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ABSTRACT

This report describes a program for improving the retention of science concepts and motivation through the use of technology. The targeted population consisted of seventh grade students in a suburb of a large Midwestern city. The problem, due to lack of access to technology, was documented through student surveys, teacher observation, previous test scores, and IGAP science and vocabulary scores. Analysis of probable causes revealed that students do not have adequate access to technology due to funding, reluctant teachers, and the configuration of the existing technology in the school. A review of literature reports on the poor performance of students in science, and the reluctance of teachers with the implementation of technology. Solution strategies suggest funding technology in schools and giving adequate time and training to teachers. There are numerous documented examples of the benefit that students have experienced as a result of using technology. Post intervention data indicated a slight increase in average test scores for those students who used technology. Students expressed a desire to use technology over the traditional hands-on science activities. Teacher observations indicated an increase in student motivation and time on task with the use of technology. Appendices include the student survey and results, the Scientific Method Test #1, and the Cell Test. (Contains 25 references.) (Author/AEF)

IMPROVING STUDENT RETENTION THROUGH THE USE OF TECHNOLOGY

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ABSTRACT

This report describes a program for improving the retention of science concepts and motivation through the use of technology. The targeted population consists of seventh grade students in an established suburb in a large Midwestern city. The problem, due to lack of access to technology, was documented through student surveys, teacher observation, previous test scores and IGAP science and vocabulary scores.

Analysis of probable causes revealed that students do not have adequate access to technology due to funding, reluctant teachers and the configuration of the existing technology in the school. A review of literature reports the poor performance of students in science, and the reluctance of teachers with the implementation of technology.

Solution strategies suggest funding technology in schools and giving adequate time and training to teachers. There are numerous documented examples of the benefit that students have experienced as a result of using technology.

Post intervention data indicated a slight increase in average test score for those students who used technology. Students expressed a desire to use technology over the traditional hands-on science activities. Teacher observations indicated an increase in student motivation and time on task with the use of technology.

TABLE OF CONTENTS

CHAPTER 1

PROBLEM STATEMENT AND CONTEXT

Problem Statement

The targeted group of seventh graders did not have adequate opportunities to use technology in science which resulted in lower retention of science concepts. Evidence of this problem was gathered from teacher observation, Illinois Goal Assessment Program (IGAP) concept and vocabulary scores and teacher assessment.

Local Setting

The school has an enrollment of 540 students in grades seven and eight. The breakdown of the student population is 80% White, 14.3% Mexican-American, 4.4% Asian/Pacific Islander, 1.0% Black and 0.4% Native American. The number of low-income students at the school has nearly doubled from last year's 12.8% to 24.1%. Nine point six percent of the student body are eligible for bilingual education and approximately 12% have an active Individual Education Program(I.E.P.). This school has an attendance rate of 94.5% with a 12.4% student mobility rate. Truancy has not been an issue as the truancy rate is only .8%.

The staff consists of 40 teachers, two administrators, two student advisors, three teacher aides, a speech therapist, two social workers and nine support staff including custodians, secretaries and a school nurse. The staff is 100% White, 59% are female and 41% are male. Most staff members are in their mid-forties. The teachers, on average, have taught 18.7 years and make $55,600. Seventy percent of the staff holds a Master's Degree, 28% have a Bachelor's Degree and 2% have their Doctorate. The average class size at the school is 22 students.

The school is located in a northwest suburb of a large Midwestern city. It has twenty "traditional" classrooms and eleven special purpose classrooms which include the following: an art room, four science labs, a music room, a wood/metals shop, an industrial technology lab, a resource center, a video production lab, three computer labs and a home economics area. The building also has a gym with locker rooms and a multipurpose room which serves as an additional gym, a stage for assemblies and productions and a cafeteria. Outside, there is a 220 yard asphalt track, softball field and additional athletic field space. Over one half of the classrooms and hallways are carpeted. The remainder of the floors are tile and the entire school has been freshly painted.

As part of the district's plan to integrate technology, each classroom has recently been equipped with a 32" video monitor, VCR and multimedia computer. One of the computer labs has thirty computers hooked up to the Internet and about three-quarters of the classroom computers are connected to the Internet. As for the other two computer labs, one is mainly used for word processing and the other is a multimedia lab where students learn how to do presentations on ClarisWorks and Power Point.

Students are provided with a wide variety of classes and activities at the school. Seventh graders have the core math, biological science, geography, literature and composition classes with time in their daily schedule for physical education and two other enrichment classes. The choices for enrichment include French, Spanish, music, art, industrial technology, service learning and multimedia.

The life science curriculum is focused around the State Board of Education's Learning Standards. Seventh graders are exposed to the scientific method, cell biology, microscopes, genetics, biotechnology, human growth and development and body systems. Textbooks are no longer used for science in this district, but trade books are available for most of the lessons for background reading. A majority of the lessons, at the seventh grade level, are hands-on or activity based.

After school, students participate in interscholastic sports including boys' and girls' basketball, track, cross country, wrestling and volleyball. The school also offers an extensive intramural program that includes floor hockey, basketball, volleyball, golf, soccer, weight training and softball. Students not involved with athletics have an array of clubs in which they take part. Yearbook, math, radio, Odyssey of the Mind, multi-cultural, foreign language, homework, cheerleading and poms, are just a few of the clubs from which students have to choose. Student council, band, orchestra and chorus are also available to students. To increase student performance, both socially and academically, a number of programs have been established. The school has begun a peer mentoring program before and after school. The school also provides Harper College mentors, Northrup Engineer math tutors, the D.A.R.E. program and a grade level student advisor who helps to address personal needs.

Community Setting

The junior high is one of four in the district. There are also 15 elementary schools and one special education school that serves more than 12,000 students from seven surrounding communities. Seventy-four percent of the students in the district are White, 3.7% are Black, 14.3% are Mexican-American, 7.6% are Asian /Pacific Islander and 0.2% are Native American. There are 16.9% of the students that considered low-income and 13.2% are limited-English proficient.

The community surrounding the school has a population of over 23,000. According to the 1990 U.S. Census, 94% of the population was White, 2% was Asian or Pacific Islander, 2% was other and 1% was Black. Currently, AMS Homefinder(1997), reports that the age of the surrounding population is 23.1% at 0-17 years old, 68.9% at 17-65 years old and 8.0% at 65 years of age or older. The median household income is $45,746. There are 8,584 housing units available with 71.3% of those homes being owner occupied and 28.7% renter occupied. The median home value is $127,00, the median rent is $676 and median year the houses were built was 1966. Industry in the community is based on manufacturing(21.3%); retail trade(17.9%); finance, insurance, real estate(10.2%); wholesale trade(8.3%); and many other miscellaneous trades. The community is home to 11 parks, a nature preserve, a sports complex and community center.

National Context

There has been a tremendous movement in education for the last 20 years to integrate technology into the classroom.

Computer labs, TV monitors, VCRs and access to the Internet have been popping up in schools across the country. But, are students gaining access to these technologies enough to increase their performance?

The current state of technology varies from state to state. Funding is obviously a major concern in any district's plan for implementing technology. Even if districts can afford to bring technology into the classroom, it is hard to keep it up-to-date and provide equitable access to all of the students. What many schools try to do is to set up computer labs so whole classes can have access. But, the obvious concern with that is that not all classes can be using the computers at one time. Many times, it is on a first come first served basis. Other problems are that students tend to develop computer skills better when they learn them in regular classes and students do better when they have their own computer (Bulkeley, 1998). It makes good sense. Big corporations that focus on productivity do not have employees sharing computers, so why should we in our schools? The national ratio of computers to students is 11:1 and this does not take into account the fact that some computers in schools are extremely outdated (Gaines, Johnson, King, 1996). McKinney and Co., a New York management-consulting firm, estimates that to get the ratio down to 5:1 by 2005, it would cost the nation about $47 billion (Bulkeley, 1998). That is a huge price tag, but the benefits seem to be worth it.

When used effectively, most agree that technology motivates and empowers students and makes learning more fun and productive (Gaines et al., 1996). Students enjoy working on computers and making videos, etc., and probably do not think of it so much as work, but as play. Technology seems to be making its biggest impact with this kind of motivation. Jostens Learning Corporation and the American Association of School Administrators surveyed 1,000 teachers and superintendents and found that 61% said computers increased student motivation (Bulkeley, 1998). Special needs students really seem to benefit from the use of technology. In a study of twenty-five 14-15 year old remedial students and students with learning disabilities, it was found that students who used hypermedia study guides had better information retention than those students who did not use the guides (Higgins, Boone, Lovitt, 1996). Just the fact that these students were reading the information on a computer screen instead of a text book seemed to help them with retention. This use of technology is not only going to help in schools but it will help students as they enter the working world.

Students are going to need to have technology skills to get a job. Workers in just about every field will need technical skills in problem-solving, communication and production. The productivity and profit of a company will be tied to the ability of the employees to use new technologies effectively (Gaines et al., 1996). Therefore, it is going to be critical for education to provide up-to-date technology to all students if we are going to prepare them fully for the future. If we are going to give access to just a few, it will be those few who will be successful. The others will not have a equal chance.

The need to increase productivity in schools and prepare students for the working world has prompted our government to call for universal access to technology for all students. The Panel on Education Technology of the President's Committee of Advisors on Science and Technology (1997) recommended that access to knowledge-building and communication technologies be made available to all of our nations students, regardless of socioeconomic status, race, ethnicity, gender or geographical factors. They also felt that special attention should be given to those students with special needs. There are pitfalls to integrating technology into the schools. High cost, outdated equipment, reluctant teachers/administrators are just a few. But, even though access does not ensure increases in students' and teachers' productivity, it is a necessary prerequisite (Bain, 1996). This study will take a look at access to technology and the retention benefits it has on students who use it in the classroom.

CHAPTER 2

PROBLEM DOCUMENTATION

Documented evidence of the problem comes in the form of Illinois Goal Assessment Program (IGAP) data and a student survey. The student survey focused on the technology used by the students. The IGAP scores focused on the vocabulary and concept development of the students at the targeted site the previous three years.

Student surveys were given before the intervention began. The survey(see Appendix A) consists of five questions concerning the students' use of technology at school and at home.

Table 1 illustrates that 35% of students did not have any experiences with technology in science last year and 79% of students experienced technology less than three days a week. Only 9% of students personally used technology more than three days a week in science. Furthermore, 71% of students stated that they have access to a computer at home yet only 48% use them three or more days a week. When students were asked to indicate their top three uses of technology, the majority of responses (90 of 126 students) reported playing games, followed by the Internet, then word processing and research (for a complete breakdown of the student survey, see Appendix B).

Table 1

Results of student technology survey at target site

Question	Response (days/week) 0	1-2	3-5
1. Last year, how often was technology used in science class?	35%	44%	21%
2. Last year, how often did you personally use technology in science class?	48%	44%	9%

The science portion of the Illinois Goal Assessment Program is administered to the seventh grade students every year in the spring. The test consists of two 40 minute sessions with 40 multiple choice questions in each session.

Table 2 illustrates the science IGAP scores for the targeted site. An analysis of the IGAP science scores for the previous three years shows that Goal 1, concept and vocabulary, was consistently the lowest of the four science goals.

Table 2

Target Site Goal Scores from the IGAP Science Assessment

	Year		
IGAP Goal	1996	1997	1998
Goal 1: Concept and Vocabulary	257	270	271
Goal 2: Implications of Technology	273	294	285
Goal 3: Principles of Research	287	318	323
Goal 4: Techniques of Science	275	302	310

In conclusion, many of the students at the targeted site do not get adequate experiences with technology. This problem seems to be evident at the school and at home. When computers, one form of technology, are used, it was indicated that they are mainly used for playing games. Concept and vocabulary development is clearly a problem when you analyze the state standardized test scores. For the last three years, these scores have been the lowest of the four IGAP goals for the targeted site.

Probable Causes

Analysis of probable cause data indicates that students do not get adequate access to technology due to lack of money and reluctant staff members. Evidence of these probable causes was found at the targeted school and in the review of literature.

Inadequate Access to Technology

Science instruction at the targeted site has a very limited use of technology. The technology available in each lab includes one to two computers(of which one is connected to the Internet), optical microscopes, a 32" television monitor, VCR and a minimal amount of CD-roms and videotapes. The monitor is mainly used to monitor the one or two students who are on the Internet at a time. Most schools try to infuse technology into the curriculum by setting up computer labs (Bulkeley, 1998). Computer labs are a problem because they are usually on a first come first serve basis. A majority of the targeted school's computers can be found in three computer labs. One lab, with approximately 30 computers, consists of equipment that is so out-dated that they are only used for word processing. The second lab, also containing approximately 30 computers, is networked with the district and has the capabilities for research, word processing and some multimedia functions. The last lab is strictly a multimedia lab which has 12 computers. The first two labs are used on a first come first serve basis with priority given to those classes who are working on graduation requirements and/or School Improvement Plan curriculum. The School Improvement Plan is a set of assessments given to students each year to help track the students and teachers progress. Based on the size of the targeted site, there could be as many as 550 students trying to use these two labs at any one time. The last lab has enrichment classes scheduled in it for six of the 10 daily class periods. Therefore, it is only available to use during the remaining four periods. There is also a problem with computer memory in this lab, since six other classes have multimedia projects already saved on the computer.

Lack of Financial Support

The lack of funding for technology in schools is one of the main reasons science students do not have adequate access to computers. After Sputnik, the funding for the National Science Foundation (NSF) went from $18 million to $130 million. By 1982, the financing had dropped to zero for the NSF's education division. In 1990, the NSF was scheduled to receive $147 million earmarked for science and engineering education for K-12 (Dolan, 1989). If this money was divided equally among all schools throughout the country, and it was exclusively used for technology, it would still fall short of what is needed. One of the problems is that the costs do not end with just the purchase of a few computers. The three year cost for a multimedia computer/projection system would surpass the beginning purchase price when you add in software upgrades and technical assistance (Green & Gilbert, 1995). Even if the school can financially supply the appropriate technology, you need a willing staff to use what is given to them.

Reluctant Staff

A reluctant staff can take the best technology and make it useless. Many teachers at the targeted site are older and have had little previous experience with technology. They are at a very basic level of computer awareness and that frustrates and scares them away from learning and using computers in their classroom.

Nationally, technology has brought about change. Teachers feel safe and in control when teaching with traditional methods. When students work on computers, teachers can feel irrelevant as they may no longer be seen as the conveyor of all knowledge (Baston & Bass, 1996). A textbook and worksheets put the teacher in control and conveys the same information or facts year after year. If given technology to use, teachers will ask, "How can I cover my current syllabus with this new equipment?" They see the current teaching paradigm as an end in itself (Baston & Bass, 1996). It is difficult to let go of the traditional ways of teaching when there is such a reliance on standardized test scores, which tend to measure proficiency of basic facts, for how well a school is doing (Vogel, 1997).

Another reason staff may be reluctant to use technology is the time needed to learn how to use it effectively. Fulton (as cited in Hope, 1996) stated that teachers recognize the need for sufficient time to learn and plan the use of technology in their teaching (Hope, 1996). Districts need to provide the training and the staff needs to be given time to learn. The target district has provided classes for all members of the district. Over the last three years teachers who were involved in the district sponsored teacher buy program could take classes. In the district's computer buy program, teachers could purchase their computer after three years for market value if they have completed at least 60 hours of classes. The problem was that the district only offered training when they could find an "expert" in that specific technology. That "expert" is usually another teacher in the district. Another problem with these classes is that many of the teachers are at a very basic level when it comes to technology. Therefore, a majority of the class time is spent helping those teachers understand the basics instead of learning meaningful classroom applications. Thomas and Knezeh (1991) report that teachers are unlikely to develop and obtain the skills needed to use technology productively without significant learning engagements (Hope, 1996). McKinsey & Co., a New York management consulting firm, estimated that almost 50% of teachers have little training or experience with technology (Bulkeley, 1998). Time must also be allowed for the teacher to do other parts of their job such as: curriculum development, discipline, parent communication, and expanding on their own knowledge base.

Another reason that may add to the reluctant staff at the targeted site is the pressure put on teachers to use computers. Technological advances are occurring so quickly that it puts a lot of pressure on teachers to provide a quality of education to students who will need to use that technology in the workplace (Peralta, 1998). Many staff members are not responding to that pressure very well. According to Willis & Giannelli (as cited in Hope, 1996), putting pressure on teachers to use computers does not correspond with successful technology use (Hope, 1996). The pressure is also on when teachers are trying to learn and implement the wide configuration that technology can take. It is felt that teachers would embrace technology if it is not too complex (Bauchner et al., as cited in Hope, 1996).

Inadequate access, lack of finances and staff reluctance all contribute to the lack of access students have to technology. Evidence for this problem can be seen the student survey and observation of the targeted site. The lack of technology has hindered the retention of science vocabulary and concept scores as seen in the IGAP Science Assessment.

CHAPTER 3

THE SOLUTION STRATEGY

Literature Review

A review of the literature on technology revealed various ways technology could be used to benefit student performance in science. The use of technology increases student motivation, hands-on experiences, real-life experiences, reading and writing performance, and access to information. The research also shows some possible solutions to providing training for teachers and dealing with the high cost of technology.

Technology motivates students in the classroom. According to a 1997 survey of teachers and superintendents, 61% said computers caused a great improvement in student motivations and 33% more said it resulted in a small improvement in motivation(Bulkeley, 1998). There are numerous stories that support this survey. Ludwig Braun, author of the book *Celebrating Success*, observed successful programs in two dozen technologically advanced schools. He saw that when students who felt that they couldn't learn got a chance to use technology, they discovered that they could do amazing things(Carlin, 1994). A young man named Juan changed from an uninterested, unmotivated student in elementary school to an A/B student, computer whiz and science award winner, with aspirations of being a computer engineering major at MIT, when a computer was donated to his family(Trotter, 1996). Motivation does not just come from having a computer, it also comes from the fact that students are doing hand-on activities.

Teaching and learning with technology means that teachers no longer have to take the lecture approach to teaching(Jukes, 1996). Students can take charge of their own learning. The hands-on approach in teaching science has shown to be very beneficial. Results from a study by Shymansky et al. (1983) show that students who use activity-based curriculum outperformed traditional curriculum students by 9 percentile points and in science process skills, outperformed them by 19 percentile points(Ostund, 1996).

Access to technology not only motivates and provides hands-on activities but can also allow students to experience real-life situations/simulations. Alan Kay, a computer pioneer, feels that the emphasis with computers should be in the area of simulations of natural or man-made systems. Kay believes that simulations give the student a deeper understanding and deeper way of knowing a problem(Business Wire, 1998). One program that puts Kay's beliefs into practice is the Junior Engineering Technical Society(JETS).

JETS is a national organization that focuses on technical literacy. They enhance high school instruction by having students apply their knowledge of concepts to real engineering situations(Peralta, 1998). Students that complete this program are better prepared not only for college but the careers they pursue. Schools must keep up with the business world because they reflect what skills students need to have when they leave school(Morton, 1996). The use of real-life situations help students meet those ever changing needs of the business world. In mathematics, A study done by the Educational Testing Service showed that eighth graders who used computers for complex math problems like simulations, improved by more than a third of an academic year(Bronner, 1998).

Real-world situations are not the only thing for which technology is useful. Reading and writing performance also increase with the use of technology. Just having students read from a computer screen rather than a book has shown an improvement in reading comprehension. In a study of 25 learning disabled and remedial social studies students, results indicated that hypertext (text only) support, enabled the students to retain the information they read better than the students without the study guides(Higgins, Kyle-Boone, Randall-et al, 1996). Students who use word processing programs also experience similar benefits. The quality and quantity of students writing increases with the use of technology(Baston & Bass, 1996, Hancock & Betts, 1994, Bulkeley, 1998).

Another way technology enhances the learning process is through the use of information technology and distance learning. Robert Kozma and Jerome Johnston(Change, 1991) wrote about seven ways computers and information technology can be used to transform the current curriculum:

> 1) "From reception to engagement. The dominant model of learning in higher education has the student passively absorbing knowledge disseminated by professors and textbooks.... With technology, students are moving away from passive reception of information to active engagement in the construction of knowledge."

2) "From the classroom to the real world. Too often students walk out of class ill equipped to apply their new knowledge to real-world situations and contexts. Conversely, too frequently, the classroom examines ideas out of the context of gritty real-world considerations. Technology, however, is breaking down the walls between the classroom and the real world."

3) "From text to multiple representations. Linguistic expression, whether text or speech, has a reserved place in the academy. Technology is expanding our ability to express, understand, and use ideas in other symbol systems."

4) "From coverage to mastery. Expanding on their classic instructional use, computers can teach and drill students on a variety of rules and concepts essential to performance in a disciplinary area."

5) "From isolation to interconnection. Technology has helped us move from a view of learning as a individual act done in isolation toward learning as a collaborative activity. And we have [also] moved from the consideration of ideas in isolation to an examination of their meaning in the context of other ideas and events."

6) "From products to processes. With technology, we are moving past a concern with the products of academic work to the processes that create knowledge. Students...learn how to use tools that facilitate the process of scholarship."

7) "From mechanics to understanding in the laboratory. The scientific laboratory is one of the most expensive instructional arenas in the academy. It is costly to

maintain...and to provide supervision to student scientist. It is also limited as a learning experience. So much time is required to replicate classic experiments...that there is little time left for student to explore alternative hypotheses as real scientists do."

Information technology and distance learning open up the whole world for students and faculty. It allows then to find, manipulate, find new meaning and have new learning experiences with information from any corner of the planet(Green & Gilbert, 1995). An example of distance learning can be seen in a virtual high school set up by Concord Consortium. Twenty seven schools from around the country participated in it's first year. All work is done over the Internet(Wildstrom, 1997). This program gave students a chance to have a class that might not have been offered due to low enrollment numbers and allowed them to work with experts from around the country. There are many benefits to providing access to technology. In order to reap these benefits, schools need to train their teachers properly and be able to afford to buy technology for the schools.

Providing adequate and effective training for the teachers is a key component to successfully implementing technology into any school. Staff development must be on-going, driven by teachers' needs and built into the budget. Additionally, it is important that schools do not give give a teacher technology without training or training without technology(Barnett & Nichols, 1994). Staff development for teachers should follow the same design as classes for students. Teachers, like students, learn in different ways and have different needs. The goal should be to make teachers efficient problem solvers, not computer experts(Durost, 1994). Other support staff is also recommended. Districts need to provide staff developers, help desk people, technicians and network experts to keep things running smoothly(Weiss, 1996). Even with a good staff development program, districts still need the financial support to purchase technology.

There are a number of solutions to the problem of lack of money to purchase technology. Some districts buy computers and lease them out to the students at a low monthly cost, some purchase half of a computer and the parents pick up the other half, others purchase 10 to 15 computers and transport them around to where they are needed(Ratnesar, 1998). In New Jersey, a school district teamed up with Bell Atlantic Corporation to provide computers at home for 135 poor, mostly Hispanic students(Trotter, 1996). To furnish teachers with computers, a district in Peotone, Illinois purchased computers for the teachers and had them pay it back, interest free, with payroll deductions over the next year(Hall, 1996).

In order to keep costs down, it is important that a school district decides on one platform for their schools. Nonstandard systems that use many types of hardware and operational tools require one support person per 50 to 70 computers whereas a highly standardized system requires one support person per 500 to 700 computers.(Weiss, 1996).

There are many solutions to the problem of lack of adequate access to technology in science. The solutions presented here relate to financially being able to afford technology, providing staff development, and all of the benefit of technology like information technology, reading and writing improvement, involving students in real-life experiences, using hands-on activities and motivating student to learn.

In summation, the use of technology greatly enhances motivation. It provides students with authentic, hands-on activities that increase a student's academic performance. There are many ways that districts that cannot afford technology can still reap it's benefits. Choosing one platform, leasing and working with companies are some ways to defer the high costs. Teacher training is an important aspect to making sure the technology is implemented successfully.

Project Objectives and Processes

After reviewing the literature on the problem of students' access to technology and their retention of science concepts, the researcher created the following project objective:

> As a result of increased access to technology during the period of September, 1998 to January, 1999, the seventh grade students in the targeted classes will improve their retention of the science concepts taught, as measured by teacher constructed tests.

In order to accomplish this project objective, the following processes are necessary:

1. Obtain the necessary pieces of technology or lab time to complete the project.
2. Develop technology-rich activities for the students to

experience.

3. Arrange time to teach and work on the various forms of technology.

Project Action Plan

Week 1

Administer technology survey to all students.

Begin scientific method unit.

Set-up lab stations: Blocks B & C begin hands-on activities:

Station #1- Density Lab, Station #2- Paper towel Lab, Station #3- Easy As Pie Activity, Station #4- Paper airplane Lab, Station #5- Problem Solving Puzzles, Station #6- Recording Data Worksheet, Station #7- Scientific Method Worksheet.

Blocks D, E & F begin technology activities: Station #1- Thinking Like A Scientist CD-rom, Station #2- Paper towel Lab, Station #3- Dr. Brain CD-rom, Station #4- Paper airplane Lab, Station #5- Density Lab, Station #6- Scientific Method on Power point*, Station #7- Problem Solving Puzzles.

*Some students knew how to use Power point from previous experiences (home or elementary school), some learned how to use it in multi-media class and most learned how to use it as they did this project.

Week 2-4

Continue rotations within the science lab (each group of 2-3 students spend approximately 60 minutes per station)

Week 5

Block B & C review with study guides and the text

Block D, E & F review with Thinking Like A Scientist CD-rom

Week 6

Scientific Method assessment with teacher-made test.

Week 7

Begin Cell unit.

All groups begin with reading (from text), lecture and discussion about the cell.

Week 8

Assign Cell Project: Block B & C begin the project on Microsoft or ClarisWorks Paint program (most students learned how to use these programs by using them during this project).

Block D, E & F begin constructing their cell models by hand.

Week 9-10

Continue work on cell projects.

Transfer computer projects to power point for presentations.

Week 11

Present Projects: Block B & C present their power point projects

Block D, E & F present their hand made cell models.

Week 12

Block B & C review with video:The Magic of Cells and computer animations from CD-roms.

Block D, E & F review with study guides and text.

Week 13

Cell unit assessment with teacher-made test

Journal writing: Positives and negatives of each unit and the use of technology.

Methods of Assessment

In order to assess the effects of the interventions, a post-test will be given following the scientific method and cell units. In addition, a final journal entry will be assessed to see student motivation with the use of technology.

CHAPTER 4

PROJECT RESULTS

Historical Description of the Intervention

The objective of this project was to improve the retention of science concepts through the use of technology. The use of computers, videos and cd-roms were used to effect the desired changes.

During the intervention, each group of students went through two complete science units. The topic of these units were the scientific method and cell biology. In one of the units, the students used technology and in the other unit, they used traditional hands-on science activities. Each science class, or block, is 80 minutes long and meets every other day. Blocks B and C started with the non-technology activities in the scientific method unit. Seven lab stations were set up around the science classroom. All students participated in the traditional labs on density, paper airplanes, and paper towels. The remaining stations were problem-solving puzzles (non-technology) or Dr. Brain cd-rom (technology), recording data worksheet (non-technology) or scientific method video (technology), scientific method worksheet (non-technology) or Thinking Like A Scientist cd-rom (technology) and Easy as Pie hands-on project non-technology) or scientific method project on Power point (technology). Each group of students had approximately 60 minutes to complete each station. All of the technology stations were completed in groups of two to three students. Due to scheduling difficulties and lack of computers, and the non-technology stations were done individually.

After the targeted students completed the stations, they spent two class periods reviewing the material for the scientific method test. The non-technology groups used their worksheets, labs, and the textbook to review. The technology groups used the Thinking Like A Scientist cd-rom and their Power point projects to review. The students then took a teacher-made test on the scientific method (Appendix C).

The second unit of study was on cell biology. This unit began with two to three class periods of reading (from the textbook), lecture and discussion about the plant and animal cell. Technology was implemented into the unit but this time, blocks B and C used the technology and blocks D, E and F used the traditional hands-on activities. The technology groups used Microsoft or ClarisWorks Paint programs to draw and label a plant and animal cell, explain the functions of each part and compare the parts to a house, car or factory, etc. The finished project was then transferred to Power point for a final presentation to the class. Blocks D, E and F, the non-technology groups, designed a 2-D or 3-D model of a cell, labeled it and drew a comparison between their cell and a house, car or factory, etc. These students also presented their project to the class.

After the presentations, students were given two to three class periods to review for the final test. The non-technology groups reviewed with their notes, study guides, their models, and the text book. The technology groups reviewed with a video, their projects, and computer pictures from various cd-roms. The students then took the final test, which was a teacher-made, cell unit test (Appendix D).

At the end of the intervention, students were asked to reflect on the two units and answer the following two questions in their journals:

(1) What did you like/dislike about each unit?

(2) Did you like using technology or the non-technology activities better? Why?

In summary, students were surveyed before the intervention to determine their previous experiences with technology in science. After the intervention, they completed two teacher-made tests and a journal entry reflecting on the two units they experienced. The results of the tests and the journal entries will be discussed below.

Presentation & Analysis of Results

Many positive results were observed while the students worked with technology instead of the traditional hand-on activities. In general, students who used technology did a better job of staying on task, seemed to be more enthusiastic about coming to class and more eager to present their projects.

The students who used technology were very excited to begin work when they came to class. Part of the excitement may have developed from working in a group of two or three. Part of the excitement may have come from the idea that they could not take these projects home so they needed to complete the work during class time.

Students working with the traditional hands-on activities often got caught up playing with the materials they were using for their projects, consequently, they were off task. These students also did their projects individually instead of in groups so there was less interaction with their peers.

Enthusiasm of the students seemed to be much higher with the use of technology. Again, the opportunity for students to work on a computer, and with their peers, seemed to boost their energy levels and desire to do well on the projects. This observation was reaffirmed with the results from the journal entry at the end of the two units.

Table 3

Results of Journal Entry: Number of students in each class that preferred technology vs. non-technology activities.

Block	Technology	Non-technology
B	28	6
C	20	6
D	11	5
E	20	7
F	13	8
Totals	92	32

Table 3 indicates that 74% (94 out of 124) of the students preferred using technology over the traditional hands-on activities. Students who like technology commented that:

"I'm a bad drawer so technology made my project look better."

"Technology got things done quicker and was fun to use."

"It was fun to learn how to use a computer."

"I liked using technology better because if you messed up you just edit it."

Additional comments mentioned things such as: with technology, all materials were available right there so you didn't have to locate anything, it was easy to use and it was fun working with other people.

Another observation made, was that the students who used technology seemed to be more eager to present their work to the class. This observation was most apparent with the lower-level(academically) students and those who did not have the fine motor skills to draw well or create a model. A number of students commented in their journal that technology made their projects look better. The projects done on Power Point looked neat and professional and that seemed to carry over to the students presentations.

To access the retention of science concepts, the results of the teacher-made tests were analyzed. There appears to be very little difference in test scores when comparing the two groups. A total number of 124 students participated in the teacher-made tests. The scientific method and cell test consisted of multiple choice, matching, fill-in-the-blank and short answer questions that were used to measure the retention of the science concepts taught.

Table 4

Average test score for each class with and without technology.

	Average Test Score	
Block(no. of students)	with technology	without technology
B(34)	66	66
C(26)	67	72
D(16)	76	71
E(27)	79	78
F(21)	88	86
Total(124)	74.04	73.86

Table 4 compares the test scores of the targeted students when using technology, to their scores when not using technology. There was no substantial difference between the test scores. The students scored an average of two-tenths higher on their tests than they did when not using technology. Four of the five classes test score remained the same or improved with the use of technology. One class, Block C, scored and average of 4.7 percent lower when using technology.

Conclusions & Recommendations

There is a strong emphasis, in the school and district of the targeted students, to implement technology into the curriculum. A majority of the science curriculum is already hands-on. The intervention allowed for a continuation of the hands-on experience while infusing technology. Based on the analysis of the data and the observations made in the classroom, technology appears to increase students motivation but does not substantially improve the retention of science concepts.

Although there was not a substantial increase in science test scores, the use of technology still provided some positive results: (1) Students expressed their desire to use technology over the traditional hands-on experiences; (2) Classroom observations showed a higher level of interest and less off task behavior from those students not using technology and; (3) Students were able to socialize, share ideas, and work together, while maintaining the academic scores that the students who worked on their own achieved.

For educators desiring to implement technology into their curriculum, it is important to have the proper resources available, and the time for students to learn and use those resources. Due to problems with scheduling, Blocks C, E and F, were unable to use the multimedia lab that Blocks B and D used. Instead, they rotated on a three computer set-up around the science classroom. This shortened some of the time they had to use the computers and also added to the possible distractions in the room. In addition, time is needed to teach the students the programs being used. The targeted students came with a wide range of experiences, from never used a computer to uses a computer all of the time. A majority of the students had to learn Power Point, and the ClarisWorks and Microsoft Paint programs, while they were trying to learn the information they were putting in their project. This added another dimension to their learning task, and may have detracted from their learning the science material. Another consideration that may have effected test scores, was the limitations the students who used technology had as far as studying for their tests. The non-technology students could take their projects home, spend more time on them and use them to study for the final test. The technology students had only the class time to work on and study their projects, and were unable to bring anything home.

A special motivation was observed by the researcher that could have a positive long-term effect. The targeted students wanted to use technology to do their projects. They were focused, they had fun, they learned to work together in a group and still learned the concepts and vocabulary that the students who worked on their own did. The students where learning while doing things that they liked to do. If increasing motivation and attitudes of the students is the only thing that technology does, it would be a beneficial intervention. This desire for technology is also going to help them as they move into society.

We live in a society where technology is all around us. Textbooks, lecture, and traditional hands-on activities can no longer compete with computer games and television. Schools need to change the way they present and the way students gather information to keep them interested and motivated in the classroom. Technology will also prepare students for their careers when they are pursuing a job in this technological society that we live in.

Overall, technology seemed to provide a hands-on experience for student while providing social benefits. Student indicated that they were more interested in using the technology and it's use did not harm the retention of science concepts.

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APPENDICES

Appendix A

Student Technology Survey

1. Last year, how often was technology used in science?

   _____ not at all
   _____ 1-2 days a week
   _____ 3-4 days a week
   _____ 5 days a week

2. Last year, how often did you personally use technology in science?

   _____ not at all
   _____ 1-2 days a week
   _____ 3-4 days a week
   _____ 5 days a week

3. Do you have access to a computer at home?

   _____ yes
   _____no

4. How often do you use your computer at home?

   _____ not at all
   _____ 1-2 days a week
   _____ 3-4 days a week
   _____ 5-6 days a week
   _____ 7 days a week

5. For what purpose do you use your computer most often? (choose up to 3 items)

   _____ research
   _____ word processing
   _____ play games
   _____ spreadsheets
   _____ database
   _____ multimedia presentations
   _____ Internet

Appendix B

Student Survey Results

(126 students surveyed)

1. Last year, how often was technology used in science?
   44 Not at all
   55 1-2 days a week
   26 3-4 days a week
   1 5 days a week

2. Last year, how often did you personally use technology in science?
   60 Not at all
   55 1-2 days a week
   9 3-4 days a week
   2 5 days a week

3. Do you have access to a computer at home?
   89 Yes
   37 No

4. How often do you use your computer at home?
   40 Not at all
   26 1-2 days a week
   30 3-4 days a week
   17 5-6 days a week
   13 7 days a week

5. For what purpose do you use your computer most often?
(choose up to three)
   64 research
   59 word processing
   90 games
   6 spreadsheet
   2 data base
   9 multimedia
   72 Internet

Appendix C

Scientific Method Test #1

Multiple choice

1. What a person performing the activity sees, hears, smells, feels or tastes is called ____________.
   A. observations
   B. theory
   C. variable
   D. objective
2. When using the scientific method, the first step is to ____________.
   A. gather information on the problem
   B. form a hypothesis
   C. state the problem
   D. record and analyze data
3. What is the last step of the scientific method?
   A. experimenting
   B. stating a conclusion
   C. forming the hypothesis
   D. stating the problem
4. Which phrase describes a hypothesis?
   A. reviewing information related to a problem
   B. testing a factor, or variable, in an experiment
   C. suggesting a solution to a problem after studying it carefully
   D. performing a controlled experiment
5. A hypothesis is formed ____________.
   A. before the problem is stated
   B. before the experiment is done
   C. after the conclusion is stated
   D. after analysis of the data
6. The system that scientists use to solve problems is called ____________.
   A. experimental treatment
   B. data collection
   C. scientific method
   D. adaptive response
7. When you write down step by step how you are going to do your experiment, you are writing a(an) ____________.
   A. procedure
   B. data
   C. conclusion
   D. objective

8. You are conducting an experiment to determine if putting an additive in gasoline will improve gas mileage. All cars used are identical. The gasoline used in each car is the same. The car used as the experimental <u>control</u> contains ________________.

A. one part gasoline and one part additive
B. two parts gasoline and one part additive
C. only additive
D. only gasoline

9. If you were testing how well different laundry soaps cleaned your clothes, the <u>independent variable</u> would be the ______________.

A. how clean the clothes are
B. soap
C. water
D. washing machine

10. Using the same scenario as #9, the <u>dependent variable</u> would be the _________.

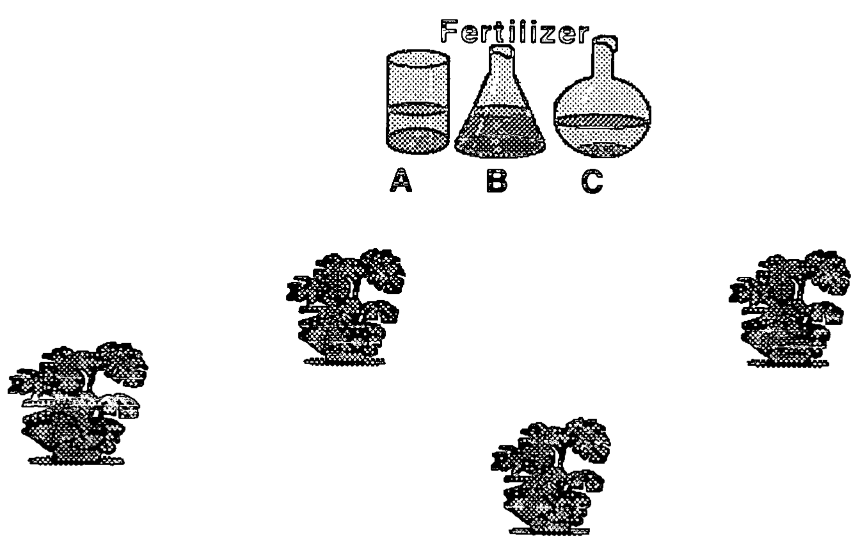
A. how clean the clothes are
B. soap
C. water
D. washing machine

<u>Read the statement(s) then answer the questions following them</u>

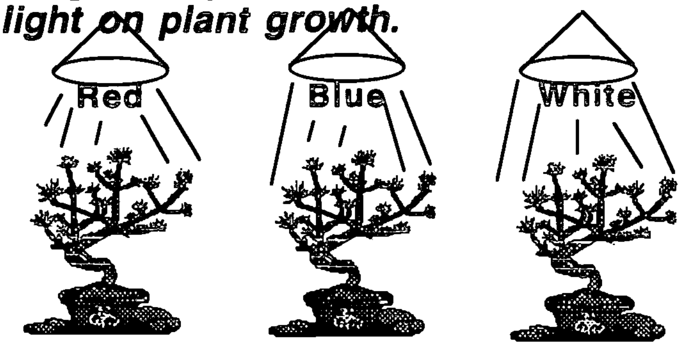
To test to see if fertilizer helps plants grow, a scientist must use a control.

11. What would the <u>control</u> be for this experiment?

12. Why is a <u>control</u> important in any experiment?



You are designing an experiment to test the effect of different colors of light on plant growth.



13. What is a possible hypothesis for this experiment?

14. What is the independent variable?

15. What is the dependent variable?

16. The plant that get normal white light or sunlight would be the ________.

17-20. What are 4 constants for this experiment?

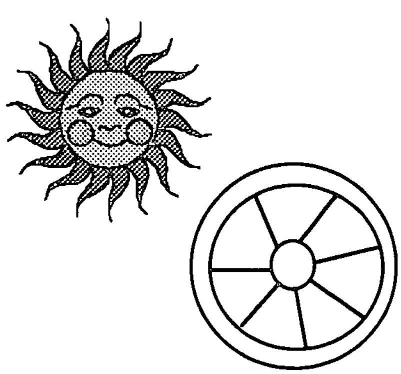
After many observations, you find that your bicycle tires look flatter on cold winter days than they do on hot summer days--even though you fill them with the same amount of air.

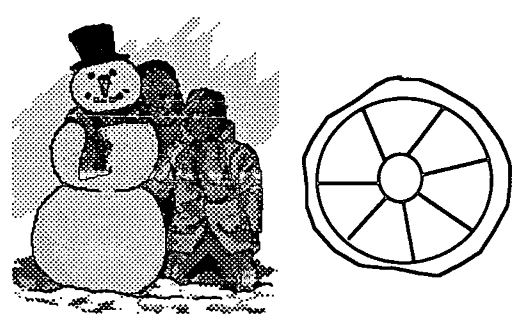
21. State the problem.

22. Form a possible hypothesis.

23. What is the independent variable?

24. What is the dependent variable?





Read the following statements and then answer the questions:

A. A scientist wants to find out why sea water freezes at a lower temperature than fresh water.

B. The scientist goes to the library and reads a number of articles about the physical properties of solutions.

C. The scientist also reads about the composition of sea water.

D. The scientist travels to a beach and observes the conditions there.

E. After considering all of the information, the scientist sits at a desk and writes, "My guess is that sea water freezes at a lower temperature than fresh water because sea water has salt in it."

F. The scientist goes back to the lab and does the following:

1) Fills two beakers with 1 liter of fresh water
2) Dissolves 35 grams of salt in one of the beakers
3) Places both beakers in a freezer
4) leaves the beaker in the freezer for 24 hours

G. After 24 hours, the scientist examines both beakers and finds the fresh water to be frozen. The salt water is liquid.

H. The scientist writes in a notebook, "It appears as if salt water freezes at a lower temperature than fresh water does."

Questions

25. Which statement contains a conclusion?
26. Which statements refer to research?
27. In which statement is a problem defined?
28. Which statements contain observations?
29. Which statement contains the hypothesis?
30. Which statements describe the procedure?
31. What is the independent variable in the experiment?
32. What is the dependent variable in the experiment?
33. Which beaker is the control?

34-35. What is the difference between a prediction and a hypothesis?

Appendix D

Cell Test

Matching

_____1. cell wall
_____2. mitochondria
_____3. endoplasmic reticulum
_____4. nucleus
_____5. chromosomes
_____6. cell membrane
_____7. ribosomes
_____8. chloroplasts
_____9. vacuole
_____10. cytoplasm

A. produces proteins
B. storage area
C. rigid structure that supports and protects the cell
D.allows material into and out of the cell
E. produces energy for the cell
F. transportation system
G. jelly-like material that supports cell organelles
H. control center for the cell
I. passes on traits to new cells
J. helps plant change sunlight into food

Fill in the blank

11. A general statement based on a hypothesis that has been tested many times is called a ________.

12. Wood from a tree is made up of crushed layers of _____________. (Clue: part of a cell)

13. List the five levels of organization from simplest to most complex
_____--->_____--->_____--->_____--->_____

14. The _____ is the main source of energy for all living things.

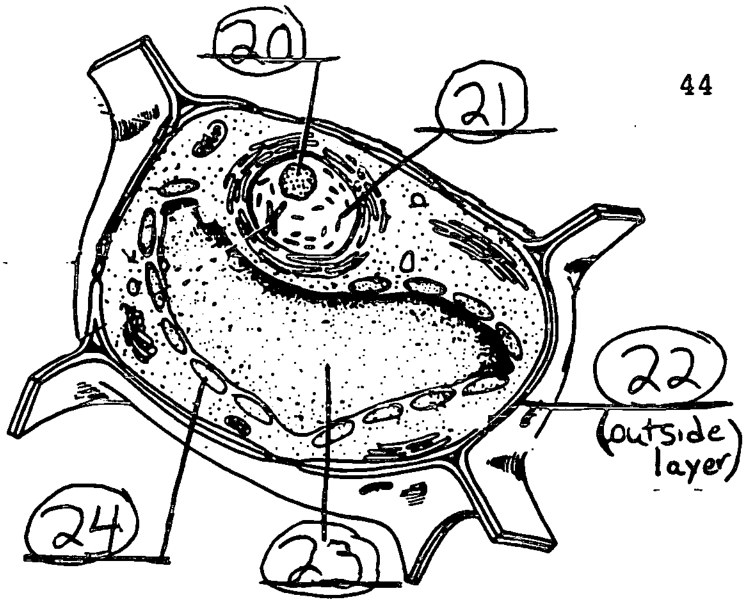
15. A group of tissues working together to do a specific job form ________.

16. ________ are the basic unit of structure and function in a living thing.

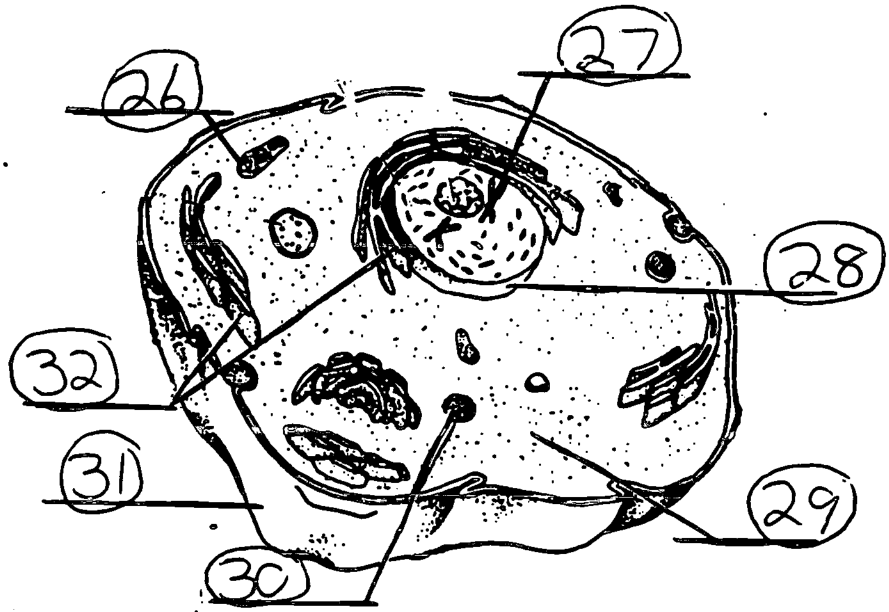
17. The ________ is found inside the nucleus and is believed to produce ribosomes.

18. ____________ act as a clean-up crew for the animal cell.

Identify the parts of the cell:



Typical ___19___ cell



Typical ___25___ cell

Short Answer

33. What are the three parts of the cell theory?

34. List four differences between plant and animal cells.

35. Why would muscle cells have more mitochondria that other types of cells?

36. You are a scientist walking on a beach when you come across a strange looking object that you have never seen before. What are 5 observations that you could make to determine if this object is a living thing?

37. Why is the process that takes place in mitochondria often described as being the opposite of the process that takes place in chloroplasts?

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