to save time by using the software Help sections and consulting with others who might have answers to the problems encountered. As well, Dianne has attended training workshops on such programs as Marco Polo, Website in a Week, Microsoft Office and FrontPage, Dreamweaver and PhotoShop. In addition to facilitating student-directed use of technology, Dianne has regularly used Inspiration, Tangible Math, self-created PowerPoint presentations, and a document camera for teacher-directed lessons. She creates and stores her lesson plans in a Microsoft Word table template, and uses Grade Quick software for grade recordkeeping and publishing report cards.

Dianne's Classroom

Introduction

Even though Dianne was a skillful user of technology in the classroom and had read *Classroom Instruction That Works* (Marzano, Pickering and Pollock, 2001) during her Master's Degree program, she said she wanted to participate in the Sustainable Classroom Project because "…I love using technology, desire to develop effective methods for increasing student learning in my classroom, and need to be part of a learning community." She continued, "I have found that I benefit greatly from opportunities where I interact with other teachers…"

During the first year of the Sustainable Classroom Project, Dianne taught mathematics, science, geography, and computers to all forty-one students in Grades 6-8 in the school. When the school year began, 34% of her students were eleven years old, 22% were twelve years old, and 44% were thirteen years old. There were slightly more males (56%) than females (44%).

The Book Study

Chapter 1: Beginning the Study

Dianne began the project with great enthusiasm and high hopes. "I am so excited!" She wrote. "I applied for a grant and was selected! They are putting $12,000 worth of technology into my classroom! It is a dream come true." She expanded her thoughts:

> *I see so much potential in this technology. Designing quality lessons is much easier than it is with Power Point even. These lessons can be made to be very interactive. Students have the opportunity to give me feedback through [wireless response systems]. They work like the audience voting on "Who Wants to be a Millionaire." I think they will be a powerful tool for me to use to get immediate feedback from my students and give them a place to take risks without repercussion in their learning process.*

After reading the first chapter in *Classroom Instruction That Works*, Dianne journaled:

> *I have read the first chapter in our book study and one idea hit me right between the eyes. The teaching profession really is different than when we were educated in the 1970's. In fact,*

research at that time said that student achievement was tied to factors that are outside the influence of teachers and schools. I don't think I ever believed that. But later, researchers found just the opposite. A good teacher can make a difference in student achievement. In my inner self, I know instinctively that the latter is true.

INSTRUCTIONAL STRATEGY 1: SIMILARITIES AND DIFFERENCES

Unit Topic: 5-7th Grade Mathematics – Prime Factorization
Technology Used: Interactive whiteboard, document camera, wireless response system

In the second week of the project, Dianne read *Chapter 2: Similarities and Differences* and wrote, "I've read another chapter of Marzano's book. He discusses the use of identifying similarities and differences to increase student learning." She continued:

> *...I believe more firmly that a simple activity which encourages and provides tools for students to think, process, and draw conclusions leads to increased learning. These concepts can range from incredibly simple all the way to very complex.... Today I realized that students would be able to increase their understanding of Vitamins C and D by organizing what they have learned in a Venn diagram and purposely thinking about the similarities and differences.*

For the instructional strategy, *Similarities and Differences*, Dianne devised an experimental lesson on prime factorization for her 5^{th} –7^{th} grade mathematics students. Her goal was that the students would recognize when all numbers in a factor string were prime and that the students would be able to use the factor string to determine the lowest common denominator and the greatest common denominator.

The external observer sat in on one class period and reported the following:

Observation #1

Dianne's classroom was observed on November 3, 2005. The lesson observed was a first period (8:30 a.m.) 6^{th} grade math class. Eighteen students sat at clusters of tables in the room. The one computer in the classroom was used by the teacher in conjunction with a document camera, projector, interactive whiteboard, wireless response system, and classroom sound system.

The period began with the teacher going through homework with students and students volunteering responses to homework. To begin the lesson of the day the teacher pointing out the terms "unique" and "common" which were written on the interactive whiteboard. She distinguished between them by pointing at pictures of animals (also on the whiteboard) that were common or unique to the Pacific Northwest and made an analogy to unique and common numbers – 1 is unique, 2 is the only even prime number, etc.

A picture of a traffic light with green, red, and yellow lights was displayed on the whiteboard and used as a metaphor for prime (red), composite (green), and not sure if prime or composite (yellow). In keeping with the metaphor, the teacher provided students with strings of numbers and instructed students to use red, green, or yellow papers to designate the types of numbers in the string. She set the clock on the interactive whiteboard to limit the time for students to work on the exercise. Students worked at their tables with others to discuss which category each number would fit. Student used calculators to check numbers to be sure they got correct answers.

Students took turns writing factor strings on the interactive whiteboard in designated squares and were asked relevant questions by the teacher. Students commented on problems with the "board" recognizing some writing and adapted their writing techniques to be recognized by the interactive whiteboard recognition software.

> The wireless response system was used to check students' understanding of the different categories of numbers – unique or common. About 50% of students were still unsure of categories.

Dianne reported the results of her first experimental lesson. She wrote, "I taught my students prime factorization this week using a totally new approach that incorporated metaphors, similarities, and the technology. I am not sure who learned more, them or me." She went on to describe her lesson:

> *When I have taught this concept in the past, students have always seemed so confused. I used a teacher given metaphor "unique is to prime factorization as common is to composite numbers." To assist students with actually finding a prime factorization I paired red (stop) with prime numbers, green (go) with composite numbers, and yellow (caution) with not too sure. Instead of starting with pencil and paper, I used square blocks of construction paper that could be written on with markers. The unique-common metaphor was not as successful as I would have liked for students making connections, but it was successful in making them think.*
>
> *The red-green-yellow was very successful in helping students process prime and composite and helping them know when to stop. It also gave me excellent feedback regarding their understanding of prime and composite. I demonstrated construction paper factorization with the document camera....Finding greatest common factor was easy. We moved highlighted numbers on the [interactive whiteboard] to show matches. Then we had an excellent graphic that showed what was left to be added to find least common multiple.*

In her lesson analysis, Dianne wrote:

> *I felt that all students got it the first time. Students were able to factor small numbers. What I learned is that the reason students have trouble understanding factorization is they have a hard time seeing part to whole and finding the individual factors in the factorization string when they are combined like 2 x 3 = 6. They must be able to do this to take the next step and use the string to find the [lowest common denominator] and [greatest common denominator]. Using the [wireless response] system to ask students to vote at regular intervals really helped me to see that they just weren't getting it. This feedback led me to continue cycling through the same material in a different way. I believe they went into subsequent lessons with a much better foundation.*

Dianne summarized the lesson, saying, "I spent a lot of time thinking about this lesson and challenging myself to teach in a different way. It was exciting and I feel productive."

In using the wireless response system to evaluate the lesson:

- 71% of the students in Dianne's classes voted that they totally or mostly understood the lesson ideas;
- 62% indicated that they thought the instructional strategy absolutely or mostly helped them understand the ideas;
- 62% thought the technology absolutely or mostly helped them understand the lesson ideas; and
- 65% absolutely or mostly liked the way they learned the lesson.

INSTRUCTIONAL STRATEGY 2: SUMMARIZING AND NOTE-TAKING

Unit Topic: 5th - 7th Grade Mathematics – Finding Slope and Writing Equations
Technology Used: Interactive whiteboard, document camera, wireless response system

After reading *Chapter 3: Summarizing and Note-Taking*, Dianne wrote, "I am now ready to tackle the dreaded math word problem again this year. My new ammunition is called the problem/solution frame." She wrote in her first journal for the chapter:

> *I may actually have to start with a rule-based frame, so that students with reading comprehension struggles can understand the problem before they start to solve it. I have already been working on empowering students to complete something at home, even if it is simply restating the problem in their own words and documenting one solution....I do believe teaching these frameworks will make this homework policy more successful ...I'm going to use the document camera to display student attempts at word problem solution and at note taking to encourage students to compare their work and have meaningful discussions*

Dianne's goal was for students to know the terms: slope, y-intercept, positive slope, and negative slope. She also wanted them to understand combination note-taking skills and experience reciprocal teaching practice. She described the lesson:

> *I chose two students to summarize about a page of reading in our math book. These pages described how to find slope and explained positive slope and negative slope. Each student leader was given 30 minutes to prepare an [interactive whiteboard] presentation and two [wireless response system] questions. This was the summarizing and questioning stage. Each led a discussion to clarify any confusion. Prediction didn't really fit this situation, so I gave students some time to summarize their learning using a combination technique for note taking. I gave students the learning goal. On one side, they summarized in writing using key words and ideas. On the other, I encouraged them to use pictures, charts, symbols, graphs, or whatever to demonstrate their understanding of the key ideas. I also encouraged them to make text-to-text, text to self, and text to world connections. They picked up their pencils immediately and used the time completely to create their own set of notes. Most students demonstrated understanding and made some meaningful connections. One student wrote notes about the note taking process and didn't seem to understand how that was different from what I asked. Several students created images or metaphors to use for memory and understanding that were unique, but accurate.*

In evaluating the lesson, Dianne wrote:

> *I felt that students enjoyed the lesson and created a good set of notes. Their feedback also indicated this. [The two selected students] enjoyed their roles as student leaders and other students were willing to learn from them....I am happy with this lesson. I feel that all of the strategies: reciprocal reading, combination note-taking, [interactive whiteboard] use and [wireless response system] use, increased student attention, learning, and enjoyment.*

Student evaluations of the use of technology in the lesson indicated that:

- 93% said they absolutely or mostly understood the lesson ideas;
- 87% said the instructional strategy absolutely or mostly helped them understand the lesson ideas;
- 80% believed the technology absolutely or mostly helped them understand the lesson ideas; and
- 87% absolutely or mostly liked how they learned the lesson.

INSTRUCTIONAL STRATEGY 3: REINFORCING EFFORT AND PROVIDING RECOGNITION

Unit Topic: 5th–7th Grade Geography – Locating Geographic Features on a Map
Technology Used: Interactive whiteboard, wireless response system

"Reviewing classroom policies regarding recognition of achievement is always valuable," Dianne wrote after reading *Chapter 4: Reinforcing Effort and Providing Recognition.* "It is important to me mostly to keep it simple." She continued:

> *As a primary teacher, I came to the conclusion that stickers and other trinkets were not that rewarding....And I still believe that grades should be a motivator for students....I have*

> *purposely structured my system to reward effort, attendance, and learning achievement. But, I have that 'giving up' problem with some students. I'm going to try giving a tangible reward for an excellent product on an upcoming map project that is particularly tedious to see if more students overcome challenges.*

Dianne's goal for the lesson was that students would be able to locate and label geographic features on a map. As well, they will be able to spell the features. Finally, she wanted them to increase their performance level by practice lettering and shading and improve their skills in outlining and shading of maps. Dianne began the lesson by using the wireless response system to pre-assess student knowledge then, she led a whole class activity in which students in created an assessment rubric on the interactive whiteboard. At this point, Dianne gave the students an assignment to complete a map and told them there would be a reward for students who achieve 100% score on the rubric. Once students had completed their maps, they evaluated their own map and another student's map using the rubric. Finally, Dianne gave a post-assessment using the wireless response system.

Dianne was pleased with student achievement. She noted, "I believe using a student-made rubric and student peer evaluation for this project increased overall student performance and learning." She continued:

> *I don't think chocolate was a motivator, but students did feel rewarded for hard work. Recognition in the form of displaying excellent products seemed to be more rewarding. Peer review of the product before grading was also motivational. Many students used the feedback to improve their product before I graded it.*

Student evaluation of the lesson indicated:

- 86% absolutely or mostly understood the key lesson ideas;
- 59% believed the instructional strategy they used absolutely or mostly helped them understand the ideas;
- 64% believed the technology absolutely or mostly helped them understand the lesson ideas; and
- 77% absolutely or mostly liked how they learned the lesson.

INSTRUCTIONAL STRATEGY 4: HOMEWORK AND PRACTICE

Unit Topic: Study Skills – Completing Homework
Technology Used: interactive whiteboard, wireless response system

Dianne was comfortable with what she read in *Chapter 5: Homework and Practice*. She reflected, "In reading Marzano's comments regarding homework, I find that my practices are very much in line with what he believes to be effective. I like my homework policy this year and am receiving most work on time very consistently." She did note one problem area, however:

> *There is one problem. It is in math. Students who are well prepared will not take the risk of solving problems on their own or use the "tutorial" lifeline by writing problems in their own words. For some of the 8th grade students, I think it may be reading comprehension that is really keeping them from trying. I want to work on this. If they will not attempt a solution, they will not learn what I need them to learn. These students see themselves as students who don't get math and yet they share profound comments during class. I want them to attempt every problem and I want their homework to reflect their skill level.*

The goal Dianne developed for her study skills lesson was for students to complete every homework assignment within the given guidelines. She wanted her students to learn to review assigned homework and clarify questions. As well, she wanted them to use the Phone-a-Friend Lifeline and Tutoring Lifeline tools she had provided effectively and to eliminate the need for Organization Lifeline (detention). The lesson began with Dianne asking a question about who the students did their homework for – themselves, their parents, or their teacher. Students responded using the wireless response system. Then she reviewed the lifeline tools she had set up for homework. Because she assessed that lack of knowledge of vocabulary was impeding student completion of math homework, Dianne wrote

math questions on the interactive whiteboard and led the students in an analysis of the words used in the story problem.

Dianne reported her analysis of the results in her journal:

> *Math students have turned in two homework assignments and taken two [wireless response] surveys designed to help them compare the standards set to their actual performance. Students have responded with sincerity and a renewed commitment to meeting the standards. It will take more time and data to draw any conclusions, but I am hopeful. I believe students feel better equipped to meet these challenges.*
>
> *I underestimate the power of having a middle school student evaluate his or her own performance against a standard. I feel that students have been more honest with me after reflecting on what they were able to do. Some are being very honest about needing more help and are communicating more clearly what they do understand as well. I am convinced that using a [wireless response] quiz to reflect on past performance will lead to more aggressive tackling of difficult homework in the future. We will see.*

Student evaluation of the lesson indicated that:

- 90% absolutely or mostly understood the lesson ideas;
- 89% believed the instructional strategies absolutely or mostly helped them understand the ideas;
- 100% thought the technology absolutely or mostly helped them understand the lesson ideas; and
- 90% absolutely or mostly liked the lesson.

INSTRUCTIONAL STRATEGY 5: NONLINGUISTIC REPRESENTATIONS

Unit Topic: Geography – Test Review
Technology Used: interactive whiteboard, wireless response system

The lesson Dianne applied for the instructional strategy, *Nonlinguistic Representations*, was a geography review. The goals for the lesson were that students would learn how to study for a test, be able to accurately assess their current level of learning, and make realistic plans for studying at home at night. Dianne developed a game modeled on "Who Wants to be a Millionaire" in which students role-played contestants, hosts/hostesses, and audience. In preparation, the students developed a U.S. map with place names and locations of 91 cities, physical features, etc. The map with 20 locations was displayed on the interactive whiteboard. Students played the game the day before their geography test. The "audience" used the wireless response system to register their responses to each question.

In her analysis of the lesson, Dianne observed in her journal:

> *During the activity, students were very engaged and enjoyed playing the roles. The audience used the [wireless response system] to register their responses to every question. I believed this would increase their engagement and their learning. I was also able to tell each student his or her percent correct. This hopefully would make them aware of whether or not they were ready for the test. Students did indicate in the follow up survey that they enjoyed this activity very much. They also indicated that it was a useful learning tool. Scores on the test reflected students who were prepared.*

Student evaluation of the lesson indicated that:

- 88% of the students said they absolutely or mostly understood the lesson ideas;
- 82% believed the instructional strategy absolutely or mostly helped them understand the ideas;
- 88% believed the technology absolutely or mostly helped them understand the lesson ideas; and
- 76% absolutely or mostly liked the way they learned the lesson.

INSTRUCTIONAL STRATEGY 6:
COOPERATIVE LEARNING

Unit Topic: 8th Grade Geography/Science – Visibility of Objects at Increasing Elevations
Technology Used: Interactive whiteboard, wireless response system

Chapter 7: Cooperative Learning was a familiar strategy for Dianne. She was able to add caveats to those found in the text. She noted:

> *Cooperative learning is a unique and useful tool. It isn't always the best tool for student learning, but can be quite effective....This book discusses group size, composition, and frequency. These are important, but equally important is having the right kind of problem and setting the scene. Students must be presented with a question, scenario, or problem that is engaging. Then there must be an activity that sets the stage and gets the creative juices flowing. Students must be given problems that require tools that they already own in their tool belts. It seems that one of the challenges then is letting go and letting students struggle with the problem in their own unique ways and yet control the outcome so that your learning objectives are accomplished.*

The goal of the cooperative learning lesson Dianne developed was that students would understand how visibility and resolution of images of man-made and natural structures change with increasing elevation. She wanted the students to be able to use knowledge and landmarks to identify familiar places on aerial and satellite photos. She wanted them to know that as elevation increases, human-made structures disappear and to reflect on the relationship of powers of ten.

The external observer watched the second class period of the lesson:

Observation #2:

The second observation in Dianne's classroom took place on March 1, 2006 at 9:30 a.m. Dianne used cooperative learning strategies discussed in Chapter 7 of *Classroom Instruction That Works* (Marzano et al) to teach a lesson on 'Visibility of Objects from Increasing Elevations' to her 8th grade Science/Geography class. The sixteen students (6 boys, 10 girls) sat at desks some pushed together with another one and a few sitting apart. The interactive whiteboard, wireless response system, whiteboard, and classroom sound system were used during the lesson.

Dianne began the class by reminding the students of the lesson from the day before on elevations and comparing the elevations (in meters) to distances of local and regional cities from their school to give students a concrete idea of the elevations. Students paid attention.

Dianne displayed the notes for her mini-lecture on the interactive whiteboard and talked through them while the students listened. For further understanding, she showed slides of pictures and structures to provide nonverbal representations of the concepts and ideas.

Following the mini-lecture, Dianne told students they had 3 minutes to divide into groups of three (one 4). The students negotiated groupings. Dianne, then, assigned each group a particular elevation and gave each group one task sheet, a packet of photos and an evaluation rubric. Using the document camera, Dianne oriented students by going through the contents of the packets – aerial photos, Google satellite maps, transparency grids, etc.
She told students to select one of the three tasks from the sheet that they were most responsible for (assigned roles): The Who Person (the person who took the picture, what tools were needed to take the picture, etc.); The Linear Relationship Person (the person that identified what could be said about the relationship between the elevation and such things as resolution); and The Recorder (the person that determines what goes on the chart for the group presentation at the interactive whiteboard).

> Students began working through the tasks, collectively looking at the materials and discussing each of the questions. They were engaged in the materials and the process. Dianne went from group to group listening to the students, asking analytical questions, and assisting as needed.
>
> When each group completed their tasks, Dianne explained the charting process and the group Recorders began recording their group's notes into the grid displayed on the interactive whiteboard. The other members of the groups worked individually to prepare their own presentations. Dianne went from person to person and gave them tips for presenting their information so they would meet the highest levels of the evaluation rubric. Finally, Dianne described how the presentations would take place the next day.
>
> Summary of cooperative learning strategies in lesson: groups self-selected, one information packet per group, individual roles assigned, individual accountability for all information.

During the third day of the lesson, students selected any technology they wished and made presentations to the rest of the class. Students had been given a rubric for their presentations so the 'audience' used the wireless response system to rate each presentation using the rubric. Students took a short quiz at the end.

Dianne evaluated the lesson in terms of both the instructional strategy and the technology. She reported, "Students enjoyed and demonstrated that they learned from the cooperative learning lesson." Continuing to evaluate, Dianne wrote:

> *...Quiz results showed that students had a clear understanding of the learning objectives. Survey results indicated that almost all students thoroughly enjoyed the lesson and learned from it with mostly A's and B's....I would use this lesson again. I enjoyed teaching it. The work for me was in preparation, but it wasn't that overwhelming....Each presentation clearly showed understanding of the elevation they were representing. This lesson was rewarding.*

When the students evaluated the lesson:

- 94% believed they absolutely or mostly learned the key ideas in the lesson;
- 94% thought the instructional strategy absolutely or mostly helped them learn the lesson ideas;
- 94% thought the technology absolutely or mostly helped them understand the lesson ideas; and
- 94% absolutely or mostly like the way they learned the lesson.

INSTRUCTIONAL STRATEGY 7: SETTING OBJECTIVES AND PROVIDING FEEDBACK

Unit Topic: Middle School Math – Solving Word Problems
Technology Used: Interactive whiteboard, wireless response system

Chapter 8: Setting Objectives and Providing Feedback provided Dianne with a challenge. She wrote:

> *This idea comes back to a common theme in my development as a teacher. How do we get students to take some ownership in their learning? How do we get them to set and achieve learning goals instead of performing for us to receive a grade? How does the teacher become a facilitator while students actively pursue their own learning?*

In terms of feedback, she observed, "He challenged me to think when he brought up student-led feedback. I can't think of an instance where one student has asked another for feedback on a project. ...In conclusion," Dianne continued:

> *I would like to address two new areas in my classroom. They are students making learning objectives their own and students asking other students for feedback. I honestly am struggling with how to do this with students. I'm going to do some research and see if I can get some ideas before*

> *I try to invent my own. I would like to encourage students to use the [wireless response] system in asking for feedback from their peers. It seems that as I learn more about teaching and learning my role always shifts to doing less of the actual assessment of student work. If a student participates in a lesson, he covers the material once. If he completes an activity, he covers the material twice. If he evaluates someone else's product, he has seen the material three times and made some decisions about what fits and what doesn't. This student has to learn more.*

The goal for the experimental lesson was for students to recognize which math skills and strategies are useful to solve a particular problem and explain why their solution makes sense. If they are unable to solve it, explain their current thinking and ask questions of the class to clarify their thinking. Dianne began the lesson by reviewing a problem-solving method and related rubric, then she assigned a Washington Assessment of Student Learning (WASL) question card to each student and assigned them to solve a problem and prepare a presentation for the class that included two audience questions to get feedback on success. Dianne circulated among students and assisted them as needed during the problem-solving phase.

She described the lesson below:

> *Unfortunately, I planned to use this lesson with my 7th grade class of only seven students and two were absent today. So, I went forward with an extremely manageable five. Students understood the task well and went right to work solving their problems and preparing their presentations. They were able to solve this set of problems with very little teacher help. These first presentations took longer than I expected, as students were a bit clumsy with the technology and only three of the five students presented....Students were attentive to each other and presentations were generally good. There were some unique, but accurate solutions to problems and all of these students solved their problems correctly.*

Dianne reflected:

> *These students assumed the role of teacher. I found their [wireless response system] questions simpler than I would have liked. They mimicked me and gave a pretest, made their presentation, and gave a posttest. I was hoping they would ask if we believed they were correct in their thinking or would ask a question that would extend the lesson to another situation. These students knew how to solve the problems they were given.*

She set some goals for future lessons:

> *I want students to feel comfortable with putting their thoughts out there, even if they are not sure and asking for feedback. I want to work on this more. I would like to give some more guidelines for questions the next time I do this activity. I'm toying with the idea of making the presentation like a "Truth or Dare" type game. You can either tell us a real solution or try to trick us into believing a false solution. I think this might get students to try even if they are not sure without having to say, "I don't know how to do this problem....I don't think a student asking for self-feedback is an event. It's more like a journey. I would like to continue down this road for a while to see if students will more freely take risks when solving math word problems before asking for clarification (i.e. I don't get it. I couldn't do any of my math.).*

In the student evaluation of the lesson:

- 80% thought they absolutely or mostly learned the lesson ideas;
- 80% thought the instructional strategy absolutely or mostly helped them learn the ideas;
- 100% thought the technology absolutely or mostly helped them learn the lesson ideas; and
- 80% absolutely or mostly liked the way they learned the lesson.

INSTRUCTIONAL STRATEGY 8:
GENERATING AND TESTING HYPOTHESES

Unit Topic: Middle School Geography – Geography of South America
Technology Used: interactive whiteboard, document camera, wireless response system

As she read and thought about *Chapter 9: Generating and Testing Hypotheses,* Dianne mused, "It is a reality that my middle school students balk at creating one possible solution, let alone two, three, or more. I can see them rolling their eyes when asked to test and prove which solution is most accurate." She resolved, "So, in this lesson my goal will be that students decide on at least two ways to solve a problem and prove whether neither works, or one is better, or both are equal and defend their decision."

The goal for the lesson was for students to be able to write hypotheses regarding the geography of South America and its relationship to culture, climate, and natural resources using several maps.
The outside observer was invited in to watch the first day of this lesson.

Observation #3:

Dianne's classroom was observed for the third time on a beautiful, sunny spring day at 1:45 p.m. on April 24th, 2006. Fifteen 6th – 8th grade students (13 boys and 2 girls) sat at desks arranged in vertical rows. The wireless response system, interactive whiteboard, world atlases and worksheets were used during the lesson.

The lesson began with Dianne instructing students on what materials and tools they would need for the lesson. Students picked up their wireless response system and returned to their seats. The teacher then introduced the study by reminding students of a previous study they had undertaken several weeks previously. The students listened attentively. Dianne proceeded by introducing the term "hypothesis" and describing their task for the day. Students were asked to open their world atlases to a map of South America. Using the document camera, Dianne displayed the map of South America and asked students what they could learn from this map and the reference keys to the map. Students offered a variety of responses. Displaying a vegetation map, she asked students what statements they could make about vegetation in South America by looking at the map. Students offered their observations and hypotheses. Dianne then displayed a map of South America depicting GNP and asked students the same questions. After students had responded, she displayed a population map and modeled a thought process for hypothesis formation, relating the hypotheses to the students' observations about the vegetation map. Students then suggested hypotheses about the relationship of vegetation to population areas.

Finally, using the document camera, Dianne displayed a climate map and charts of high and low temperatures in South America on the whiteboard and discussed the impact of the high and low temperatures in Washington state on local life styles to be sure students understood the relationships. Following the discussion, students began working in small groups examining the maps of South America and generating three hypotheses about a possible relationship existing between the geography of South America and the climate, culture, and/or natural resources.

Dianne circulated from group to group working with them to formulate and write hypotheses on their worksheets. After 10-15 minutes, she asked students to share the hypotheses they had written thus far. Students volunteered and wrote their hypotheses on the interactive whiteboard.

When several hypotheses were written, the students used their wireless response systems to vote on whether they agreed or disagreed with the hypothesis being discussed. Each vote was followed by students explaining why they voted as they did using evidence from the maps of South America to justify their votes. The students were highly engaged in the process and discussion. Dianne probed the students' thinking and pointed out information on relevant maps. When it became apparent that a number of students had randomly selected agree or disagree with no apparent rational basis for their choice, Dianne wrote an alternative hypothesis to model effective

hypothesis formation, and asked students to look at climate and rainfall charts. Finally, she shared a hypothesis developed by a previous class and asked students to use it as a model. Students continued working individually to write hypotheses on their worksheets and turned them in.

To end the class, Dianne summarized the value of hypothesizing and gave students their assignments for the rest of the project.

Dianne was not happy with the results of the lesson. She wrote in her journal, "I feel like this strategy is extremely powerful and I feel like this lesson did not accomplish the objectives." But, she resolved, "I will use this lesson again with some changes." She analyzed:

> *Students writing hypotheses to discover new material was very challenging for me as a teacher. I am not convinced students were totally clear on what I wanted because it was such a new idea to me that I didn't know what I wanted. When I looked at hypotheses written by students, I liked those that put information from two maps together. For example, "Central Brazil has a small population because it is not near the ocean where it is easy to trade and you can make a living fishing." Another example of this category is; "I think that the southern tip of South America is cold because it is close to Antarctica." I gave this type a category "R" rating for researchable. I gave an "O" rating to hypotheses that restated what was obvious from one map. For example, "Argentina makes the most money because it is green" or "I think that most people lived by the ocean because all of the heavily populated areas are by the ocean." And last, I gave hypotheses a rating of "N" if it was about a topic not represented in the maps. "I think the more dominant languages erased smaller ones because almost all of the countries know Spanish." 41% of the hypotheses restated the obvious, 2% were not based on the maps and 57% were researchable. I really didn't know what I wanted until I looked at what students had done. When I do this again, I will have lots of examples of hypotheses and a rubric for students to use as a test. The goal will be for each student to write one excellent hypotheses.*

On a positive note, Dianne observed, "This lesson was extremely successful in encouraging students to think beyond simply placing locations on a map. I believe they did some awesome thinking about what the geography looked like and how that affected the people who lived there. It is excellent for introducing an area of the world."

Student evaluations of the lesson, completed the next day, indicated that:

- 93% believed they absolutely or mostly learned the key ideas in the lesson;
- 87% thought the instructional strategy absolutely or mostly helped them learn the ideas;
- 67% believed the technology absolutely or mostly helped them learn the lesson ideas; and
- 43% absolutely or mostly liked the lesson.

INSTRUCTIONAL STRATEGY 9: CUES, QUESTIONS AND ADVANCE ORGANIZERS

Unit Topic: Middle School Science – Time and Rotation of the Earth
Technology Used: Interactive whiteboard, wireless response system

"I know the strategies in this chapter are effective in increasing student learning and motivation," Dianne wrote upon reading *Chapter 10: Cues, Questions and Advance Organizers*. She continued:

> *There were two thought-provoking ideas that jumped out at me. One was remembering to give plenty of wait time after a question is asked and the other was that cues and questions should focus on the important, not the unusual. First, the students in my 7th grade math class have become masters in their school career at letting others do the thinking. Thus, they have not mastered some very basic ideas and are unable to use them as building blocks to deeper math understanding. I often incorrectly assume they understand concepts that they do not. I can't forget to wait and let students really think about what I've asked. After all, if I've taken the time to ask a*

> *really good question, I need to allow all students time to form a really good answer. Second, I think I am guilty of attempting to engage students by pointing out the unusual and I agree that every word needs to be focused on the important. There have been many times I've given instructions and when I ask students to repeat my instructions, they actually repeat the opposite. It is so easy for students to be confused if I am not deliberate about what I am trying to teach and I don't reinforce it from many different angles.*

Her goal, in the experimental lesson was that her students would compare and contrast the relationship between clock time and the affects of the earth's rotation. She wanted them to know that 24 hours is the length of our clock day and one rotation of the earth and she wanted them to realize that 12 noon and local noon is usually not the same time and the middle of the night is not always midnight.

Dianne described her development of the experimental lesson:

> *Designing this lesson was extremely difficult for me. I was in the middle of designing it when I realized that I wasn't sure if students needed this lesson. Day and night happen to us everyday and it seems obvious that if day is 12 hours then night is 12 hours and if day is 15 hours, then night is 9 hours. The knowledge goals I set seemed too basic. I decided to design a [wireless response system] pretest to test their knowledge. The assessment had six questions. The results showed 42% of students received 100% and 14% received 83%, which I considered passing. Therefore, 56% of the students passed the assessment. The remaining 44% failed the test, 29% with a 67% and 14% with a 14%. In addition, students seemed to understand that 12:00 noon and local noon were at different times, but about 50% could not apply that idea to the nighttime and say that 12:00 midnight and the middle of the night are not at the same time. I decided that my class did need help processing this information and went ahead with the lesson.*

In her analysis she wrote, "I liked how I applied this strategy." Dianne related:

> *I used a graphic organizer that I designed using Inspiration to review and summarize what students already knew about noon and local noon and applied it to midnight and middle of the night (elapsed time from sunset to sunrise/2 and added to sunset time). Then students added the elapsed time (day) to the elapsed time (night) and discovered that it added up to 24 hours. We also discussed whether all days and nights were the same length all year.*

In terms of questioning, Dianne recounted:

> *I....liked starting with a question that could be answered and interpreted in lots of ways. It stimulated discussion that helped students refine their own thinking. Completing the graphic organizer required that students write a one sentence conclusion (answer) to the original question.*

Finally, in terms of the overall lesson, she noted:

> *These conclusions were shared using a combination of symbols and words on the [interactive whiteboard]. All three learning goals were shared as conclusions by at least one student. I liked the combination of words and symbols in sharing conclusions because it forced students to use the vocabulary I was targeting, it focused student thinking on conclusions, and it was very time efficient.*

Student evaluation of the lesson indicated that:

- 81% believed they had absolutely or mostly learned the lesson ideas;
- 63% thought the instructional strategy had absolutely or mostly helped them learn the ideas;
- 81% thought the technology absolutely or mostly helped them learn the ideas; and
- 63% absolutely or mostly liked the way they learned the lesson.

CHAPTERS ELEVEN AND TWELVE: COMPLETING THE STUDY

Chapter 11 was especially meaningful to Dianne. "This chapter is fantastic," she wrote. "I learn anew several times a year that what is simple works."

> *This chapter affirms that it is worth the time it takes to teach vocabulary. I often get discouraged with this task. It seems too simple. I shouldn't waste time focusing on vocabulary. This research states the opposite. And it even tells me how to do this effectively. I will definitely be more focused in teaching vocabulary and using these methods.*

In summarizing her yearlong experimentation with the wireless response system, Dianne said, "Using [the wireless response system] during this school year I have gained a whole new appreciation for that fact that teaching does not necessarily equal learning....I understand that students must be able to state and support ideas. I think this is a tedious part of learning for students."

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