Using Technology to Support Curriculum:

Engaging and Inspiring Students through the Use of Technology in Science

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Introduction

Despite earning a teaching credential through an accredited program, many elementary school teachers who teach all subjects will often feel that they are most confident teaching only one or two content areas. Thus, many elementary teachers may be required to teach subjects in which they are not subject-matter proficient. One study stated, "Primary teachers have very much less confidence in their knowledge and skills in science, information technology and technology than they have in the traditional core subjects of English and mathematics" (Harlen,YEAR, pg. 34). It is important that teachers possess subject-matter proficiency in order to create a parallel sense of confidence with learning the subject matter by their students. The purpose of this study was to discover ways in which a teacher, not classically trained in science, can use technology to support the content area and better engage and support student learning.

Statement of the Problem

With the implementation of the Common Core State Standards (CCSS) (National Governors Association Center for Best Practices & Council of Chief State School Officers, 2010) across the U.S., science and social studies have been de-emphasized because the new standards are only complete in the areas of language arts and math. Teachers and administrators alike are overwhelmed with learning the new math curricula and writing expectations and how best to implement them. As a result, there is concern that an over-emphasis on implementing CCSS will result in other subjects slipping between the cracks in the agenda of schools and school districts. This statement was validated at one school district in northern California. In

2014, surveys were sent out to teachers, 55% anonymously responded that they often let science and social studies slip through the cracks when pushed for time to get core subjects (math and language arts) completed. Of the 11 teachers who responded, seven said they taught both social studies and science from the textbook and rarely created integrated or hands-on curricula for their students, an activity mandated by the new standards, One teacher said, "Many school districts have increased instruction time for language arts and math due to low test scores and state requirements. Therefore, teachers are required to teach short units in science and social studies," (Guzik, 2015). When teachers don't have the time to teach or prep for these subjects they may not feel as comfortable in teaching them. This often results in students not being engaged in the curricula.

Background and Need

Whether or not a teacher uses technology appropriately with their students is a broad and contemporary topic for many researchers and applies to all general education teachers across all content areas. At the elementary school in which this study took place, technology and project-based learning (PBL) and 21st century learning skills rose to a new level of emphasis for student learning when the district became part of the New Tech Network in 2014. During the 2014-15 school year, a local non-profit paid for professional development days for the teachers as they began to develop their New Tech teaching pedagogy. The elementary school embraced PBL as early as 2008, yet not *wall-to-wall* where PBL was integrated in most of the classrooms. In 2014, the author became the grades 7-8 teacher simultaneously with the school's transition to being a New Tech school. Along with this transition, interdisciplinary technology-based projects became an integral part of the learning model in every classroom.

Literature Review

The purpose of this project was to find ways to increase student engagement in science using technology and to show examples of ways to use technology to support a content area that a general education teacher is not classically trained in. This literature review will address the areas related to student engagement, use of specific technology in the science classroom, and other studies on the general use of technology in the classroom. The first section addresses research related to a general focus of technology and its effects on the middle school classroom. The second section will focus on research about very specific technology that has been proven to create positive results in a science classroom. Finally, the third section will review studies on technology and its effect on student engagement in the classroom.

Technology in the Middle School Classroom

In 2000, James evaluated and analyzed the implementation of science, math, and technology in the middle school classroom. Project. This study, supported by the GTECH foundation, was conducted to not only to analyze the project itself but also to see its effect on the schools involved. Over a two year period, local schools were taught the strategies and guidelines set out by the GTECH Project in order to be able to integrate science, math, and technology in their middle school classrooms. Teams of teachers and administrators were required to collaborate on a regular basis, the focus was on the local school objects (not curriculum), teachers created active learning environments that integrated technology, teachers were also asked to use locally developed and locally relevant project based

learning units, and teachers were expected to attend workshops and a 2-3 week institute during the summer. The GTECH staff came to the school and classrooms for follow-ups and to check in with teachers and administrators.

The results of the study showed that after a year, many teachers hadn't truly implemented the program into their classrooms and they were apprehensive on how to do so correctly. Year two showed a large increase in the number of teachers applying the GTECH procedures into their classrooms and integrating technology into their PBL units. As the teachers implemented the strategies into their classroom, their concern level went down. Interestingly, site visits showed that it was usually only the science teacher at each school that was truly implementing the entire GTECH strategy in their classroom.

Based on these findings, the GTECH Foundation advocated that it is very valuable to have teachers and students involved in the creation of curriculum. They also said that the use of multimedia authoring and mind mapping tools were very effective at this grade level. Results showed that this not only empowered the students but also helped the teachers take a more active part in designing the experience.

Tillman (2012) analyzed three articles to create a dissertation that studied digital fabrication as an instructional technology in middle and elementary school. He analyzed three other studies in which digital fabrication was used as an instructional technology and combined this information to create a dissertation on this strategy's effect in math and science in elementary and middle school classrooms. The first paper analyzed digital fabrication being used at a summer camp. The second analyzed its use in pre-service

teachers' instruction. The third analyzed its use in a series of NASA-themed lessons. The main result from the summer camp model was that some students who scored poorly on a paper test later demonstrated their skills very well during the digital fabrication activities. In the case of teacher preparation, , the results showed that pre-service teachers showed a significant gain in science teaching efficacy beliefs. In the final paper, the Nasa-themed lessons resulted in a significant gain in questions answered correctly from pretest to posttest after the teacher used digital fabrication as an instructional method during the unit.

Popejoy (2007) found similar results in a case study conducted in a 4th and 5th grade classroom that documented the effect of using technology via eight desktop computers in a science classroom. To eliminate the Hawthorne effect, Popejoy integrated herself into the classroom to better be a part of the environment and community. As significant modifications to the curriculum were made, positive change in the classroom environment was observed and students demonstrated openness to sharing their ideas. Learning emerged in a rich, diverse way.

The use of specific technology applications and programs in the classroom.

Pena (2011) investigated the use of podcasts, screencasts, and vodcasts in two Texas schools and how this correlated with the students' scores on the Texas Essential Knowledge and Skills (TEKS). Scores were taken and compared from two Texas schools. One school was using podcasts, screencasts, and vodcasts as a regular part of their science curriculum while the other school did not use them at all. These podcasts, screencasts, and vodcasts were being

used at the student created level. Analysis of the test score data showed that there was a strong correlation between higher testing scores and the use of the podcasts, vodcasts, and screencasts in the science classroom. This could be because the students were actively engaged in their learning as each podcasts, vodcast, and screencasts was made at the student level, allowing for creativity and autonomy.

Lazaros (2012) implemented a free online source called Science Kids into a classroom to study the change in engagement and science scores in the students. There are many useful and free sources that teachers can use to help engage, excited, and support their students in science. Science Kids is just one of the many sources out there for teachers. Science Kids is specifically designed for elementary and middle school kids and has many different resources on it: lessons, videos, quizzes, virtual experiments, projects, images, and facts. These resources can be used as a unit in themselves or used to supplement a classroom's science curriculum.

This study was meant to collect data on students' familiarity and experiences with computer technology. Perry (2012) used this study to gather information on students' opinions on having a science classroom that utilizes computer technology. After having the students use a 3D animation online program, 139 students were asked to respond to the experience. These responses, along with computer background responses and biographical information were compiled. On average, data showed that students used computer for 3.9 hours a day. Along with this 86% of the students surveyed said they wished their teachers would use technology

more often.

Student interest and engagement in the classroom

The purpose of Robelen's (2012) study was to report on and bring to conversation the lack of science instruction in California schools. This report is a follow up report to a study that was done by the Lawrence Hall of Science at the University of California, Berkeley, and SRI International. Follow up was done by studying the previous research and analyzing the data. The report found that most students in California public schools were not getting a high-quality science education, if any at all. The report suggests that too much emphasis is being placed on improving test scores in math and language arts and so teachers are letting science and social studies slip.

The purpose of Whitehead's (2010) study was to evaluate and analyze the impact of robotics as a content organizer in teaching mathematics and science in middle school. Whitehead (2010) specifically studied this impact based on students' beliefs and interested toward these STEM concepts. Pre and post interest surveys were analyzed. These surveys were taken from the ten Pennsylvanian middle schools that participated. This studied lasted 2-6 weeks (depending on the school) with 20 teachers and 107 students participating. Results supported the hypothesis that this would have a positive impact on the students' beliefs and interests towards STEM but the results were not statistically significant in ALL areas that were tested.

The purpose of Leila's (2013) study was to collect data on students' perceptions of having a future career in STEM (science, technology, engineering, and mathematics). Pre and post program interest surveys were given. A STEM intervention energy-monitoring program was implemented in the middle schools. Data results showed an increase in interest level in the students in the STEM subjects as a possible future career.

Purpose of the Study

The intent of this project is to test and analyze the effect of different technology-based approaches to the science curriculum on student learning and engagement. The tasks will align with the California State Standards for Science and will align with the New Tech model of teaching.

Research Question

- How can I use technology to engage and excite my students?
- How can I use technology to support the science curriculum?

Methodology

A group of twenty 7th and 8th grade students participated in an action research project that took their regular science units and integrated a different technology program into each. The sample group was 60% male and 40% female. Of these students, 30% spoke English as a second language. All 30% were native Spanish speakers. Fifty-five percent of the students were in 8th grade while the other 45% were in 7th grade. Of the 20 students, two students were in the resource program, one was in Title 1, and three were in the EL program. Two of the students

were 12 years-old, 11 were 13 years-old, and the other 7 were 14 years-old at the time of the study. One student had been held back in primary school for one year and four were new to the school in the 2014-15 school year.

The students were given pre and post surveys asking about their enjoyment of science prior to and after the technology based units. Each unit began with a pre-test, consisted of 4-7 lessons, and ended with a post-test. Each student was also required to complete a technology-based project for each unit.

For the first unit, Astronomy, students were to create a VoiceThread in which they choose one topic from astronomy (a planet, a nebula, a constellation, etc.), researched it, and used the online application, VoiceThread, to create a visual and audio presentation on their topic. The second unit, Sex Education, required each student "couple" to create a YouTube video about their experience having a "baby" (a sack of flour) for a week. They were to talk as a "couple" about sharing the responsibilities, what it was like to carry a "baby" around with them all the time, and finally they were to talk about what they learned in sex education. The finally unit, physics, focused on roller coasters. After learning about the physics behind roller coasters, the students went on a field trip to Six Flags in Vallejo, California, to see first hand how a rollercoaster worked. After this experience, students were asked to create an Explain Everything in the style of Sal Khan (from Khan Academy) in which they created a video that they wrote on and voiced over.

Data Analysis and Interpretation:

Four data sets were taken of the 20 students participating in the research. The first two, a pre and post survey (Appendix A), asked the students if they liked science, enjoyed using technology, and what kind of technology they thought would be fun to use in the science classroom. The post survey consisted of the same questions, but at the end specifically asked about the students' reactions to using three specific types of technology: 1) VoiceThread, 2) YouTube, 3) Explain Everything on the iPad. The last two data sets were the students' pre and post unit test/quiz score. They were given a pre-test to each unit asking 10 questions. Then the unit was given to the students and the technology piece was implemented. Finally, a post-test was given to the students.

The data compiled revealed the following information:

Astronomy

Of the 20 students, only two scored at or above a 50% on the pre-test. Of that same group, only 2 students scored BELOW a 75% on the post-test. When surveyed, 10 students who said they did not like Astronomy in the pre-survey and of these students 7 changed their answer to "liked astronomy" in the post-survey. Of the 20 students, 75% said they liked using VoiceThread in the unit.

Sex Education

Of the 20 students, three scored at or above a 50% on the pre-test. Of that same group, only two student scored below a 75% on the post-test. When surveyed, all 20 students said they

liked sex education prior to the unit starting and two of those 20 said they no longer liked sex education after the unit. Out of the 20 students, only one did not like using YouTube as a portfolio tool for their final project during the unit on sex education.

Physics (focus on rollar coasters)

Of the 20 students, only three scored abve a 15% on the pre-test. After the physics unit, 60% scored above a 75% on the post-test. Of the 40% that scored below a 75%, only two of those students scored a 50% or below. Prior to the unit, 65% of the students said they did not like physics. After the unit, only 20% said they still did not like physics. When asked if they enjoyed using the app "Explain Everything" as the technology tool for the unit, only one student said they did not.

Overall

Out of the 20 students surveyed, 90% said they loved using technology in the science classroom, 5% said they it was "OK," and 5% said they did not enjoy it. When asked about the different applications used, 20% said they liked VoiceThread the most, 35% said they preferred Explain Everything, and 45% said they liked using YouTube most. The students were also asked about their favorite unit that technology was used in. Of the 20 students, 35% said they liked astronomy the most, 25% voted for physics, while the other 40% said they prefered Sex Education.

Recommendations and Summary:

This study sought to find and test different ways that a teacher could use technology in the science classroom to engage students and to help them retain the information taught. The

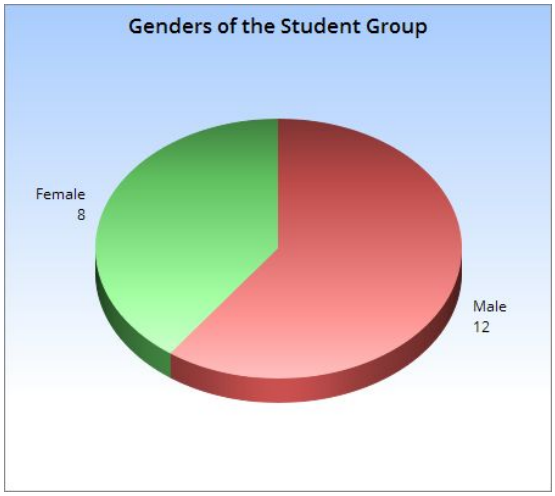
researcher used three different applications (VoiceThread, YouTube, and Explain Everything) as the variables and used Google Docs as the constant. Data showed that the students preferred using YouTube as an assessment tool for their Sex-Ed class; however, pre- and post-test data showed that the application Explain Everything, used in physics, showed the most overall improvement.

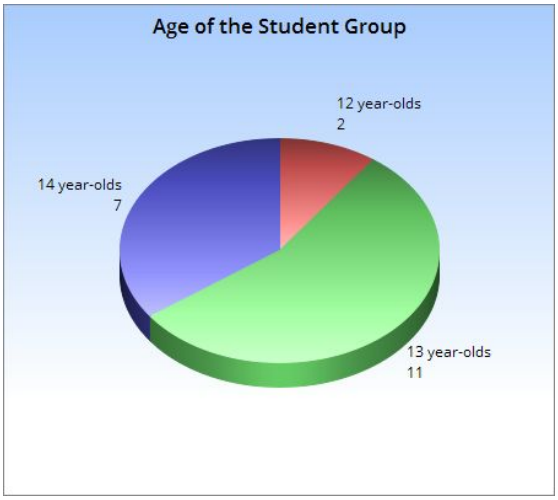
If the research had the opportunity to conduct this study again, some changes would be made to the methodology and the data collection. First, the study would be extended over longer units with sub-tests given in between. All three of the applications would have been used in each unit with their own pre and post tests to determine whether or not it was the application or the subject matter that made the difference in the data.

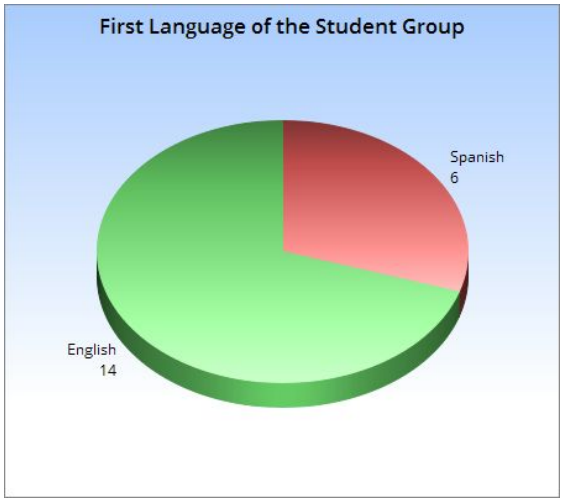
This study sought to determine what application would be better used in a middle school science classroom to engage students. The researcher found that all three applications have their own pros and cons. Some students liked one better than the other, which is a reminder that all students have individual needs and strengths. Overall, this study showed that using technology increases the final scores of the students compared to their pre-tests.

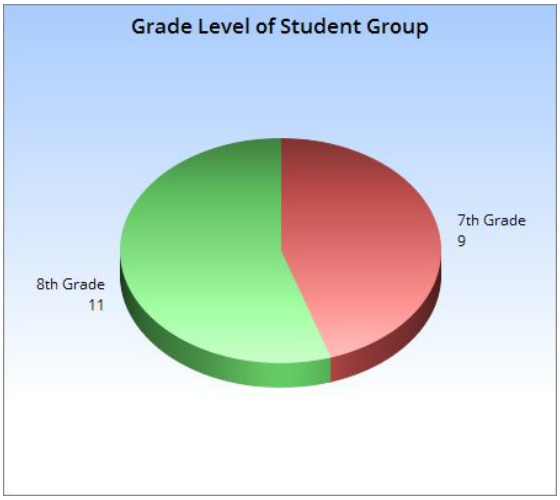
Appendices

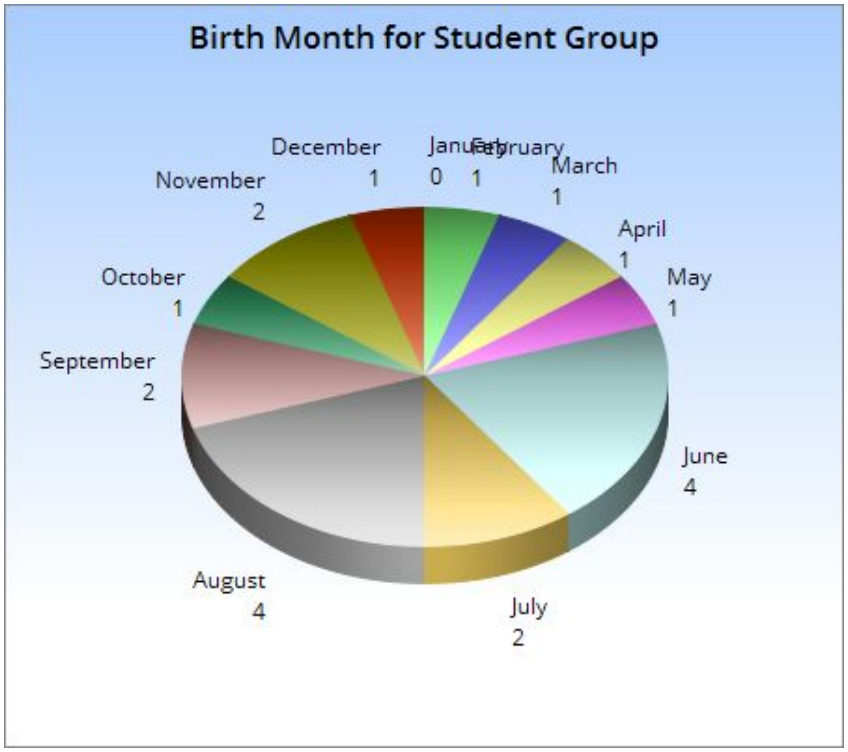
Raw data can be found here.










Birth Month for Student Group
December
1
January
0
February
1
March
1
April
1
May
1
June
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July
2
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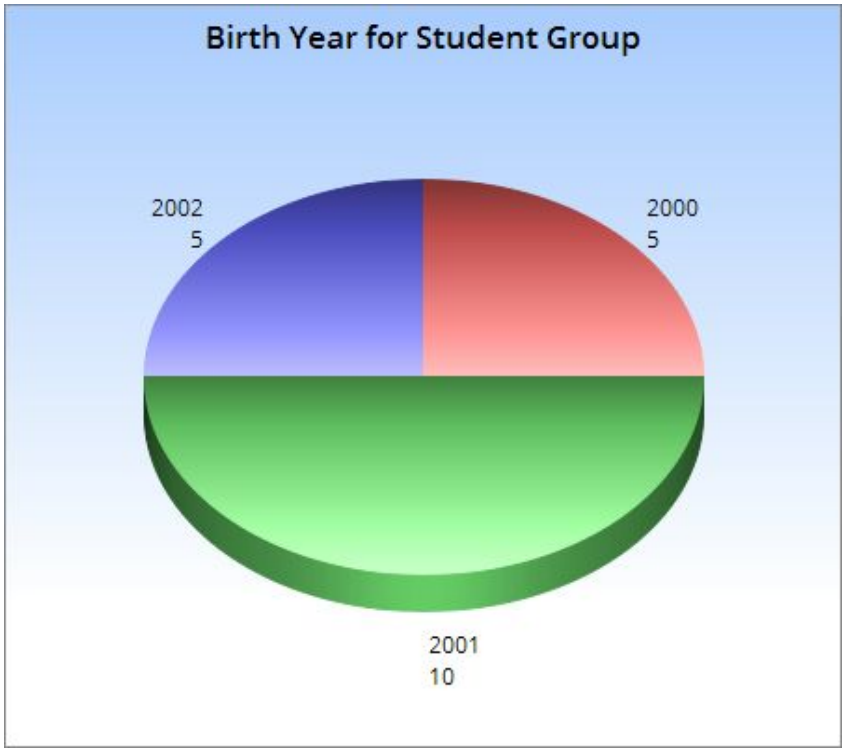
October
1
November
2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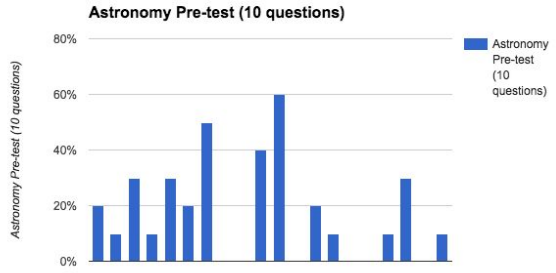
2000
5
2001
10


Astronomy Pre-test (10 questions)
Astronomy Pre-test (10 questions)
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60%
40%
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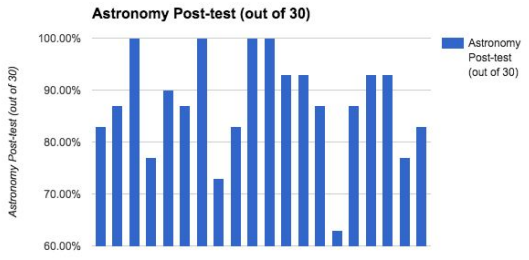
Astronomy Pre-test (10 questions)


Astronomy Post-test (out of 30)
Astronomy Post-test (out of 30)
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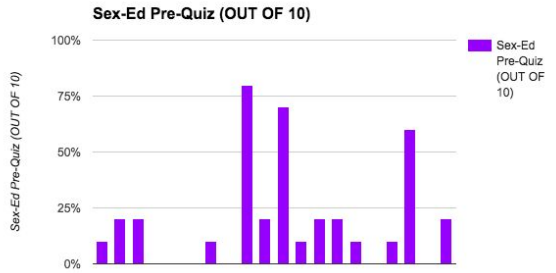
Astronomy Post-test (out of 30)


Sex-Ed Pre-Quiz (OUT OF 10)
Sex-Ed Pre-Quiz (OUT OF 10)
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50%
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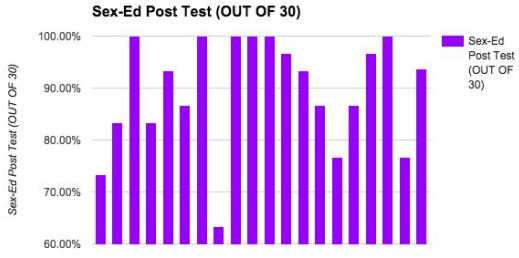
Sex-Ed Pre-Quiz (OUT OF 10)


Sex-Ed Post Test (OUT OF 30)
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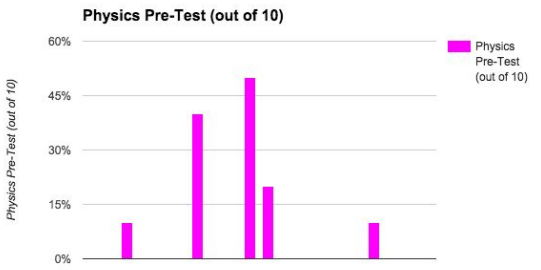
Sex-Ed Post Test (OUT OF 30)


Physics Pre-Test (out of 10)
Physics Pre-Test (out of 10)
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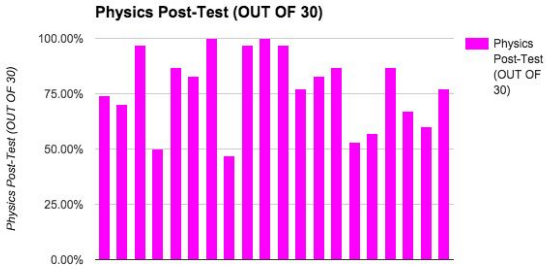
Physics Pre-Test (out of 10)


Physics Post-Test (OUT OF 30)
Physics Post-Test (OUT OF 30)
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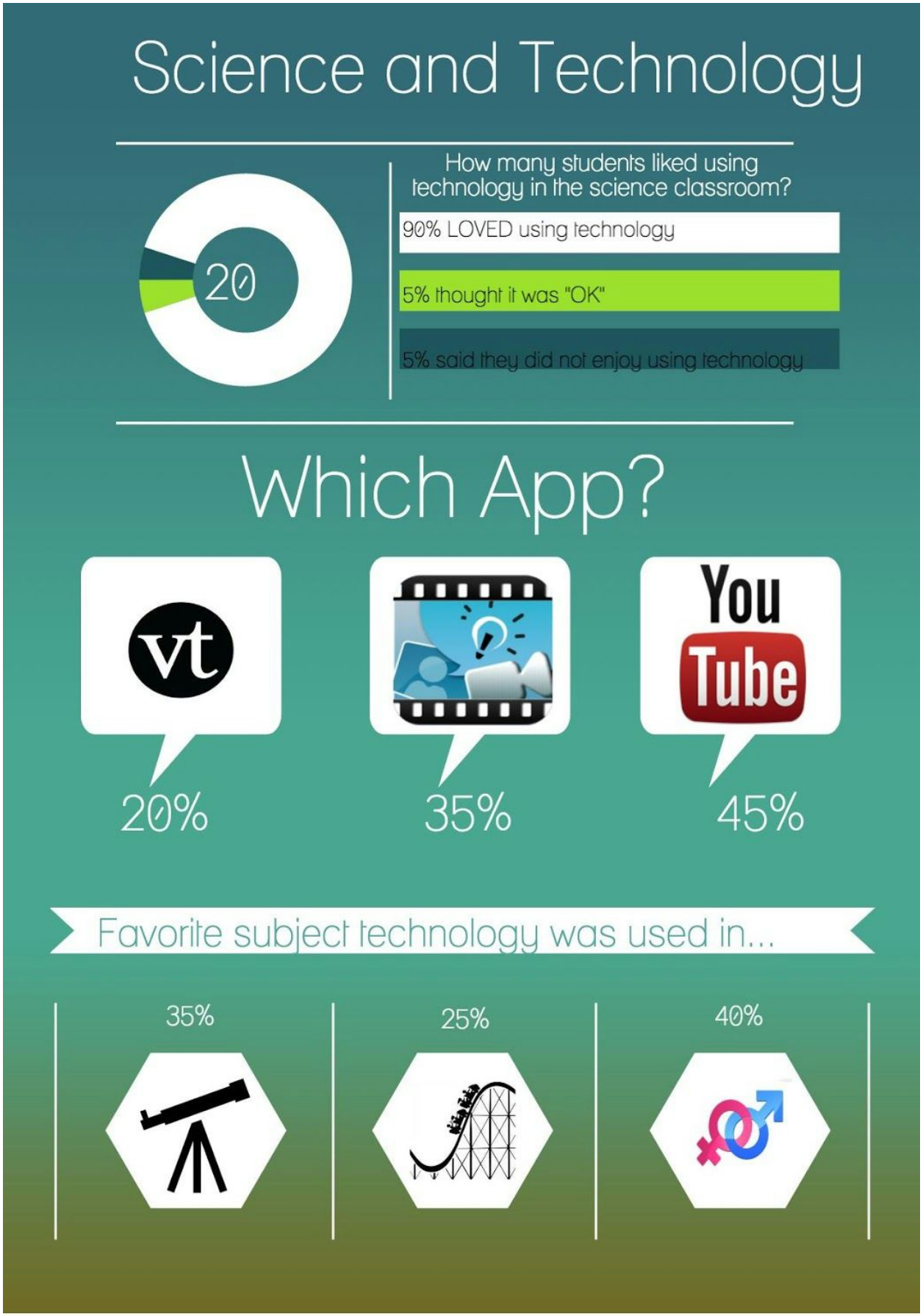
Physics Post-Test (OUT OF 30)


Science and Technology
20
How many students liked using technology in the science classroom?
90% LOVED using technology
5% thought it was "OK"
5% said they did not enjoy using technology
Which App?
vt
You Tube
20%
35%
45%
Favorite subject technology was used in...
35%
25%
40%
powered by
Piktochart
make information beautiful

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