WHY USE TECHNOLOGY IN THE SCIENCE CLASSROOMS?

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ABSTRACT
With access to technology in the classroom, use of technology has become essential in the public schools of the United States. Even with the availability of technology in the classroom, many times, its use is in the teacher-centered approach. With the view to understand the lived experience of the science teachers and their technology use in the classrooms, this study took its initiative to analyze and document the lived experience of middle-school science teachers' technology use in the classroom. Observations and interviews with the teachers provided evidence for this study. The data obtained were analyzed based on the constructivist theoretical framework to construct knowledge and draw conclusion. The findings indicate various uses of technology in science classroom to engage students in learning. In conclusion, teachers, students and technology are three sides of a triangle where technology is a medium that bridges teacher's responsibility of providing content knowledge to the students who are familiar with the technology.

INTRODUCTION
The international assessment such as Trends in International Mathematics and Science Study (TIMSS) and Program for International Science Assessment (PISA) compares science education of students from various countries. The mean score of US students in PISA in the year 2015 is 496 which is below average when the average was 493 (OECD, 2016). This indicates a problem in science education in the United States.

Technology is available for teachers as well as students in the classroom (US DOE, 2010). With the assumption that technology brings change in teaching and learning (Bang & Luft, 2013), classroom are filled with technology (Earle, 2002; Waight, 2014). Furthermore, to improve students' science learning, benchmarks for Scientific Literacy (AAAS, 1993), the National Science Education Standards (NRC, 1996), and Next Generation Science Standard (NGSS, 2013) all referred to technology as a medium to improve science teaching and learning.

However, the use of technology in the classroom can be a problem when teachers use the latest technology in teacher-centered approach. Becker (2000) mentioned two types of technology use in the classroom. The first one is teacher-centered, which does not involve students in higher-order thinking and is considered low-level technology use and the second is student-centered which focuses on students technology use for computational, analytical, and critical thinking. Use of technology in science classroom for high-level use is still low (Zhao, Pugh, Sheldon, & Byers, 2002) which suggests a problem in technology use in science classroom.

Besides above mentioned problem, education has become a big consumer of technology, a marketplace (Roberson, 2003). These days, classrooms have the latest technology such as laptops, iPads to facilitate students' learning. The aim of education is to enrich students in their interest and to "make them critical thinkers" (Rajbanshi, 2017). However, these days, education is influenced by standards, and learning is assessment based, which indicates that students need to be computer literate and be able to operate computers as the standardized test are conducted in either computers, laptops or iPads. Furthermore, teachers are content expert but are in stage of adopting technology or exploring technology, which makes teachers use technology in the traditional way without engaging students in actively participating and self-directed exploration which indicates problem with technology use in science classroom.

DEFINITION OF TECHNOLOGY
For this study, technologies are digital devices that are used in the classroom as a learning tool and for knowledge construction. This definition is adopted from Inan and Lowther (2010) and Haley (1998). Inan and Lowther (2010) used technology for instructional preparation, for instruction delivery, and a learning tool. Furthermore, Haley (1998) regarded technology as "tool or medium that helps people accomplish task" (p. 30). Therefore, for this study, the focus of technology are laptops, desktops, iPads, iPhones with internet access, and digital camera that are frequently used in the science classroom as a learning tool and knowledge construction tool.

RESEARCH QUESTIONS
Despite the huge investment in technology to enrich teaching and learning, its use in the classroom is limited. The purpose of this study is to document the middle-school science teachers' technology use in the science classroom and its effect on science teaching. Based on the purpose of this study, research questions were formed that guided the study. The research questions are as follows

- How are science teachers utilizing technology in the middle school science classrooms located in Southern New Mexico?
- What are the effects of using technology in middle-school science teacher's pedagogy?

THEORETICAL FRAMEWORK

Constructivism is the theoretical framework that provides direction to this study, which is both "a theory of learning and a theory of teaching" (Richardson, 2003, p. 1629). Constructivist approach to teaching and learning depends on the developmental stages of the children (Piaget, 1969, 1970), their interaction with the environment and with the peers (Vygotsky, 1978). Knowledge construction depends on "different approaches such as inquiry-based learning, experiential learning, hands-on learning, project-based learning, technology-based learning, communication, discussion, and observation" Rajbanshi (2017, p. 12). In this study, teachers used different pedagogies as well as different technologies as an instruction delivery tool, learning tool, and knowledge construction tool, which are mentioned throughout the paper.

RESEARCH METHODS

This study was conducted in public schools located in southern New Mexico, on the US-Mexico border. The focus of this study was on middle-school science teachers who were teaching seventh grade life science in public schools. Five participants were chosen for this study who were referred as regular attendees of technology-based professional development and technology users in biology classroom. The participants of the study also verified that they use technology regularly in their classroom. All the participants of this study had a bachelor's degree and two of them had a master's degree and one was a bilingual science teacher. All the teachers had more than fifteen years of teaching experience except for the bilingual teacher who was in his fourth year of teaching.

This is a phenomenological qualitative study that focused on the phenomenon or the lived experience of the participants in a population (Marshall & Rossmann, 2006; Creswell, 2007). The phenomenon under study is the teachers' technology use in science classroom. Sampling is done "with some purpose in mind" (Lincoln & Guba, 1985, p. 199) and the purpose of this research is to study the technology use of science teachers in the classroom. Thus, participants who used technology in the science classroom were selected as participants.

DATA COLLECTION

To understand the purpose of using technology in the science classroom, different methods of data collection such as observation and interviews were used to construct knowledge and make meaning of science teachers' experience focusing on technology use in the classrooms. In addition, multiple method of data collection provided multiple views on the gathered data giving it a broader and better result (Fontana & Frey, 1994). Furthermore, different data collection methods validated the gathered data through triangulation, which is a "process of using multiple perceptions to clarify meaning verifying the repeatability of an observation or interpretation" (Stake, 1998, p. 97).

Observations were conducted for a month and a half at the end of the academic year. A general observation protocol and a TUSI (technology Use in Science Instruction) observation protocol (Campbell & Abd-Hamid (2013) were used to note the pattern of technology use in the science classroom. After observations were done teachers were interviewed. After each observation and interview, teachers' classroom practices were linked with the tenets of constructivism, which helped during data analysis process, and reflect on the process of making meaning and develop the themes. For ethical consideration, all the names used in this paper has been changed and a pseudonym has been used.

DATA ANALYSIS--FINDINGS

While analyzing the data, it was found that science standard played a huge role in the middle-school science teachers' teaching, who considered content and vocabulary important for students' science learning. In order to teach science content and vocabulary to the students, middle-school science teachers especially depended on technology along with hands-on activities, lab work, and field trips. Based on the data, following themes have been formulated and described in detail below.

USE OF TECHNOLOGY TO PROVIDE SCIENCE CONTENT AND VOCABULARY

Providing science content knowledge is one of the emphases of science teaching. In the past, science contents were taught in a traditional didactic approach, which is basically teacher-centered. However, teachers in this study have adopted various pedagogies to teach science content as well as vocabulary. Teachers, in this study, understood that students do not get science vocabulary in their homes. For instance, Ms. Lopez said, "you know, you do not sit around and talk about mitochondria and diffusion at the dinner table. I think vocabulary is huge

one." For her, science content and vocabulary are learnt in schools and it is important to provide students the content and vocabulary.

Furthermore, science learning is understanding the natural phenomenon and laws of the nature, and technology acts as a medium to understand the natural phenomenon (NRC, 1996). For Mr. Watson, it's really important that the kids know how to read and get the vocabulary down. He said, "…vocabulary and having been able to read and understand and be able to talk that way [scientific way], to understand what it means to investigate, do scientific method, think for themselves and figure things out on their own." This suggests that science teachers considered vocabulary important for science learning.

To provide content knowledge, teachers used different pedagogies and one of them is hands-on activity. For example, one of the lab work students conducted and enjoyed was dissection of vertebrates to learn the internal organ system. However, teachers not only used hands-on activity to provide students the science content and vocabulary, they also "accommodate[d] technology to their existing pedagogy to support students' learning" (Rajbanshi, 2017, p. 179). For example, Mr. Cortez used technology to provide students with science vocabulary. He said, "quizlet for vocabulary is just great because they can test themselves on how they are doing. I can get data, because they are part of my class. I can see how they are doing. So, I like quizlet for vocabulary." Thus, these statements suggest that "technology is becoming a part of science teachers' repertoire to connect students with the content" (Rajbanshi, 2017, p. 179). Edelson (2001) also said that use of technology in Learning-for-Use model supported students with deeper content understanding. Thus, use of technology in this study was to support students with elaborative science content as well as vocabulary.

INFLUENCE OF SCIENCE STANDARDS ON TEACHING

With the view of making science consistent throughout the nation and to make students scientifically literate, science, math, and literacy standards are implemented in the schools (AAAS, 1996; NRC, 1996, 2012). The main aspect of these standards is to provide students with the content knowledge in an inquiry-based approach utilizing technology to bring change in teaching and learning. However, the scenario of public schools is different; standards have taken deep roots in the public schools. Teachers modify their lessons based on the standards. Learning has become more test-driven, which isolates students from their interest (Rajbanshi, 2017; Bybee, 2013). Teachers do not have much control over the curriculum (Snider & Roehl, 2007). For example, Mr. White said, "instructional guide is what guides me every day and I read my lessons from there." To add to this, Ms. Lopez said, "So, I make sure, I hit the standards and teach according to the standards."

Even though teachers realized that scores of the standardized testing is not what the students take away from their class, standards and testing have huge influence on middle-school science teachers' teaching and how they based their lessons. Some examples of how standards influence science teachers' teaching are provided below.

Mr. Watson said, "sometimes, you even alter what you teach, based on what you are anticipating the test questions are going to be." Not only are the teaching are affected by the testing, teachers are also emotionally hurt by the testing. For example, Mr. Watson added,

> Teaching gets harder and harder, because, they stress the testing… So, how a kid does in my class determines how good of a teacher I am on, a test. So, that's judging a race car driver based on a car that he is driving. If you get a race car driver, you [he/she] can do the best in the world, but if you have a poor car, he is not going to finish well on the race and some kids perform different on the test…

These statements show that teachers are in constant pressure to fulfill the requirement of the standards. So, they base their daily lesson trying to cover the standard and its requirements. Furthermore, standards puts students' interest at the bottom and stakeholders and districts interest at higher level (Marsh & WIllis, 2007). The assessment-based standards bring only superficial change in the science education (Kubieck, 2005). The assessment-based standards will not make students critical thinkers and a citizen who can implement science understanding in the real world. Thus, there is necessary to bring change in science teaching and make it student-centered learning by focusing on students' interest. The following paragraphs on technology show how middle-school science teachers are using technology to make science learning fun in student-centered approach as well as provide students with the content knowledge.

TECHNOLOGY USE IN SCIENCE CLASSROOM

Based on the pattern of technology use amongst the middle-school science teachers, following sub-themes are generated. Through data analysis, it was found that teachers used technology mainly for research, communication, to provide individualized instruction and for presentation, the details of which are provided below.

RESEARCH. Observations of the classrooms and interviews of the teachers showed that middle-school science teachers frequently use technology in the classroom and mostly for students to do research. When the classrooms were observed, teachers used technology in the class for research which was one of the results of Dunleavy, Dextert, and Heinecket, (2007) study. This study also found out that teachers used technology to find up-to-date information, to engage students, to do project work and let students present their finding. For instance, Mr. White said,

> For example, we were learning about human development. So they had to choose between conception to birth and it's hard to teach every month. So, I make sure that every group has a coverage of one of the months … so that they get the concept from their peers and plus it's good for them to learn and research, have research skills, learn how to look for the information.

The statement of the teacher showed that research is one of the reasons for students to use technology in the classrooms. Furthermore, the use of technology in this case was to find relevant information in which students worked in group and find information and presented in front of the classroom. These data showed that research is one of the most common use of technology in the classroom.

COMMUNICATION AND COLLABORATION. These days, students use different social media such as Twitter, Facebook, Instagram and other means of communication (Turkle, 2012). Communication through technology has become essential these days. Not only students, but teachers also use technology to communicate with parents regarding students' needs and progress, as Ms. Lopez mentioned "It's a neater way to get the parents involved because kids, especially middle-school kids are not good at getting notes home." This shows that technology is a way to communicate with parents and make them involve in their children's academic growth.

In addition, collaboration is another component of technology that helped students progress in their learning. Technology increases students' interaction among themselves and collaborate (Dunleavy et al., 2007) which is also true for this study. For example Mr. Cortez said,

> In my previous three years, what I have been doing is that I have had partner classrooms in other countries. So, I partner up with teachers from Mexico, Ethiopia, and Vietnam, and we would do like Skype sessions with our classrooms and they will do a project and we will do a project and we will compare our results and things like that.

This shows that science teachers use technology for communication and collaboration. This collaboration with other countries' helped not only his students but also the students in other countries. The students learn from each other even though they are in different parts of the world, as Dunleavy et al. (2007) states that one of the computer uses in the classroom is for collaborating and sharing their work. To this, Neilson, Miller, and Hoban (2015) added technology can be used to learn from one another as a learning tool. Access to technology creates a new phase in the evolution of technology-enhanced learning (Chan et al., 2006). They also concluded that "by extending the social spaces in which learners interact with each other, these developments, supported by theories of social learning and knowledge-building, will influence the nature, the process and the outcomes of learning" (Chan et al., 2006, p. 23) which is also one of the findings of this study.

INDIVIDUALIZED INSTRUCTION. In a class of twenty five to thirty students, it becomes hard to individualize instruction based on each student's' need. Technology helps individualize instruction (Rajbanshi, 2017; Jong, 2016). For example, Mr. Watson use Techbook and said,

> The Techbook... engages a lot of my lower-level population, a little better. Because it is self-paced and there are video-clips that go along with the reading… So technology has been helping with my special education population, my English Language Learners or Spanish speaking population and my AES advanced kid too and then they can go ahead and do a lot of things no one else get to do. So, it helps to differentiate instruction.

In addition to the above statement, Mr. Cortes stated, "Smart boards are good especially for like remedial lessons for those students who need that extra practice and smart board is really a good tool for that." Thus, the above data suggest that technology can individualize and differentiate instruction based on students' needs. It can be inferred that technology can transform learning when it facilitates individualized instruction, which was also the result of Dunleavy et al.'s, (2007) study which stated that use of technology increased the ability to individualize instruction in a 1:1 student to networked laptop classroom.

DISCUSSION

Through data analysis, it was seen that the middle-school science teachers regarded technology as an important way to provide students with content knowledge. Rajbanshi and Brown (2015) mentioned that "learning occurs when students are engaged" (p. 217) and hand-on activities along with technology engages students in learning. Ms. Lopez said, "I think, a lot of it is hands on, getting them out in the field." Thus, teachers in this study considered hands-on activities and technology important for science learning. The following paragraph illustrates answers to the research questions posed in the beginning of the study.

The question posed in the beginning of the research was *How are science teachers utilizing technology in science classrooms located in Southern New Mexico?* To answer this question, evidence provided from interviews along with the themes that emerged from the data were considered. Based on the themes that emerged from the data, it can be concluded that teachers' use of technology was basically for allowing students to do research, to do presentation,, to individualize instructions and for communication and collaboration. Likewise, the teachers in this study allowed students to use available technology to explore and investigate on the topic of their interest for research purpose. The teachers in this study rarely used PowerPoint as a method of instruction. Lecture using PowerPoint was observed only one time and the purpose of the lecture was to provide students with the instruction. After the instruction, the students performed their hands-on activity. Thus, it can be suggested that the teachers in this study utilized technology mainly for students' learning through research, presentation, and collaboration.

The second question that guided this study was *What are the effects of using technology in middle-school science teacher's pedagogy?* The participants of this study used technology in a regular basis. As mentioned before, the teachers depended on hands-on activities to provide students the content knowledge. However, many times, hands-on activities and field trips are not possible due to limited resources and funding. In one of the schools, teachers raised funds to buy frogs for dissection and for field trip, as the schools did not provide enough money to buy frogs for dissection or for the field trip. To illustrate, Ms. Bennet explained, "We do seventh grade fundraiser and we do a science fund raiser… So, we were able to buy frogs for frog dissection with that." In such situation, when resources are not available, technology becomes an alternative to teach and learn science. It was also observed that the students used iPads to learn about the internal organ system of animals before they could get frogs for dissection. Thus, it can be stated that teachers in this study considered technology as one of the pedagogical tools to teach science to the students.

CONCLUSION AND RECOMMENDATIONS

The world is changing with advanced technology and "technology has much to offer in improving teaching and learning" (Ediger, 2014, p. 649); therefore, teachers need to embrace technology and utilize it in the classroom. Technology can be used as an art, a pedagogy to transform students' learning. To transform students' learning, there has been a shift in teachers' focus from content to pedagogy and now with the inclusion of technology in the classroom, to technology (Mishra & Koehler, 2006). In this study, the middle-school science teachers basically focused on hands-on lab work, and now with inclusion of technology, technology has become a part of their pedagogy to provide quality instruction. Whenever, hands-on activity or lab work or field trip is not feasible, technology was an alternative.

The purpose of this study is to explore and document middle-school science teachers' technology use in their classrooms and its effect on their teaching. This study showed that middle-school science teachers considered content and vocabulary important for science teaching. Even though the teachers in this study believed that the scores of the standardized test do not denote students' science understanding, their teaching was influenced by the standardized testing. In order to provide students content knowledge, these teachers used technology to let students explore on the topic, to get up-to-date information, to do research, to present their work, to collaborate, and to individualize instruction, which depends on teachers' perspectives and beliefs on technology (Rajbanshi, 2017). Furthermore, the teachers of this study considered technology a part of students' learning tool and incorporated technology in the curriculum.

Can technology make students think critically? We as educators need to help students learn on their own and make them life-long learners. Technology should be a way to learn science, and teachers should encourage students to use technology as a knowledge construction tool and learning tool to get them involved in science learning. To conclude, in this triangle of teacher (content expert), student (the learner, who knows how to manipulate technology), and technology (a learning tool), technology is the bridge to teach science contents to the students where the teacher acts as a facilitator. In conclusion, it can be stated that these teachers used technology as a liaison to provide students the content knowledge.

The researchers also noticed that there is a relationship between a) number of teaching experience with technology use in classroom; b) teachers' technology use in personal life has direct or indirect impact on technology use in classrooms; and c) teachers' mindset and technology use. The researcher recommends further research in these areas in near future.

It is also recommended that teacher integrate technology frequently in the classroom for maximum effect in the classroom because teachers' technology use directly affects students' technology use. Moreover, integration of technology in inquiry-based approach encourages students in learning on their own; use of technology should be done in inquiry-based approach.

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