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Technology Use in Elementary School Classrooms  
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### Abstract

Technology has become ubiquitous in children's everyday lives, both inside and outside of school. And yet, in the year 2013, some schools and teachers do not utilize and leverage the advantages of educational technologies to improve students' learning opportunities. Survey and interview data were collected from two different 5th grade classrooms. Results indicated that most students favor technology because it sparks their interest and assists them in their learning experiences. Teachers reported that technology they used in the classroom has had a positive impact on both their instruction and student learning. These results suggest that students are well prepared to take on assignments that require them to use technological skills and to build on those skills to gain technological literacy. Therefore, for our action project, we designed an assignment involving technology that would fulfill some of the 5th grade Common Core State Standards in both writing and speaking and listening.

## Technology Use in Elementary School Classrooms

### **Back-story**

It was my first time inside an elementary school classroom in almost 20 years, so I was not sure what to expect. When it came to technology, all I could remember from my time as a student in the early 90's was overhead projectors, videos on VHS, not even one computer in the classroom and having to go to a computer lab to insert a big thin floppy disk to play Oregon Trail and Math Muncher. Now twenty years later, I was impressed by the advances and the amount of technology that was being used in the classroom where I was volunteering my time.

Everyday during silent reading time, students took turns taking quizzes on a computer in the classroom. I quickly discovered that students in this school use an online computer application called Accelerated Reader where they take quizzes on certain books that they read. Each book is given a point value based on the reading level and the length of the book. Students take a pretest using the computer software to determine what reading level they are at. The teacher then assigns each student a reading level range so that they have an idea of what books are suitable for them so that they can take quizzes on after completion. There are only about ten questions per quiz, no time limit, and the option to retake a quiz if not happy with the initial score. The kids love it because it allows them to work on the computer in the classroom to take quizzes. The best part is that the principal is involved and keeps the students motivated by rewarding them each week for reaching certain milestones. Some of the prizes include the following: stickers, erasers, pencils, pens, toys, gadgets, free movie passes, free personal pizza vouchers, and much more. For example the way it works is when a student reaches 10 points, the

principal will personally deliver a cool looking pencil to the student and for 20 points he will give out vouchers for a free personal pizza. One of the top prizes is for 200 points, the principal will take the student out to lunch, and my favorite is for 500 points the student gets to be principal for the day. Not sure if anyone has gotten to do that yet.

Another technology that I seen being used at the elementary school that I actually have used as a university student is responders/clickers. A responder/clicker is a device the size of a cell phone that allows students to submit their answers electronically instead of having to raise their hands. I love that they are being used because not all students feel comfortable raising their hands to answer questions out loud and this technology allows them to participate. It is also beneficial for the teacher since it allows her to get instant feedback from all her students because the responses are sent electronically to her laptop. The teacher is able to instantly see what each individual student thinks the answer is, and how the class has done as a whole. I think it helps teachers out a lot because they may see if certain material needs more time spent on and what certain students need extra help with.

Besides recess and lunch time, the part of the school day I noticed that most of the 5<sup>th</sup> grade students looked forward to was the walk over to the computer lab to work on Success Maker. Once they got in the lab, each student jumped onto a computer, put a headset on, and already knew their credentials to log in on their own. Success Maker is a computer software that consists of two separate subject matter to choose from that last for 20 minutes at a given time; Mathematics and Language Arts. Questions consist of multiple choice, fill in the blank, and critical thinking. In the Language Arts section, there are questions pertaining to spelling, vocabulary, grammar, and short passages. In

the Mathematics section, there are questions pertaining to decimals, fractions, addition, subtraction, division, multiplication, geometry, and word problems. When students answer the questions wrong, the program interacts with them using an animated character which gives clues and hints on what to do. It works out well for the students' problem solving skills because the students usually learn how to find the answer without requiring extra help from the teacher. The best thing about it is that questions are individualized based on the students' level of comprehension and productivity. So it will not move onto harder material until the student has mastered the concepts. Every students' performance is tracked; the teacher has access to the scores of all the students over the whole period of the academic school year. As a future elementary school teacher, I believe the software is great because it allows the teacher to track what level each student is recurrently at, and what concepts they have already mastered, and how they are progressing.

Technology has come a long way from when I was in school and it is only going to keep advancing. From the technologies I have seen being used in the 5<sup>th</sup> grade class I spent some time in, in my opinion, they are all positive innovations for both students and teachers. I believe all schools need to be aware of the different technological advancements that are out there to catch the interest of students and make learning fun. The reality is that we live in a technology driven world so we need to prepare our students for it.

### **What is the Issue and Why is it a Problem and/or Opportunity?**

In today's world, technology has a big role and it sometimes takes over people's lives. It has its benefits, just as it has its negatives; it can be used to gain further research in the matter of seconds by the tips of one's fingers, but it can also be a major distraction

that pulls people out from the real world around them and keeps them hooked on a screen. Technology is the new innovation being introduced to elementary schools throughout the world. It is important to keep up with technology in this day and age, but is it good for elementary aged students? When is it appropriate for teachers to use it? There is a debate amongst people; how much technology is too much?

My service learning experiences have given me insights on the ways technology is being utilized in elementary school classrooms, in particular, at El Roble Elementary School in Gilroy, California. The school is located in a middle class suburban Latino dominated neighborhood which borders a park and has many other useful resources in its proximity such as a library, community center, and public transportation. The school has not been meeting adequate yearly progress under the Elementary and Secondary Education Act so it has qualified for Program Improvement for the past 4 years. Only one other elementary school in Gilroy Unified School District has been on the list longer. Because of efforts to improve standardized test scores, the school provides supplemental educational services at the school districts expense; some of which include online tutoring. The school also has a speech therapist, and math, language arts, and reading programs (Our School [OS], 2012). Throughout the week, students at the school use a personalized interactive computer program called Success Maker that focuses on language arts and mathematics. Another computer program that is used is Accelerated Reader which tracks how much students read by giving them quizzes on particular readings. One more technology that was used was responders/clickers; students submit their answers using these devices for particular activities and lessons.

The elementary school students and their teachers are the targets who are directly impacted by the technological advances because they are the ones who have to use them. Teachers are moving farther away from traditional lessons and teaching styles, and are adapting to using more technology to assist them everyday in class lessons. It might be easier for the newer and younger teachers, but older teachers and those who are not technologically savvy might be feeling the pressure from administration. Some students might not have access to the technology at home that they use in school, but are expected to maneuver it at school as if they had unlimited access. With some of the programs used, students are not necessarily being taught directly by the teacher but instead by a machine.

The people who have the power to impact decision making starts from the bottom up. Students are the focus so it begins with them; it is about what works for them and how their performance is affected. Teacher's perspectives are also important because they are the ones in direct contact with the students and assess them on a daily basis. In meetings they can bring up issues, concerns, and opportunities to enhance the students' learning experiences. Next it moves up to the parents of the students; they want what is best for their children, and can also advocate the change they want though attending and vocalizing their perspectives in PTA and school board meetings. Principals are the ones who make the decisions on how their schools are going to be run and what programs and technology will be implemented. Towards the top are the district officials, who give the schools guidelines they are suppose to follow. And finally at the top we have the state who decides which districts are going to get funding and for what. In addition, the researchers may also have an impact because of the study they will conduct on this

capstone project. The researchers hope to bring awareness to people by sharing their results.

This project is meaningful to the researchers because they plan to be elementary school teachers in the near future, and will be directly impacted as a result. They want to know the pros and cons in using technology in the classroom from others' perspectives, especially from an elementary school setting. The researchers have only started using significant amount of technology in the classroom once they began their collegiate career, so the future of technology in the classroom fascinates him. They want to know the answers to the following questions: What are both students' and teachers' attitudes about technology? What technologies work and how much of it is suitable? Is technology turning kids on to learning and are they learning more because of it?

The researchers are qualified to carry out this project for good reasons: The researchers are currently university students in their last semester of college, and have been studying to become multi-subject elementary school teachers for the past four years. Both their majors are Liberal Studies with a minor in Human Development so they have some expertise in those fields. They have completed well over 60 service learning hours where they worked directly with elementary students and teachers in a school setting. One of the researchers also currently works as an online academic coach where he tutors students K-12 through a computer program, and has over five years experience doing so.

The researchers are different from their stakeholders in comparison to age and education level. Some of the stakeholders are elementary school aged students and the others are teachers whom are college graduates with teaching credentials. The differences should not cause any biases that will impact the research. The only bias

might be that one of the researchers uses technology as a way of tutoring his students at his job and he finds it beneficial, but then again he also comes across negative issues because of it.

There are always going to be assumptions made when it comes to a concern. The stakeholders and the researchers may assume that because technology is new and advancing it must be beneficial for students' learning. On the other hand, those who have had any difficulties in the past understanding how to use a particular technological device or software may presume that something new will always be hard, frustrating, and be discouraged to want to use.

In this paper, technology is defined as any device or machine that is man made which usually has a screen and/or some kind of software that makes it run. Service Learning is the term for college student volunteer work done at schools. Success Maker refers to an interactive and personalized computer learning program. Accelerated Reader is an online computer program that quizzes students and tracks readings they have done. And Responders/Clickers are devices used to submit answers electronically.

### **There is No Equality or Equity in Education**

One of the issues when it comes to education in this country is that there is no equality or equity. "A high-performing school in a wealthy suburb offers a very different work environment than a chronically low-performing inner-city, high poverty school" (Roza, Hill, Sclafani, & Speekman, 2004, p. 204). There is a huge gap in performance and resource availability amongst low SES and high SES schools. "School systems are mini reflections of society. Of course, school districts with homogeneous White populations may not see the need to consider why race matters. Districts with more

diverse populations that mirror society must face the issue head on” (Barbara & Krovetz, 2005, p. 16). Many times this issue of the lack of equity is not apparent to those that are not affected. The truth is the state and the districts do not do a good job dispersing government funding, and the schools who need new resources the most are the ones who hurt the most from this inequality (Roza et al., 2004). There are technologies being used at some schools that are provided by their funding that are not given to less fortunate schools. Students are not given the same opportunities that they deserve.

### **Technology Improves Cognitive Development**

Despite the problems with the equality and equity in education, Biggers (2001) informs that over the past couple of years, computer based literacy programs have increased in schools in efforts to integrate technology into the curriculum. Technology use in classrooms does occur and it is important to understand the learning opportunities it offers. Based off their own research, Roberts and Samuels (1993) conclude that “well-designed computer software provides the student with individualized attention and continuous feedback and is based on positive reinforcement practices. Students [also] maintain high levels of motivation for computer use” (p. 118). Individualized attention and continuous feedback is exactly what students need to help them learn because of the stage they are at in their cognitive development. Cognitive development has to do with intellectual abilities such as attention, memory, problem solving, language, academics and everyday knowledge (Berk, 2012). The technologies students are starting to use represent all those aspects. According to Berk (2012), children in middle childhood are more selective and have more of a control in their attention, thus using computers would spark that interest and hold their attention which will assist them in their learning.

Computers can be used as a learning tool which helps with cognitive self-regulation. Metacognition and cognitive self-regulation expands in middle childhood, so children are learning to progress towards a goal, check their outcomes, and know how to redirect themselves if their efforts are unsuccessful (Berk, 2012). The computer software student's use in schools offers tools which allow students to self-regulate, so they are able to seek assistance with material they do not understand. Lingnaue , Hoppe, & Manhaupt (2003) found that computer supportive collaborative writing benefits children because they can apply the knowledge they have already when it comes to reading and writing and also acquire new skills at their own pace.

### **Policies are Incorporating Technology**

When it comes down to what is incorporated to curriculum, a lot of it has to do with what policies are instilled. Some districts out there realize that technology is the way of the future, and make policies which integrate technology. In 2008, the Gilroy Unified School District Board Policies (2012) indicated that “the Superintendent or designee shall develop a three- to five-year technology plan which: 1. Focuses on the use of technology to improve student achievement and is aligned with the district's vision and goals for student learning” (Board Policies, 2012, p. BP 0440). The researcher (Jaime Muñoz) worked with a school in this district, and he admitted that the school definitely followed through with the district's plan. The school uses an animated assisted learning program called Success maker daily, along with a nation wide popular computer program called Accelerated Reader. Biggers (2001) revealed that Accelerated reader is “not the only “computerized reading tool” on the market; however, it is the most widely advertised and used software available” (para. 2). On the contrary, according to Mallette,

Henk, and Melnick (2004), there can be some problems with the Accelerated reader software; “Unfortunately, the students and parents (and often classroom teachers) seem to focus more on the stature of the AR reading levels and on the acquisition of external rewards than on children’s actual growth in reading” (2004, p. 76). This can be a problem if their actual learning development is not the focus. Conversely, the school the researcher worked with really pushes these computer software mentioned. They want the district as a whole to use technology inside and outside the classroom. In their district’s policy it states that they plan on “11. Employing technology in ways that enhance learning, teaching, and non instructional operations” (Board Policies, 2012, p. BP 0200). Yes, it is great that the district is pushing for students to use technology, but it is just as good that they are requiring teachers and other staff to step up to the challenge. The problem is that not everyone is up to date with the latest technologies and computer software, so if new technologies are repeatedly being brought in then not everyone is going to be technologically literate.

### **What Has or Should Be Done to Incorporate Technology into the Classroom**

#### **Computer Based Learning Enhances Students’ Interest to Learn**

Technology is advancing rapidly more each year, and for that reason schools have been implementing the use of technology in the classroom. In Ciampa’s (2012) observation, she found that students were more engaged in the reading assignment when they used an e-book as opposed to a physical book. Students were also more confident answering questions about the readings after using the e-books. Technology is a way to reel students in because it really attracts them. “Children seemed to really embrace the benefits of the electronic features and understood the role that the computer could play in

assisting them” (Lefever-Davis & Pearman, 2005, p. 451). The results of Navarro, Marchena, Alcalde, Ruiz, Llorens, and Aguilar’s (2003) study suggest that children who used computer assisted instruction demonstrated better attention behavior towards the lesson.

More than 10 years ago, many people believed that the only way to do math problems was by putting pencil to paper, and the only form of technology to use was a calculator, but that is no longer the case. When Haung, Liu, & Chang (2012) asked fourth graders how they felt about working out math problems on computers, they found that “all users agreed that solving math questions through the computer was easier than through the test sheet. [And concluded] it is unanimous that solving word-based math questions through the computer is both interesting and enjoyable” (p. 257).

Most kids are not thrilled about math or look forward to it, but by using computers it changes their perspective. More computers should be used when teaching math to students to attract them to the subject. Many people have their perspectives on technology use in the classroom, but the opinion that is most important is that of students. Lee (2006) reports on his finding of children’s attitudes of integrating technology in their learning environment:

The student interviews revealed that:

- their interest in learning had increased because they were attracted by the animations, multi-media elements and the different yet flexible functions on the ILE [Integrated Learning Environment];
- the students readily showed willingness to go to other web sites to explore and look for more information on their own, with minimal teacher guidance;

- they felt that they could always use the information on the ILE to achieve better scores, since the exercises and activities were repeatable and they could continually work to improve;
- many of them preferred doing the exercises on the ILE because they could get immediate feedback and avoid any embarrassment;
- they felt that they could always move on to the next set of exercises when they had finished the ones they had been assigned;
- they had more time to think for themselves; they gained more satisfaction from their own achievement (p. 97).

Students' responses about their online integrated learning environment proves that such technology interest them to learn. The internet provides many resources that attract the interest of students. It allows them to do research on their own without requiring constant help from their teachers.

### **Computer Assisted Learning Offers Instant Feedback**

Computer based instruction provides instant feedback that kids like. Roberts and Samuels (1993) write, "Well-designed computer software provides the student with individualized attention and continuous feedback and is based on positive reinforcement practices. Students maintain high levels of motivation for computer use" (p. 118). Because students are maintaining high levels of motivation it proves that they are attracted to and like the computer software. A great feature of computer learning software for both teachers and students is that there is immediate feedback on the students' written work (Lingnaue et al., 2003). Ciampa (2012) informs that e-books have the capability to read the text to children if they can not read it on their own. If students

are not sure how to pronounce certain words, all they have to do is click on the word and it will read it to them (Lefever-Davis & Pearman, 2005). The e-books have post reading assignments, which gives instant feedback after each problem. Students smile and pat themselves on the back when the computer praises them (Ciampa, 2012). “Consistent with Skinner (1969) and Thorndike (1932), students need to receive immediate feedback in order to make corrective modifications and guide subsequent responses” (Ciampa, 2012, p. 16). That is why it is important that schools choose computer software that provides instant feedback so that they can self-regulate.

### **Teacher Pedagogy, Training, and Professional Development**

Technology is both beneficial for students and teachers. Technology keeps students engaged and helps them learn, while it makes the lives of teachers easier and helps them teach. It is important that schools realize the effects that technology is having on their population and support teacher training and professional development to ensure they are prepared to utilize existing and emerging technologies in their pedagogy in innovative and effective ways to enhance student learning.

Technology needs to be part of everyday lesson plans. Haung et al., (2012) reveal that, “Computer-assisted mathematical learning system developed can serve as a supplementary tool that helps teachers with remedial instruction and enhances the problem-solving ability of low achievers” (p. 258). If low achievers are enhancing their problem-solving abilities by getting assistance by a computer, then that is a good indication that technology is doing its job in schools.

It is important that teachers feel comfortable using the latest technologies because most likely it is what their students are using. According to Ertmer and Ottenbriet-Leftwich (2010):

Teachers can think they are doing a great job, even if they or their students never use technology. Although this may have been true 20 years ago, this is no longer the case. We need to broaden our conception of good teaching to include the idea that teaching is effective only when combined with relevant ICT [Information and Communication Technology] tools and resources (p. 259).

The reality is that technology has become part of the job of teachers to make sure students have opportunities to use technologies as part of their learning experiences. Ertmer & Ottenbriet-Leftwich (2010) write, “To achieve the kinds of technology uses required for 21st-century teaching and learning we need to help teachers understand how to use technology to facilitate meaningful learning” (p. 257). Yes, technology is out there for the taking, but if teachers do not understand how to use it effectively, what is the point? It is the job of the school to train their teachers in using technology, so that it can be meaningful to their students.

Meaningful learning means that students gain the knowledge and skills to apply what they have learned to the real world. What they learn through technology in one class can benefit them for future classes and life outside the classroom. According to Lee (2006):

It became clear that with the introduction of the ILE the teachers were for the first time pushed beyond their comfort zone to rationally consider how they could in fact generate a higher degree of classroom interaction. The ILE also opened the

door for students to use self-assessment as an instructional tool. Customized worksheets completed periodically on the computer at school or at home acquainted students with the learning objectives of the unit and allowed them to gauge their level of mastery at their own pace (p. 101).

One of the beauties of technology is that a lot of the programs/software that schools are beginning to use is personalized to individual students' abilities so there is not much pressure on being on the same page as everyone else. Everyone comes from different backgrounds and the good thing is that no matter what SES a person is from, technology can have the same positive effect. Cobb (2010) elaborates on the SES situation by stating, "Compass Learning is software that has substantial outcomes in increasing the reading achievement of minority students who live in poverty" (p. 38). So long that there is equity in the school systems and technological resources are provided for all schools, students will be up to par when it comes to technology.

There are so much forms of technology that are being used in the classroom. Purcell (2013) reports that, "In addition to desktop and laptop computers and classroom projectors, significant portions of these teachers report cell phones, digital cameras and recorders, e-readers and tablet computers being part of the learning experience" (p. 33). What has to be understood is that no longer are phones just used for placing calls. Smart phones are basically mini lap tops in the sense that they have access to the internet, so schools need to reevaluate their cell phone regulations.

The bottom line is that technology is constantly changing; it is advancing as we speak. Because of the rapid advancement, schools cannot afford to stay out of the loop. They need to make sure that teachers know how to utilize technology properly to its full

potential and support them because at the end of the day it is the teachers who are interacting most with the students. There are so many ways that technology can be used by teachers, and they can learn so much information just as their students. When teachers are benefiting from technology, so are their students.

## **Method**

### **Context**

Two 5<sup>th</sup> grade classes from two different Latino dominated schools participated in this study. The first school is El Roble Elementary School (Class 1) which is located in Gilroy, California. The school is in a tree lined middle class suburban neighborhood bordering a park. The second school is Natividad Elementary School (Class 2) which is located in Salinas, California. The School is in a middle class residential area adjacent to a park.

### **Participants**

Out of the 34 students in Class 1 who were asked to participate in the study, 14 students decided to complete the survey at home, and 5 were given brief one-on-one interviews. Two of the interviewees were females and the other three were males. The students who were chosen for an interview were selected based on their responses on the survey that the researcher had further interest in for follow up questions. An interview was also conducted with the class' 5<sup>th</sup> grade Caucasian female teacher.

In class 2, 21 of the students participated in the survey and 5 of them were also selected for a one-on-one interview based on their responses on the survey to better understand their perspectives. An interview was also conducted with the class' Hispanic female teacher.

**Researchers**

The researchers that conducted the study are Jaime Alejandro Muñoz and Francisco Javier Gutierrez Jr. They both are Liberal Studies Major and Human Development Minor students at California State University of Monterey Bay and are in their senior year. This project is meaningful to the researchers because they plan to be elementary school teacher in the near future. In their time as service learning students and volunteering time in the classrooms that partook in this study, the researchers came to understand that technology used in 5<sup>th</sup> grade classrooms are advancing. The researchers are interested in finding out more about the types of technologies being used in elementary school classrooms, how effective they are, and the attitudes of the teachers and students who use them.

**Survey and Interview Instruments**

In order to understand the experiences that 5<sup>th</sup> grade students are having with various technology and software, students were asked to complete a survey with questions that focused on their technology use inside and outside of the classroom.

**Technology use survey.**

(Circle your answers)

1. Is there a computer/laptop at home that you use?

Yes    No

If yes, how many hours a week do you use it?

1-5 hours    6-10 hours    more than 10 hours

2. Do you have your own personal computer or is it one your family shares?

3. Do you access a computer somewhere other than home and school (library, friend, relative, etc)?

If yes, how many hours a week do you use it?

1-5 hours    6-10 hours    more than 10 hours

4. How much time per week do you spend using a computer in school for school work?

Little or no time    15-30 minutes    30-60 minutes    60-90 minutes    more than 90 minutes

5. What subjects do you use the computer for?

Math    Language Arts    Science    Art/Music    Social Studies    History    Health

Others (if other, please write it in) \_\_\_\_\_

6a. What technology and computer programs do you use at school?

(Circle all that apply)

Computers    Television    VCR/DVD/Blue Ray    Mp3/iPod    Phone/Smartphone

Accelerated Reader    Success Maker    iPad/Tablet

Others \_\_\_\_\_

6b. And outside of school? (Circle all the apply)

Computers    Television    VCR/DVD/Blue Ray    Mp3/iPod    Phone/Smartphone

Accelerated Reader    Success Maker    iPad/Tablet

Others \_\_\_\_\_

**How Do You Feel About Technology (Circle your answers):**

(Circle your answers)

1. Do you like using the computers at school?

Yes    No

2. How do you prefer doing problems?

Worksheet or Computer

3. Do you think it is a good idea that your school uses technology in the classroom?

Yes No

4. Does the technology you use in the classroom help you learn?

Yes No

5. Since what grade have you been using computers in school?

6. In an average school year, how often do you use computers at school?

Never once or twice a year monthly weekly almost daily

7. Do you decide when you want to use a computer to work on assignment?

Always often sometimes rarely never

8. Have you taken a technology class at my school?

Yes No

9. Do you believe that knowing how to use the computer will be important for me in my future?

Yes No

10. Do you use computers to find information from sources that are like printed books?

Yes No

11. Do you use technology for skill-building programs to learn things such as math facts, spelling and typing skills?

Yes no

12. If you are willing to answer a few more questions with me in a one-on-one interview what is your name\_\_\_\_\_

**Interview protocols.** Teachers and students were asked a set of different questions during the interview. The following is the list of questions used for the semi-structured interview:

**Teacher interview questions.**

1. In what ways do you see technology use in the classroom as an opportunity and why?
2. In what ways do you see technology use in the classroom as a potential problem?
3. What are you concerned about when it comes to technology use in the classroom?
4. Do you feel comfortable using technology as part of your classroom activities and pedagogy?
  - a. If yes, in what ways do you use technology as part of your classroom activities and pedagogy?
  - b. If no, what are the challenges or obstacles that make it difficult for you to incorporate technology into your classroom activities and pedagogy?
5. Do you use technology to help you implement a lesson plan? If so what kind of technologies do you use?
6. What forms of technology do you encourage your students to use for homework or projects? What forms of technology do you require your students to use technology for homework and/or projects? If so what kind of technology do you students use in the classroom? How about at home?
7. Do you use technology not provided by the school? If so, what do you use?
8. What is currently being done to improve how technology is used in the classroom? By whom?

- a. What efforts to improve technology use in the classroom do you think have had or will have a positive impact on student learning?
  - b. What efforts to improve technology use in the classroom do you think have had or will have a negative impact on student learning?
9. If you are in favor of encouraging technology use in the classroom, what do you think should be done about ensuring technology use is taking place? If you are not in favor, how do you discourage technology use from taking place?
  10. What do you think are the obstacles/drawbacks/disadvantages to incorporating technology use in the classroom?
  11. In what ways do you think of using different forms of technology during class time can have a positive influence on certain aspects of students' cognitive/academic development? (such as imagination, creativity, and ability to learn new skills and knowledge)
  12. In what ways do you think of using different forms of technology during class time can have a negative influence on certain aspects of students' cognitive/academic development?
  13. Is there anything else that you would like to say about technology use in the classroom and/or the improvement of technology use?

**Student interview questions.**

1. What do you use the computer at school for? How about at home?
2. What kind of programs/applications do you use?
3. In what other locations do you use computers?

4. Does your teacher require you to use a computer or any other kind of technology for homework? In what ways?
5. What other forms of technology do you use for schoolwork? What do you use them for?
6. What helps you learn better? Computer activities or worksheets? Big group lecture, small groups, or one-on-one?
7. How do feel about the computer software and applications you use at school? Do they make it easier to learn or is it harder?
8. How comfortable do you feel about using the technologies in your school? Do you need a lot of help with it, can you use it on your own, or are you able to show others how to use it?
9. Do you think it is a good idea that your teacher/school uses technology in the classroom? Why and why not?
10. What else do you want to tell me about technology?

### **Procedure**

First the researcher (Jaime Alejandro Muñoz) contacted the principal of the school via email and provided him a project proposal. The principal allowed the researcher to conduct his study and recommended the 5<sup>th</sup> grade class the researcher had worked with the prior semester for his service learning. The researcher then contacted the 5<sup>th</sup> grade teacher, and arranged a date for him to interview her and talk to the whole class about the study. After describing the study to the class, a letter to their parents about the project, and consent forms were passed out to everyone. The students were asked to bring back the consent forms signed by both them and their parents along with

the survey filled out if they chose to participate. After reviewing all the eligible surveys, 5 students who mentioned they were willing to do an interview were taken out one at a time outside the classroom to continue onto the interview process. All interviews lasted about 10 minutes and were voice recorded using a smart phone application. A similar process was used by the second researcher (Francisco Javier Gutierrez Jr.) for class 2.

### **Data Analysis**

The data from the surveys was inserted into a table using Microsoft Office Excel. The organization of the table made it easier to compare and contrast all data. The questions along with each student's response made up a column in the table. Similar responses were tallied up and given a percent in order to determine the commonality of each response. The interviews were analyzed by repeatedly listening to the recordings and taking notes on everything that was said. After analyzing the data, common themes appeared and were given their own column in the table.

### **Results**

The results are separated into three parts; 1. Student surveys, 2. Student interviews, and 3. Teacher interviews. After reviewing some of the responses from the survey, listening to what was said in the interviews, and my prior knowledge from spending time in the classroom, it is apparent that some of the questions were not fully understood.

#### **Student Surveys.**

The majority of students (75%) have a computer/laptop at home that they use, and of those students 93% use it for 1-5 hours a week. Only 20% of the 5<sup>th</sup> grade students in this study do not have access to a computer/laptop at home. The data indicates that half

of the students use a computer/laptop that their family shares, while 14% have their own personal computer/laptop. Besides computer usage at school and home, half of the students responded that they also have access to computers in other locations such as the library and friends' or relatives' homes.

Seventy nine percent of all the students acknowledged that they use computers daily and understand that the programs/software they use is for skill building to learn, although we know for a fact that all students in this study spend at least 40 minutes each day on computers at school because that is how long they use it for Success Maker. Some of the responses suggest that the students didn't understand survey questions. According to the data only 57% of students use computers at school, although Success Maker and Accelerated Reader are accessed by computers daily at school. However, all but 1 student did say that they use success maker at school and all but 3 said they used accelerated reader at school. The other thing that surprised me was that only 1 student mentioned the Elmo, but that probably had to do with the fact that it was written in under "other." The majority of students (79%) watch television outside of school. What was surprising to me was that only 29% mentioned a gaming console, but I think that is because it was not listed as an option and was written in under other. I did think that more than 43% would have mentioned VCR/DVD/Blueray, but that was not the case.

It is unanimous that students like using computers at school, all of them said they like them. The results show that it is clear that the majority of students (71%) prefer doing problems on computers oppose to worksheets. All students agree that it is a good idea that schools use computers in the classroom. Every student that participated in the survey indicated that technology use in the classroom helps them learn, and all students

realize that knowing how to use computers will be important for their future. Students are split in half when it comes to using computers to find information from sources as they would with a book and that is probably because most of them (86%) have not taken a technology course.

### **Student Interviews**

As I analyzed the data from the student interviews, I came across a few themes that kept appearing amongst the five interviewees from class-1. The analysis questions that were answered were the following: 1. What did I expect students to use technology for? 2. What other things students use computers on their own for? 3. What other forms of technology do students use? 4. How students like learning? 5. What impact does technology have?

Because I spent time in the classroom, I had expected that the students would talk about Success Maker, Accelerated Reader, and other computer games when it came to computer use. When asked about what the computer is used for at school and home Katrina responded, “We use it to learn about language arts, math, and Success Maker, also for Accelerated Reader so we can take quizzes on books, and also for playing games.” The central theme in my findings was as I expected, students used computers for math and language arts, specifically the Success Maker software and the Reading application Accelerated Reader.

Some students use computers on their own when they are not in school. The findings reveal that despite being away from school, students usually use computers for school related things such as school projects or to further research something they need help with. Brianna expressed:

Sometimes I get stuck on math only on math though so I use it. All I do is type in math and click a random name sometimes for some of them it says click search for what you need help on, so then I put whatever is on the paper the title and it will help by steps. It helps a lot.

Some students have special interest in certain things such as music, art, or astronomy so they browse websites to those topics of their liking. For instance, Bradley said, “The music program is called musicracer.com and it teaches us the note and the fingerings so that we can have a game to play on it.” Not only are students utilizing the internet for material that is the focus at school, but also extra curricula subjects that catch their interests.

During the interviews, students kept talking about the Elmo and the Mobi. They have a great understanding for the technology they are using and how it works. Collin did a good job explaining it to me when he told me:

Sometimes she will let us use her phone, and also the Mobi and the Elmo that shows up and lets other people tell us about learning. The mobi is a little key pad and a pen and you have a screen and the mobi shines off a reflection that you transfer from the computer and you can write things down with the pen on the pad. Whatever you write down on the pad comes up on the screen and the mobi transfers it to the computer so you can use it while looking at the computer or while looking at the screen because you can see it either way. It is kind of like the white boards we use but there is no ink.

Students were very aware and descriptive of how they functioned. Students also spoke about how they are able to use smart phone applications to do Accelerated Reader.

When the students were asked about how they prefer to learn, most of them mentioned how they like working in groups because they are able to help each other out.

John stated:

I think when we are learning on a computer with a group because if you have a couple of people who are not getting it you can help them and if you needed help you know that you're with a group and there has to be at least one person who picked up what we were learning about so it would be much easier just working in groups.

The range of tech savvy students was apparent, but they were willing to help each other out. Most of the students did mention that they learn well with the computer software, but others found it a problem since they had to use scratch paper to solve math problems on anyways and didn't like that they had to also insert the answer into the computer.

Students have mixed emotions about certain technologies. For the most part they enjoy it and think it is good so long that it is helpful and easy to use. Referring to his attitude about the technologies used in his class, Cal said, "I think that they are pretty well made. I like all of them except for Success Maker... Sometimes it makes it harder but mostly it's pretty easy." This student had mixed feelings about Success Maker depending on what subject he was using it for; he did not like it when it was too hard but also when it was too easy. Johnny said, "I think they are really cool because unlike other teachers we are pretty lucky because all we mostly use is stuff that encourages people to learn more and it's more funner than having to read a lesson from the book." When it comes to technology use in the classroom students have their differences and are able to acknowledge that they have their pros and cons. As Kaila put it, "You can be using

technology that makes it harder for people to learn and you can use some that make it easier to learn, so it's either way but it depends on the person and how they pay attention." At the end of the day it comes down to each individual because everyone learns differently.

### **Teacher Interviews**

After analyzing the interviews of both teachers, a few themes arose; 1. technology is a helpful tool in implementing lessons, 2. technology use can be an issue when it is not being used properly, and 3. technology is great for students' cognitive development.

Although the teachers were from different schools, they used the same technological tools such as PowerPoint and the internet to help them develop and carryout lesson plans. Their students used a lot of the same technology as well such as Accelerated Reader, Success Maker, and the Elmo. Both teachers made it clear that they are in favor of technology use in the classroom. Mrs. Salinas said, "Technology serves as a visual and makes learning and teaching easier." And Ms. Chapman responded by saying, "I see technology as an opportunity because it allows students to access things outside of the textbooks. The mobi and the clickers provide instant feedback. In every way possible technology works for both of us." Both teachers are very fond of the technology that is available to them for instructional purposes.

Both teachers agreed that technology can be a problem when it is used the wrong way. As Ms. Chapman put it: "

I think some teachers sometimes get new tools and don't know how to utilize them. For example, the Elmo, which is an awesome tool but what it has done is caused teachers to be centralized in one part of the classroom sitting down doing

their work there versus walking around being there for the kids. Kids do much better with the whole proximity thing versus a teacher just in front of the classroom, it is kind of old school and we are trying to trend away from that because that can be a potential problem.

Part of the problem is some teachers are not trained properly on how to use some of the new devices that are available. Mrs. Salinas said, “To ensure that technology is being used at its full potential we need to make sure that everyone has access to it and provided the necessary technology courses so that everyone knows how to use it.” Teachers need to be trained so that they are not set up to fail. A big problem is that there is not enough funding to go around to all districts and schools.

Ms. Chapman and Mrs. Salinas did not think it was fair to give homework assignments to their students that would require technology. They said that not all students have technology available to them at home, so they do not require students to use technology at home although they do promote it if they have it. They recommend certain learning websites in math and language arts, and also encourage them to complete AR quizzes. Both schools do have computer labs which both classes visit on a daily basis. Teachers are also bringing in their own personal devices to share with the class to complete AR quizzes and using them as incentives for students because they want to use them.

The technology teachers are using grabs their students’ attention, so it helps with their learning. Mrs. Salinas reports that, “In a cognitive sense of thing the screen keeps students focused and engaged. I think that when it comes to academic development the computer programs are a huge help because they indicate who needs help with what.”

When asked in what ways do you think of using different forms of technology during class time can have a positive influence on certain aspects of students' cognitive/academic development? Ms. Chapman replied:

I would just say any type of technology is going to tap into something for students' cognitive development. Obviously always using the same type of technology is going to get boring but you change it up and show them something different. I don't always use the same thing every day. I keep it new and exciting sometimes. I sometimes put music when they are working on something, and they like it. Any form of technology can help tap into their learning development as long as it is all used correctly.

Part of cognitive development has to do with attention, so teachers are advised to change up their methods of teaching so it is not always the same or else students will get bored. Both teachers did not feel that technology had any negative influence towards their students' cognitive development.

### **Description and Justification of Action**

Technology is the new innovation being introduced to elementary schools. The researchers believe that there are many benefits to bringing technology into the classroom, but also understand that there are some negatives. It is important to keep up with technology in this day in age, but is it good for elementary aged students? The researchers believe so, and that is why they want to make sure the opportunity of using technology in the classroom is given to all elementary students.

There are a few actions that can take place to ensure that students are given the opportunity to use technology in their classrooms. One involves the awareness of the

different technologies that are being used in schools already that have proved to show positive impacts on students' learning. Researchers could visit many schools around the area that are not currently up to par when it comes to technology use, and spread the word to principals of the technology and software that are working for other schools. The new Common Core State Standards that come into effect this upcoming 2013/2014 school year has requirements in 5<sup>th</sup> grade language arts which technology has to be used to complete. Since the researchers believe it would be wise to have an assignment prepared before hand that fulfills the requirements, they can come up with an assignment that they can use when they become teachers and share with their colleagues. A third action that can take place is to reach out to the developers of children's learning software programs and technology companies to see if they are willing to make any contributions to needy elementary schools.

Evaluation of Action Options			
	<u>Speaking to Principals</u>	<u>Making an Assignment</u>	<u>Finding Contributors</u>
<b>Impact</b>	High	High	High
<b>Cost</b>	Medium	Low	High
<b>Time</b>	Medium	Low	High
<b>Access</b>	Medium	High	Low
<b>Reasonableness</b>	Medium	High	Low

Table 1: Describes the likelihood amount in low, medium, or high.

All three of the proposed actions are great ideas and should all be done. The researchers would like to start off by advocating the second proposed action that was mentioned earlier. They have made an assignment that focuses directly with technology so that students can understand there capabilities with technology, and also meet that part of the Common Core State Standards.

Given the impact, cost, time, access, and reasonableness, the researchers recommend making assignments that will incorporate some of the technology aspects of the new Common Core State Standards that will be in effect this upcoming 2013 school year. Some of the following English Language Arts Standards (2013) require technology use:

W.5.6 With some guidance and support from adults, use technology, including the Internet, to produce and publish writing as well as to interact and collaborate with others; demonstrate sufficient command of keyboarding skills to type a minimum of two pages in a single sitting. W.5.8 Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources. And S.L.5.5 Include multimedia components (e.g., graphics, sound) and visual displays in presentations when appropriate to enhance the development of main ideas or themes.

It is the best option because the teacher has full control on the assignment that they will make up. They can make sure that all the technology sections of the Language Arts Standards (2013) are being met. There is no issue of having to wait for anybody that is up on the latter to approve anything or hear what they have to say. Action can be taken immediately.

It is important to start off by first introducing the action project to schools that might take part in getting new technology. Speaking to the principals would be the second step so that they are aware of the opportunities that are available out there for elementary students. Principals are the ones who are in charge of making the final

decision of what goes on in their school that is why it is wise to first speak to them. It would be a good idea to also set up a presentation about the topic so that teachers, students, and parents can all be informed and given an opportunity to express their opinions on the possible technology that would take part in students' learning. Because students and teachers are the stakeholders that are directly affected by the use of technology in the classroom, it would be very beneficial to hear what they have to say about it. Teachers can express how they feel about having to learn and teach the new technology because they are the ones that are going to be mandated to show students how to use the technology and assess students. Students' outlook is most important because at the end of the day it is about what is working for them. Any changes are going to affect the way they learn. It is best to accommodate students so that they can reach their full potential in their education. And of course it is always important to keep parents involved in any ideas or decisions the school may plan to formulate that affects their children. Schools need the parents' support and vice versa. By listening to the capstone project and the input of all stakeholders, principals can then decide what types of technology and software are best for the school they are leaders of.

Although the researchers do consider contacting district officials and corporations, it would not be the initial action they would take. It is already difficult getting a hold of principals as it is because of their busy schedules, and the fact that we are only student researchers ourselves. By some, the researchers may not be viewed as credible to have their ideas be heard and taken serious, because they do not experience and understand the issue the same way other stakeholders do. One can only imagine how much harder it is for us the researchers getting in contact with people outside of the

school who are higher on the ladder. Contacting districts officials would be a clever idea because perhaps they are not aware that some of the schools in their jurisdiction are not up to par with California State Standards. Hopefully by being more informed by the researchers, the district officials will take some action to ensure that technology is being implemented the way it was transcribed to be in the Standards. They might feel the pressure since funding comes from the state and they want money to keep rolling in. The awareness building of the researchers is with good intentions, but it can also backfire, because they will be putting it out there that certain schools and districts are not following guidelines which may impact the funding they receive and make it even worse for them at the end. Schools and districts are not completely following California State Standards Schools and need as much help as they can get. Contacting corporations that could perhaps donate products or money would benefit students and give a better name to that company. New learning software, computers, and any other technology would be a major upgrade to the deficits many schools face today.

Although we are only student researchers, we will strive to have our capstone project be heard. We believe that technology is an opportunity for students, and the issue is that not all students are given the same opportunity to use it. Education is a God given right, and there should be equality no matter what race and social economic status one falls under. We will start off by building awareness at a micro level and hopefully work our way up till we have touched those at the top. All that care and believe in the opportunity that this project represents will do their part. By starting central then working outward, the researchers can build their credibility by rising in the number of followers and having more representation that will support them.

### **Action Documentation**

The objective of the researchers, Jaime Muñoz and Francisco Gutierrez, going into the capstone project was to gain the different insights of students and teachers about the technology that they use for school purposes. Initially the researchers wanted to spread the word about some of the technologies that are being used at certain schools to others who are not yet up to par, so that they can possibly acquire similar technologies to advance their students' learning. The problem was that there was there was insufficient time to complete that action project given the fact that there were deadlines to meet to complete this paper. However, after some investigation the researchers realized that some of the Common Core State Standards were not being met. The researchers also came to an understanding that many students are very tech savvy and able to use some technologies on their own to assists them in their learning. For that reason, Jaime and Francisco decided that because most students already have the computer skills necessary to do online research, schools need to add projects for students to their curriculum that forces them to fulfill the technology requirements in the Common Core State Standards. For the action project, the researchers came up with a specific 5<sup>th</sup> grade assignment that would satisfy some of the components of the Common Core State Standards. The following is the assignment:

#### **State Project**

- 🚩 For the next 2 weeks in the computer lab, we will go over how to work on a project with a partner by using the internet. This whole week you will have access to the computer lab incase you do not have internet access at home or have

questions for me. I recommend you use the computers at any library if you do not have one at home because our time is limited in the computer lab at school.

- ✚ In this assignment, you and partner will demonstrate your computer skills:
  1. You will use the internet to find sources.
  2. You will use Google doc, so you both can work on the assignment together.
  3. You will communicate with your partner via email.
  4. You and your partner will present your project using PowerPoint or Prezi.
  5. You will have to analyze your sources and decide whether your sources are valid (Wiki is not a valid source).
  6. At the end of your PowerPoint/Prezi you must have a reference page cited correctly (minimum 6 sources).
- ✚ In the first part of the project, you and your partner will pick one of the states from the United States of America to research (1 state per group). Together you will type up at least 4 pages (2 pages each) double spaced and in MLA format. In the paper you will provide as much information as possible about the state. For example: some history about the state, the year it became a state, why it became part of the union, the different capitals it has had, some important people from the past and present, current governor, state flag, state bird, state motto, state tree, the geography and different climates of the state, etc...
- ✚ In the second part of the project, you and your partner will present your findings to the class by using PowerPoint or Prezi. Make sure to include pictures and text. The presentation needs to be between 5-10 minutes (each member must speak for equal periods of time) and a minimum of 10 slides.

- ✚ You will have 2 weeks to complete both parts of the assignment. A rough draft of your paper is due in 1 week (electronic copy), so I can give you feedback.
- ✚ Email me if you have any questions. Good Luck!

### **Critical Reflection**

From this capstone project, I learned a lot about the first hand research abilities I attributed while being a student at CSUMB that will carry on with me the rest of my life. I know that I have the confidence to reach out to a community, and I am able to conduct my own study by acquiring participants that are willing to help. I have proven to myself that I have what it takes to represent myself as a professional that can be taken seriously when I bring about a critical issue. I can work towards change, and open the eyes and ears of the people I share my knowledge with. By at least making people aware of an issue, and having them think about it, I have taken a step forward in the long process of making a bigger impact. There is always more to be done, and that is what I will strive for on my journey in becoming a teacher.

The themes of the Liberal Studies department and its required coursework have positively impacted my professional development. During my years at CSUMB I have fulfilled the 5 MLOs; Developing Educator, Diversity and Multicultural Scholar, Innovative Technological Practitioner, Social Justice Collaborator, and Subject Matter Generalist. I have acquired much knowledge through all the courses I have taken and have had the great opportunity to practice what I have learned through service learning. Multiculturalism is important to understand, and the department does a great job of offering classes where we learn about the struggles different ethnic groups have had to overcome throughout the history of our country. All my professors at CSUMB use i-

learn because they understand the importance of technology, and also give us assignments where technology must be used. Because of some of the projects that we are given, we understand the importance of social justice, and even get the chance to contribute to the community for social change. The Liberal Studies major is great because it offers a wide variety of content from different subject matters.

I know I am prepared for my next challenge in my goal of becoming an educator. Next semester I will start the integrated credential program, and I feel good going into it. CSUMB and the Liberal Studies department have done a fine job of preparing me for what is ahead. Thank you!

## References

- Barbara, M., & Krovetz, M. (2005). Preparing principals to lead the equity agenda. *Educational Leadership and Administration: Teaching and Program Development*, 17(1), 11-19.
- Berk, L. E. (2011). *Infants, children, and adolescents, books a la carte edition* (7th ed.). Boston, MA: Allyn & Bacon.
- Biggers, D. (2001). The argument against Accelerated Reader. *Journal Of Adolescent & Adult Literacy*, 45(1), 72.
- Board Policies. (2012). *Gilroy unified school district*. Retrieved from <http://www.gamutonline.net/district/gilroy/Search?vIDistKey=2304&sSearchOne=technology&sdoc=1>
- Ciampa, K. (2012). Reading in the digital age: Using electronic books as a teaching tool for beginning readers. *Canadian Journal of Learning and Technology*, 38, 1-26.
- Cobb, A. (2010). To differentiate learning or not to differentiate? Using internet-based technology in the classroom. *Quarterly Review of Distance Education*, 11, 37-45.
- English Language Arts Standards. (2013). *Common Core State Standards Initiative*. Retrieved from <http://www.corestandards.org/ELA-Literacy>
- Ertmer, P. A., & Ottenbriet-Leftwich, A. T. (2010). Teacher technology change: How knowledge, confidence, beliefs, and culture intersect. *Journal of Research on Technology in Education*, 42, 255-284.
- Huang, T. H., Liu, Y. C., & Chang, H. C. (2012). Learning achievement in solving word-based mathematical questions through a computer-assisted learning system. *Educational Technology & Society*, 15, 248-259.

Lee, K. (2006). Online learning in primary schools: designing for school culture change.

*Education Media International*, 43, 91-106. AF-R

doi:10.1080/09523980500237807

Lefever-Davis, S., & Pearman, C. (2005). Early readers and electronic texts: CD-ROM

storybook features that influence reading behaviors. *Reading Teacher*, 58, 446-454.

Lingnau, A. A., Hoppe, H. U., & Mannhaupt, G. G. (2003). Computer supported

collaborative writing in an early learning classroom. *Journal Of Computer Assisted Learning*, 19, 186-194. doi:10.1046/j.0266-4909.2003.00019.x

Mallette, M. H., Henk, W. A., & Melnick, S. A. (2004). The Influence of Accelerated

Reader on the Affective Literacy Orientations of Intermediate Grade Students. *Journal Of Literacy Research*, 36, 73-84.

Navarro, J. I., Marchena, E. E., Alcalde, C. C., Ruiz, G. G., Llorens, I. I., & Aguilar, M.

M. (2003). Improving attention behaviour in primary and secondary school children with a computer assisted instruction procedure. *International Journal of Psychology*, 38, 359-365. doi: 10.1080/00207590244000042

Our School. El Roble Elementary School. (2012, December 11). *About our school*.

Retrieved from <http://elroble.schoolloop.com/aboutourschool>

Purcell, K., Heaps, A., Buchanan, J., & Friedrich, L. (2013, February 28). *How*

*teachers are using technology at home and in the classroom*. Pew Research Center. Retrieved from <http://pewinternet.org/Reports/2013/Teachers-and-technology>.

Roberts, G. I., & Samuels, M. T. (1993). Handwriting remediation: A comparison of

- computer-based and traditional approaches. *Journal of Educational Research*, 87, 118-125.
- Roza, M., Hill, P.T., Sclafani, S., & Speakman, S. (2004). How within-district spending inequities help some schools to fail. *Brookings Papers on Education Policy*, 201-227.
- Roberts, G. I., & Samuels, M. T. (1993). Handwriting remediation: A comparison of computer-based and traditional approaches. *Journal Of Educational Research*, 87, 118-125.
-