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TECHNOLOGY'S ROLE IN INQUIRY-BASED LEARNING

A Graduate Research Paper

Submitted to the

Division of School Library Studies

Department of Curriculum and Instruction

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by

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ABSTRACT

The purpose of this study was to explore the role of technological devices such as computers, cell phones, or tablets in inquiry-based learning. Twice a week over a three-week time period, the researcher observed a population of 24 seventh graders in a classroom from a large Midwestern school district and watched to see when they used their technological devices for inquiry learning. The researcher noted whether device usage was teacher directed or if the students chose to use the devices while searching for information. In addition, the researcher used semi-structured interviews with three students and their teacher to understand more clearly the teacher's expectations for student use of their devices during inquiry and how the students utilize those devices while looking up information. The research questions asked 1) what prompted students to look up information on their devices, 2) to what extent students evaluated information that they found, and 3) to what extent access to technological devices changed learning and teaching. Results showed that the teacher mainly directed students to look for specific information on their technological devices. Students evaluated information by looking through several sources to see if they found important information or information they could understand. Greater access to technological devices such as computers is changing learning and teaching in that the students in this study were actively engaged with information through collecting online information, creating videos and participating in virtual labs. Several areas of student difficulty were also noted. Students used images without noting whether they were free of copyright restrictions and without citing them and students were not engaged in inquiry learning through driving the questioning; rather they were guided to collect specific information for assignments.

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CHAPTER 1

INTRODUCTION

"All right, it's time for United States history. Please open your textbooks to page 30,"

says Mr. Jones. After getting out their textbooks, several students in the class pull out their

smartphones, computers, and other technological devices and start looking up causes of wars on

them. Mr. Jones then asks all students to put away their devices and concentrate on the history

text at hand, but perhaps he should reconsider that directive. Perhaps Mr. Jones should allow

students to use their technological devices in his history class or even incorporate their use into

his lessons.

Problem Statement

Technology has become commonplace in today's society. An increasing number of

students own technological devices and go online. According to Nielson, "the majority of

mobile-owning American teens (58%) now own smartphones" (Perez, 2012, p. 1). Also, "half of

all American teens have gone online on their mobile phones in the last 30 days," (Lenhart, 2012,

p. 4). Considering that these surveys represent 2011 data, ownership reported in these survey

results has most likely increased.

In keeping up with the digital age, schools are trying to integrate technology into

curriculum. "Since the early 1980's…educational and curricular reforms have been widely

premised on the perceived incapacity of schools to keep pace with technological change and its

social and economic implications" (Williamson, 2013, pp. 3-4). In reference to this educational

reform, Warschauer (2011) explains that schools need better technology in keeping up-to-date

and teaching children skills that they will need in the future. As funding permits, many schools

are going one-to-one, i.e., enabling a ratio of one device to one student. "One-to-one

environments, where all students have access to their own computer or digital device, are the best for enabling content access, community building, construction, and composition" (Warshauer, 2011, p. 31). Once schools acquire technology tools, remaining is the issue of how they are being used in the classroom, and what students are gaining through using those devices. Technology in combination with inquiry in the classroom will help students develop important life skills such as critical thinking and problem solving.

Inquiry is a 21st century skill where students are actively involved and take responsibility for their own learning. Langhorne, Rehmke, and the Iowa City Community School District (2011) state that "inquiry in the school setting is defined as engaging students in investigating and developing their understanding of significant topics or issues through a process of accessing, evaluating, creating, and communicating information" (p. 21). Through inquiry, students can discover how they can be lifelong learners and think more critically. Students can reflect on their active experiences, build on what they already know, and interact socially with others (Langhorne et al., 2011). When engaging in inquiry, it can be helpful to follow a process model that shows the stages of learning. One such model, Kuhlthau's Information Search Process Model, "involves seven stages: Initiation, Selection, Exploration, Formulation, Collection, Presentation, and Assessment" (Donham, Bishop, Kuhlthau, & Oberg, 2001, p. 5). Inquiry is a complex, constructive process where students can learn from exploring and collecting while doing their research. Armed with essential questions or big ideas, students have the opportunity to use a variety of sources and explore before "formulating a focus that identifies a clear question to pursue" (Maniotes & Kuhlthau, 2014, p. 10).

Technological devices may play a key role in inquiry-based learning. Without integration of technology in the classroom, inquiry is limited to that which is offered in the immediate

environment. The availability of digital materials in the classroom provides flexibility in meeting the needs of diverse learners as they carry out inquiry-based learning (Warschauer, 2011). Small, Arnone, Stripling, and Berger (2012) assert that "most of the professional literature on pedagogy advises that to prepare our students best for the complex world in which they will live and work we need to develop interactive, inquiry-based, technology-rich curricula" (p. 111). Through using technological devices, students have the opportunity to actively search the Internet while building on their prior knowledge and interacting with others in the process. This research study examined the usage of technological devices during inquiry learning. For the purpose of this study, a technological device means a computer, cell phone, tablet, or similar device that has Internet capabilities.

Immediate access to information is important. In the 21st century classroom, online access has been proven to be valuable. Langhorne et al. (2011) explain that in a 21st century classroom "there is ready access to information tools in many formats—print and digital" (p. 24). Print sources are useful, but with web-connected technology, students can have the most up-to-date information. Technology helps to support inquiry by providing access to information tools and resources that keep students actively engaged. Not allowing students to use technological devices to search for information during class hinders them from having immediate access to the most current information available.

Purpose

The purpose of this study was to explore the role of technological devices in inquiry-based learning. It informs teachers, teacher librarians, parents, and students of the potential place of technology in the teaching and learning environment.

Research Questions

1. What prompts students in a classroom setting to look for information on their technological devices?

2. To what extent do students evaluate information that they find using their devices?

3. To what extent is access to technological devices in the classroom changing learning and teaching?

Assumptions and Limitations

This study assumes that each student has access to a technological device with Internet capabilities in the classroom of interest. Also, this study assumes that inquiry-based learning has been adopted in the study setting. The study is limited to the study of technology usage in a seventh grade classroom in a single large Midwestern school district.

CHAPTER 2

LITERATURE REVIEW

The purpose of this study is to explore the role of technological devices in the context of inquiry learning. The first subtopic investigates adoption of innovation in schools. Technology has drastically changed in schools throughout the years, and teachers have had to learn how to integrate new forms of technology in the classroom. The next subtopic delves into inquiry-based learning. Here, the research focuses on inquiry that is supported by technology. Finally, the last subtopic analyzes the importance of educational technology, and more specifically, the access that students have to information.

Innovation Adoption

How and why individuals adopt innovation has motivated a great deal of research. Park, Kim, Shon, and Shim (2013) studied how psychological factors affected South Koreans' smartphone usage within the technology acceptance model. Park et al. strived to find the associations between individuals' innovativeness and the perceived usefulness and perceived ease of use of smartphones. Surveys were administered in Seoul to 1,360 residents between the ages of 17 and 49. Data were analyzed using structural equation modeling and t scores. Park et al. (2013) noted that the perceived ease of use of smartphones was significantly associated with their perceived usefulness, but the perceived ease of their use did not relate to the intention to participants to keep using the smartphones. The South Koreans' perceived ease of use of smartphones was related to their dependency on the phones.

Miranda and Russell (2012) examined technology innovation in the education realm. To explore factors related to teacher-directed student use of technology, Miranda and Russell conducted a research study addressing these questions: "Which teacher-level factors have the

largest effect on a teacher's instructional use of technology?" and "How do those factors interact to affect a teacher's instructional use of technology?" (p. 657). They surveyed 1040 elementary teachers from 81 schools in Massachusetts. Based on 14 factors deemed to affect technology use, the survey consisted of 330 items with three to five response options. The survey responses were transcribed, coded, and analyzed.

In making sense of the results, Miranda and Russell (2012) used a variety of scales and models. They found that teacher confidence and experience worked together in determining the extent to which teachers thought that it was important to use technology in their teaching. This suggests that teachers who have had more experience using computers were more confident in using technology in instruction compared to teachers who have had less experience with technology. Those teachers with more technology confidence recognized technology as a more important teaching tool than did teachers with less confidence. Also, teacher integration of technology hinged on the degree to which they believed technology produced benefits.

Similarly, in a study on computer use in K-12 education, Colandrea's (2012) purpose was to observe how teachers followed the requirements in using computers in the classroom and what motivated their technology use. This investigation into the extent to which teacher attitudes toward computers and their knowledge of them affected their use of computers in preparing lessons and carrying them out is particularly relevant to the current study. Colandrea collected data through surveying 120 public elementary, middle, and high school teachers in New York State.

A few findings from Colandrea (2012) are of particular relevance to the proposed study. Through a quantitative statistical analysis of data, it was discovered that teachers' knowledge of computers was the strongest predictor of their using technology while they prepared lessons and

taught them. The second greatest predictor was the teachers' attitude toward technology. Also, the grade level of the students taught by the teacher affected the degree of technology use. According to Colandrea (2012), "teachers who taught in grades 9-12 reported the highest level of knowledge of computer technology and use in lesson planning when compared with teachers in grades K-5 and 6-8" (p. 78).

James (2009) focused on middle schools to examine teachers' understanding of technology integration. Of particular relevance here is the focus on the factors that affected teachers' integration of technology in their instruction. James (2009) observed 37 teachers from three school districts as they used technology with their students. Following observation, the teachers were interviewed to ascertain more information. Data were collected over three months with 31 days of observations and 37 interviews.

Through analysis of the data, James (2009) concluded that teachers' use of technology was influenced by administration and state mandated testing. Several teachers mentioned that they wanted to be included in the decision-making about technology purchases rather than deferring to the administration. Teachers desired training in how to use the technology. Some teachers attributed their low degree of technology integration to the time restraints imposed by the requirements for state testing. Also, how the teachers viewed teaching and their degree of comfort with technology affected their technology use. Even though there were several teachers who were not comfortable using technology, they recognized the benefits it had for students.

In considering how technology innovation affects students, Donavan, Green, and Harley (2010) explored how laptops in a one-to-one environment were being implemented in one school. These researchers wanted to find the ways that a one-to-one laptop program could be

carried out at this school. During the first year of one-to-one laptop initiative, this study was conducted in seventh grade classrooms at a middle school in the southwestern United States.

Donavan et al. (2010) made an Innovation Configuration Map of the ways that teachers and students were using laptops and then used this map to identify specifically how innovation was occurring. Observations and interviews were used to substantiate this process. Of importance here is the finding regarding the use of laptops for teaching and learning as expected in the 21st century. Donavan et al. (2010) noted that there was a pattern of using the laptops as the primary tool during the teaching lesson. Also, "there was a clear expectation from students and teachers that laptops would be used" (Donavan et al., 2010, p. 431). Students used their computers to perform basic functions, for Internet-based research, to present individually and with a group, and to obtain assignments. Students had freedom to explore the technology and content during the lesson. Technology innovation affects both teachers and students and how students respond to the technological tools affects teachers' adoption of integrating technology into the classroom.

Inquiry-based Learning

Setting the stage for modern inquiry-based learning, the grounded theory research of Kuhlthau (1989) using inquiry through the library resulted in development of the Information Search Process (ISP) model. This model continues to serve as the framework for her 2012 Guided Inquiry Framework and of a wide base of educators' understanding of inquiry learning and information seeking. Kuhlthau (1989) analyzed a series of five studies on students' perspective of searching for information during a research assignment. She used data sources from a variety of ages, ability levels, and different types of library users. Results showed that the information search process is a complex learning process that happens in a series of stages.

Students went from showing confusion and frustration when they were unsure about a research topic to demonstrating confidence and satisfaction as thoughts became clearer.

Inquiry learning has become a critical part of expanding students' reasoning and thinking skills. Song and Looi (2011) sought to discover how teacher influences on classroom practices impacted student inquiry learning in a Computer-Supported Collaborative Learning (CSCL) environment. Their questions "Do teacher beliefs and practices influence student inquiry learning in a CSCL environment" and if so "what particular evidence of student learning showed the influence" (p. 134) are particularly interesting for the current study. It involved a comparative study of two cases with teachers using the same lesson plans in similar CSCL environments.

The data (including interviews, videos, and observations) from these two teachers were coded and analyzed. Song and Looi (2011) surmised that the teachers had different perceptions of how students learn and show that they understand information. One teacher thought that students learned best from progressive inquiry learning and showing how they came to a certain answer. The other teacher believed that content-based instruction was important to understanding concepts and that students needed her guidance in working through problems to avoid misconceptions. She determined that students understood a concept when they arrived at the correct answer. With the first teacher, students actively collaborated to solve problems and made use of the technology available, but with the second teacher, students did not know where to begin in connecting concepts or using support from others to generate new ideas.

In a similar case looking at technology supported inquiry-based learning environments, Hakverdi-Can and Sonmez (2012) explored using WebQuest as a teaching and learning tool. They invited pre-service teachers to develop WebQuests for middle school students. Two of the

key questions were, "What are the opinions of pre-service science teachers on the development and application of a WebQuest inquiry-based learning environment?" and "How do pre-service science teachers perceive WebQuest as a teaching tool?" (p. 342). Participants involved 22 pre-service teachers from a major university in Turkey who worked individually or with a partner to design a WebQuest. Their students were then given a questionnaire including five open-ended questions related to developing and using WebQuest as a teaching tool. Data were collected, and questionnaires were coded and analyzed.

Hakverdi-Can and Sonmez (2012) reported that participants had positive experiences using WebQuest and would use it in their own teaching. However, due to difficulties in planning and preparation, they would rather use a WebQuest that was already developed rather than creating their own. Through using WebQuest to solve a problem, the pre-service teachers said that WebQuest would actively engage students and help them to make real-life connections as well as to think more critically. The participants felt that WebQuests would motivate students to do research and become active learners but found that limitations might include not having Internet access and making sure that all links in the WebQuest are working and up-to-date.

In a study examining the effects of technology, i.e., laptops, in inquiry-based classrooms compared to traditional classrooms where textbooks are used, Frazier's (2008) purpose was to see how the achievements of fifth grade students in an inquiry-based classroom compared to their achievements in a traditional classroom. He wanted to determine the sustainability of inquiry-based programs. One of Frazier's questions investigated if students in inquiry-based classrooms had different or congruent fifth grade norm-referenced scores on reading comprehension, reading vocabulary, and reading total measures compared to students in traditional classrooms.

To answer this question, Frazier used pretest and posttest surveys with 20 male and female students attending third through fifth grade classes. The study observed one grade at an elementary school over a period of three years. The data were analyzed by using independent t tests to determine the difference between the scores of the two groups, and multiple statistical tests were conducted. After analyzing the posttest scores from the Iowa Tests of Basic Skills, Frazier (2008) reported the scores from both the inquiry-based and traditional classrooms were not statistically significantly different in their reading scores. Even though the mean scores from inquiry-based classrooms were numerically greater, the students in inquiry-based and traditional classrooms did not perform statistically significantly different on the norm-referenced test.

Through using a different form of technology, i.e., mobile devices, Jones, Scanlon, and Clough (2013) explored how personal inquiry learning was supported in informal and semi-formal learning situations. There were two case studies, but for the purpose of this study, only the first case was analyzed. In the first research question, Jones et al. (2013) wondered, "How can scripted personal technologies be designed to support effective learning in semi-formal and informal settings?" (p. 23).

For 11 weeks, the study investigated personal inquiries in two groups of students at a geography after-school club that took place one hour each week. The data collected included audio, video, notes, and transcriptions of observations and interviews, and were analyzed qualitatively and coded. Jones et al. (2013) acknowledged that students were able to use the mobile devices to support their inquiries successfully. Even when carrying on the inquiries at home, students were able to continue without the support of teachers. They took responsibility for the planning of their inquiries and used the mobile devices to figure things out for themselves. They were able to do so because they had certain software (Sustainability

Investigator) to support them. Also, the students chose the topics they wanted to study. Jones et al. declared that learner control and choice is crucial to motivating inquiries in these informal and semi-formal settings. In these ways, technology has been shown to be beneficial in inquiry-based learning situations.

Educational Technology

With extent of the technology available, it can be hard for schools to decide what to use in their classrooms and to understand the extent of the benefits of using technology in class. In trying to find out how effective educational technology was in math classrooms, Cheung and Slavin (2013) pursued the question of whether or not educational technology improved K-12 math achievement compared to traditional ways of teaching without technology. The study included students in K-12 math over a course of 12 weeks. In order to compare traditional ways of teaching, studies from the past (since 1980) were analyzed and coded. According to Cheung and Slavin, "a total of 74 qualifying studies were included in our final analysis with a total sample size of 56,886 K-12 students" (p. 96). The evidence found that educational technology applications, i.e., computer-assisted instruction, have a positive effect (though not by a large margin) on student achievement in mathematics.

Another study, this time observing the relationship between technology and student achievement, took into account students' access to technology. Knight (2008) was curious about the connection of technology to standardized testing and conducted research to discover the relationship between the capacity, usage, and access of technology with student standardized achievement test scores. The study used state-level data from *Technology Counts,* which is *Education Week's* annual assessment of technology in schools, wherein each school district was surveyed regarding technology implementation and standardized tests that were gathered from

2003 to 2007. Knight (2008) collected data from National Assessment of Educational Progress (NAEP) to get standardized reading and math test scores for students grades four and eight. The study was limited in that the scores were not available for even numbered years.

After statistically analyzing the results, Knight (2008) concluded that technology has a positive impact on student achievement. Usage and capacity of technology showed no relationship to test scores, but there was a correlation between access to technology and standardized test scores. Knight noted that "access to technology also included connectivity to a high-speed internet," and "besides keeping the ratio of computers to students low, it is also important for a school to have high speed internet connectivity" (p. 53). The study has limitations, however in that data at a state level has inherent limitations of granularity as distinctions within state are not visible, given technology implementation occurs typically school by school, rather than as statewide implementations.

Computers incorporated in classrooms offer students access to information in order to support their learning. Perera (2008) explored how teachers used computers in their instructional methods and objectives in secondary school classrooms. One of his questions was, "How do teachers incorporate computer-related technologies into instructional strategies?" (p. 6). The scope of the study was limited to private secondary schools in New York City.

A survey questionnaire was administered to 84 secondary teachers from five private high schools in New York City and its suburbs. Twenty-three of these teachers were also interviewed and the classrooms of 21 of these were observed. Perera (2008) reported that "teachers used instructional procedures that integrated technology to introduce the lesson; to motivate students; to keep them focused and engaged; to build bridges to prior knowledge;" (p. 90) and so on.

Some teachers used technology as a tool to benefit students. This study shows that technology has an important role in enhancing student learning.

Summary

Studies described here propose that when students have access to technological devices in the classroom, they will use those devices. Research on inquiry suggests that integration of technology helps to support effective learning. This study will examine how students and teachers employ technology integration throughout the inquiry process.

CHAPTER 3

METHODOLOGY

Due to the growing popularity and use of technology, many schools have access to a number of technological tools. Although schools are keeping up-to-date with technological devices, when students are not allowed to use technology in the classroom to look up information, it hinders them from having immediate access to up-to-date material. Through this study, the researcher explored the role of technological devices in inquiry-based learning.

Research Design

This qualitative case study is a single study based on one or more events or phenomenon. According to Wildemuth (2009), a case study is "often used in exploratory studies to define phenomena worth studying further" (p. 52) and that "a single case study provides in-depth investigation of and rich detail about phenomena" (p. 54). The researcher explored how technology is used in inquiry. A case study is appropriate since it "focuses on examining contemporary events in a natural setting" (Wildemuth, 2009, p. 59). The researcher observed children in their natural learning environment—the classroom setting.

Due to a case study's specificity, it may be hard for readers to make a generalization to other settings from the findings in this study. Also, the study is limited by frequency of visit. Given that the researcher was only in the classroom twice a week for approximately three weeks, the researcher was not able to include everything that happened in the classroom. Prior to undertaking the study, the researcher applied for approval from the University of Northern Iowa Institutional Research Board and received informed consent from parents of participants, assent from participants, and a letter of cooperation from the school. Participation was voluntary.

Data Sources

The researcher directly observed a classroom of 24 seventh graders in a large Midwestern school district. The classroom was selected due to the presence of a teacher who both uses inquiry with technology and was comfortable being observed. In identifying the teacher and classroom, the researcher enlisted the assistance of the principal in the target school. During observations occurring twice a week over a three-week time period, the researcher watched to see when students used their technological devices. It was noted whether device usage was teacher directed or if the students were choosing to use the devices on their own. Writing the observation form included as Appendix A, the researcher focused on how the teacher and students used technology during inquiry and recorded other interesting happenings as well.

Also, the researcher used a semi-structured interview with the teacher (Appendix B) to discover what the teacher expects of students with their devices. Semi-structured interviews with three students (Appendix C) recorded what students say they do with their devices.

Data Analysis

This case study analyzed decisions made or information seeking episodes (Wildemuth, 2009). Within the focus on the single case, the study took multiple perspectives by gathering data based on multiple units of analysis, then aggregated it to understand the case that was the focus of the study (Wildemuth, 2009). This study summarized what was seen (based on the observation form themes) and compared it with what was said (based on the teacher and student interview forms). The researcher examined 1) what the teacher expected of the students with their devices, 2) what actually happened, 3) what students said they do with their devices, and 4) what they actually did with them in the classroom. Through triangulation using multiple data sources, the findings of this study provide insight into the role that technology plays in inquiry.

CHAPTER 4

FINDINGS

Technology in education is changing rapidly, and schools are changing with it to allow

students to take advantage of a variety of technological tools. How technology is being used in

the classroom and what students are gaining through the use of devices warrants further

consideration. In this study, the researcher examined the role of technology in inquiry-based

learning.

Using a qualitative case study method based on one or more events or phenomena, the

researcher directly observed a classroom in a large Midwestern school district. Twice a week

over a three-week time period, the researcher observed a population of seventh grade students

and a science teacher in their classroom. The researcher also conducted semi-structured

interviews with the teacher and three students to gain information and clarify how technological

devices were being used. The semi-structured interviews helped the researcher discover if what

the teacher expected of the students' device usage actually happened and if the students used

their devices in the ways they said they were. An observation form with themes derived from the

research questions was used to note whether the teacher directed students to use their devices or

if students chose to use them on their own. As students and teacher were individually

interviewed before, during, or after class, the researcher recorded their responses on an interview

form.

The classroom that was suggested by the principal for observation was a Sheltered Science

class, which meant that students were considered English Language Learners or had only been in

the United States for a few months. The teacher explained that these students needed more

support or needed curriculum taught differently than it would be presented in a typical class. Thus, the researcher adapted the semi-structured interviews as necessary.

Looking for Information

The first research question this study addressed was: What prompts students in the classroom setting to look for information on their technological devices? While observing, the researcher noticed the teacher directed students to use their devices (Chromebook laptop computers) during every class session. The teacher had links to certain websites and videos in Google Classroom that he wanted the students to use. Google Classroom is a platform where students can go to a class that the teacher has set up and open documents and web links as well as turn in assignments. The teacher required students to go to Google Classroom to access interactive lab experiments, watch informative videos, and go to reputable websites that explained information about the current topic. On a typical day in class, students affirmed the teacher had them use their computers to go to Google Classroom, do lab projects, and use other sites to search for information.

Student interviews and class observations provided the insight that students mainly used their devices when the teacher told them to use them. This was due to the teacher's expectation that students were to use their devices at certain times when he allowed. The teacher explained that he expects students to use their devices when he directs them to look up information or use Google Classroom. He remarked, "I have students go to Google Classroom to do the labs." The researcher noted that the students followed the teacher's direction to look up information. For example, when the teacher told the students to research a disease, they started searching the Internet to find information and pictures concerning that disease.

Also, the teacher related that students' need for information to complete assignments caused them to look for information on their computers. The researcher observed this to be the case when the students looked up information in order to complete a video project that was assigned. For instance, after students chose a disease from the list the teacher supplied, they started looking up certain information about it. The teacher provided a template organizer where students were to put in specific information such as background facts and symptoms with visuals (images) that were required in the video. The organizer was a place to help them record their thoughts before compiling them in the Animoto video program. The researcher was only present during the first phase of this project where students were searching for images, and the researcher noticed that they used Google images. The researcher did not have the opportunity to observe the sources that the students used for finding information to create their text.

During lab assignments, the teacher had the students go to Google Classroom to go to certain sites. For one lab, students participated in a virtual petri dish experiment to find out what is most effective in killing germs. There were bacterial species such as staph and haemophilus on different spots on the dish, and the students had to add penicillin, amoxicillin, or a household substance, use time lapse to let it sit a while, and then measure it to see how much the bacteria had grown after the treatment. They had to decide what substance was the most effective against each bacterium. Another class time, the teacher had the students use Google Classroom to watch a video that explained the basics of DNA, and students used the video to answer some questions the teacher had prepared about DNA, genes, chromosomes, and heredity. The students then had the opportunity to create their own DNA model on a website from the University of Utah called Learn Genetics.

Sometimes, the students were allowed to choose the sites they wanted to use in looking up information. The researcher did not observe the students exploring information related to their own questions but rather to material regarding the teacher's questions. For instance, one day, the students were to choose a disease from a list of diseases preselected by the teacher. Students were permitted to use websites of their choosing to find information about that disease to compile into a video. Before the students began their project, the teacher modeled how to use a certain reputable site such as Mayo Clinic to find information about a disease. The teacher did not demonstrate any other sites. The students were told that the Mayo Clinic site was an option that they could use but that they could also choose to take advantage of other sites in looking for information. There was not a list of websites from which to choose. Students started with a search engine such as Google or Bing. During the first class period for this assignment, almost all the students used Google to search for images. The researcher did not have the opportunity to see where students later found their information relating to the background of the disease they chose along with its symptoms and causes.

Related to students' choosing to use their devices to search for information, the teacher stated he sees students using the search engine Google to look up information on their devices if they want to find out what something is. He said, "Yes, they Google a lot." When students were asked if they want to use their computer to look up information even if it is not required for an assignment, many affirm that this is true. One student in particular stated he can "find a lot more information" to help with the project or assignment.

Evaluating Information

The second research question sought to discover the extent to which students evaluate information they find on their devices. When some students were asked if they use the first thing

that they find or if they explore other sources when searching for information, one student replied he generally looks through several sources such as Britannica Online to see what information is most important. Another student stated he looks around in different places to find better information, or information "I can better understand." One student said he just uses the search engine Bing to search for information. He said he likes it better because "it has better resources," or resources he prefers. Upon asking for clarification in both of these student responses, the researcher received the impression that students could better understand the sources due to content and language that was on their level.

In inquiring about how the students decide if the information they have found is good information, a student says he reads "all of it" and decides if it is good. Another student states he searches through to "see what is most important." The teacher expressed that he was trying to teach the students "credible sources" and that he expects the students to evaluate information they find by examining "what's credible and what's not." He said he teaches students at the beginning of the year how to evaluate credible information and websites and teaches them to cite information. Because it can be difficult to observe students evaluating information they find on their own and seeing students evaluating information was not apparent to the researcher, the students and teacher were interviewed instead about evaluation of information.

It was noted that students did not cite the sources used for images and quotes in their movie creations. Students did not appear to limit their search to use images that were free to use and share but incorporated in their movies whatever images (not necessarily copyright free) they liked best as found on Google. The information they used were background facts, symptoms, causes, and effects of the disease they chose from the teacher's list of topics. The students chose

such diseases as the common cold, Ebola, whooping cough, and polio and used Animoto to create an informative video that lasted approximately two minutes.

Changing Learning and Teaching

The last research question addressed the extent to which access to technological devices in the classroom is changing learning and teaching. Each student participating in the study has a Chromebook to use during class. The students are allowed to use these computers while they are at school. Currently, they do not take them home because the district requires the laptops to stay at school. The teacher explained that the school went one-to-one with these computers only three months ago and remarked that he and the students were still learning to use these computers.

When asked if it seemed that access to laptop computers changed his teaching and the students' learning, the teacher said, "Yes and no." He described that the students were "more engaged" in their learning and that it is easier for them to access more information. He said his teaching has not changed but that he has to use a "different type of classroom management" now in his teaching. Sometimes, he has to get the students back on task if they are using their laptop for something other than class activities or listening to music on it when they have not been given permission to do so. Through observation, the researcher noted some times when the teacher asked students to close their laptops because he wanted to explain something to them before they started doing the project on their own on the computer. Also, there were a few times when a student was listening to music instead of doing his project.

The researcher observed that the students listened to music while they were working on lab projects on their computers or searching for information related to assignments and inquired about it. The teacher commented on this saying that he allows students to listen to music while

doing assignments and projects because he believes that some students need to listen to music in order to block out other things and concentrate on the task at hand. The students are allowed to use their Pandora or Grooveshark account to listen to music.

In response to the question about feeling as if the laptop is necessary to or important to learn, one student expressed that it is needed because he uses it to turn in assignments and see what is due. He stated that it is easier than using paper and pencil. Another student explained that he likes using a computer but does not feel as if it is necessary or "that important." He said he could do without it if needed and use a dictionary, textbooks, and other sources instead. Overall, students and the teacher expressed that they enjoyed the benefit of immediate access to information on the computers.

Summary

The data and observations in this study showed that in one science classroom, the teacher mainly directed students to look for specific information on their technological devices. Students evaluated information by looking through several sources to see if they have found important information or information they can understand. Access to technological devices such as computers is changing learning and teaching in that students were actively engaged with information through collecting information, creating videos and participating in virtual labs. Students enjoyed the increased ease of access to more current information. The teacher was provided with a technological tool to enhance instruction but may need to monitor students on such devices in order to keep their focus on working on a certain project or assignment.

CHAPTER 5

CONCLUSIONS AND RECOMMEDATIONS

With technology presiding in today's world, many schools have access to a growing number of technological tools. Not permitting students to take advantage of technology in the classroom prohibits them from searching for information immediately in the classroom. The intent of this study was to explore the role of technological devices in inquiry-based learning.

Conclusions

According to the findings, the researcher sees the importance of making projects open-ended and allowing students to look for information on their devices whenever they show interest or want to find something out. According to Jones, Scanlon, and Clough (2013), learner control and choice is crucial to motivating inquiries. Seeking information and thinking critically about that information are skills students will need in their future. They will need to make decisions related to comparing sources or information in deciding what to buy, where to live, or what sources to trust.

Several areas of student difficulty were noted in this study. Students used images without noting whether they were free of copyright restrictions and without citing them and students were not engaged in inquiry learning through driving the questioning; rather they were guided to collect specific information for assignments.

Student Inquiry

It is good for the teacher to prompt students to look for information, but students also need to actively seek out information on their own and be given the opportunity to explore their own questions. When students form their own questions, they take more responsibility for their learning and may be more interested in finding answers to their questions (Kuhlthau, 2014).

From conducting this study, it was observed that without the teacher's guidance the students would have struggled to find credible sources on their own. The teacher gave the students an example of a credible source they could use, but students seemed to rely on Google to bring up other credible sources while searching for information.

Because the teacher will not always be there in the future to tell the students to seek out different sources, the teacher needs to model this skill for the students and allow the students time and opportunity to practice this skill. Inquiry is a complex, constructive process where students can learn from exploring and collecting information while doing their research. According to Maniotes and Kuhlthau (2014), after students formulate essential questions or big ideas, they can explore them using a variety of sources; "without exploring and formulating a focus that identifies a clear question to pursue, students get mired in the collection stage of research and end up merely reporting on disconnected facts" (p. 10).

In this study, the researcher did not observe the teacher implementing a research inquiry process. Students gathered many facts from sources but were not forming big ideas with a clear question to pursue. Because the teacher was giving factual questions to answer and mainly having students collect facts, students were not empowered by delving deep into exploring the information and reasoning behind the facts and making connections to their prior knowledge.

Identification of Credible Information

It is also important for the students to evaluate sources and information that they find. According to Langhorne, Rehmke, and the Iowa City Community School District (2011), "students must develop critical thinking and evaluation skills in order to filter reliable, researched information from postings that are biased in favor of a particular viewpoint or product" (p. 56). The teacher can model this strategy, explain and discuss it with the students,

and mention it every time students look for information in order that they understand how vital it is to use reputable sources and discern creditable information from false information. For instance, when the students were looking for information about the disease they selected as a topic of study, they could discern if they had found credible material if they were using a reliable website (one that is widely known for having trustworthy information such as Mayo Clinic). The teacher stated that he had discussed at the beginning of the year how to evaluate credible sources. However, students may need constant reminders and modeling in evaluating information from their teachers and teacher librarians.

Ethical and Responsible Use of Information

Because computers with Internet capabilities allow students to easily find information, teachers have a great advantage given the breadth of educational websites that can be used in connection with instruction. Perera (2008) reported that technology is a wonderful tool to motivate students, keep them focused and engaged, and build bridges to their prior knowledge. However, along with easy access also comes responsibility. Teachers and teacher librarians must show students how to properly and responsibly employ material that they find. Students can be taught how to analyze information and cite the material that they use.

Recommendations

Seeking and evaluating information on technological devices are valuable life skills that will benefit the learner. In order to improve this study, the researcher suggests that for future research a longer period of time be allocated to perform observations and interviews. This will allow for a more authentic picture of what is happening in the classroom related to technology's role in inquiry.

Also, it may be more beneficial if different classrooms from different schools in or near the school district could be observed and interviewed. A larger sample of students and teachers would more thoroughly demonstrate what is occurring in classrooms today. It may be helpful to have other diverse populations (such as special education, typical classrooms that include native English speakers, and other grades) represented in the study to make the study more accurate.

Similar studies could give further evidence into the importance of technology's role in inquiry-based learning. Inquiry and technology skills are aspects that 21st century learners have a need to know. Another study could examine the place of technology in inquiry or research across different cultures/countries such as how students in Germany versus the United States are using laptops in the classroom. The use of technology allows learners to have immediate access to current information in order to solve a problem or scenario. However, only when technology is used in a context of inquiry learning in which students are driving the questioning rather than simply collecting data, the power of inquiry supported by technology can empower and enhance students' learning. Students have the opportunity to develop their knowledge through thinking critically about information and how ideas are connected rather than simply accepting established facts.

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APPENDIX A

OBSERVATION FORM

Teacher Actions	Notations
Directing students to use devices	
Allowing students freedom to use devices in looking for information	
Having students evaluate information that they find	
Guiding students as they use technology during inquiry	
Showing flexibility during technology use in inquiry (e.g. willingness to explain when a student has a question that is not necessarily on topic)	

Student Actions	Notations
Using devices on their own to look up information	
Taking the first thing that they find	
Exploring a few sources before deciding on information to use	
Following teacher's direction to look up information	
Using devices for other tasks/activities that are not necessarily class related	

Additional notes:

APPENDIX B

TEACHER INTERVIEW FORM

1. How do you expect the students to use their computers in class?

2. When the students are looking for information on their computers, do you direct them in this process or do they look for information on their own?

3. Do you expect students to evaluate information that they find on their computers? If yes, to what extent do they do this? Why or why not?

4. What causes the students to look for information on their computers?

5. Does it seem that access to laptop computers (1:1 environment) is changing your teaching and the students' learning? To what extent? Why or why not?

APPENDIX C

STUDENT INTERVIEW FORM

1. How do you decide when you are going to use your computer in class?

2. When you are looking for information on your computer, do you take the first thing that you find or do you explore other sources?

3. How do you decide if you have found good information?

4. If the teacher does not require you to use your laptop for an assignment, do you still want to use it to look up information? Why or why not?

5. Do you feel like your laptop is necessary or important for you to learn? Why or why not?

6. On a typical day in class, how do you use your laptop computer?