University of Kentucky

UKnowledge

Theses and Dissertations--Science, Technology, Engineering, and Mathematics (STEM) Education

Science, Technology, Engineering, and Mathematics (STEM) Education

2016

TECHNOLOGY IN A GIFTED AND TALENTED MATH CLASSROOM: HOW IT IMPACTS STUDENTS' PROBLEM SOLVING AND MATHEMATICAL LEARNING

Brandon H. French
University of Kentucky, brandon.french@uky.edu
Digital Object Identifier: http://dx.doi.org/10.13023/ETD.2016.104

Right click to open a feedback form in a new tab to let us know how this document benefits you.

Recommended Citation

French, Brandon H., "TECHNOLOGY IN A GIFTED AND TALENTED MATH CLASSROOM: HOW IT IMPACTS STUDENTS' PROBLEM SOLVING AND MATHEMATICAL LEARNING" (2016). *Theses and Dissertations--Science, Technology, Engineering, and Mathematics (STEM) Education*. 7.
https://uknowledge.uky.edu/stem_etds/7

This Master's Thesis is brought to you for free and open access by the Science, Technology, Engineering, and Mathematics (STEM) Education at UKnowledge. It has been accepted for inclusion in Theses and Dissertations--Science, Technology, Engineering, and Mathematics (STEM) Education by an authorized administrator of UKnowledge. For more information, please contact UKnowledge@lsv.uky.edu.

STUDENT AGREEMENT:

I represent that my thesis or dissertation and abstract are my original work. Proper attribution has been given to all outside sources. I understand that I am solely responsible for obtaining any needed copyright permissions. I have obtained needed written permission statement(s) from the owner(s) of each third-party copyrighted matter to be included in my work, allowing electronic distribution (if such use is not permitted by the fair use doctrine) which will be submitted to UKnowledge as Additional File.

I hereby grant to The University of Kentucky and its agents the irrevocable, non-exclusive, and royalty-free license to archive and make accessible my work in whole or in part in all forms of media, now or hereafter known. I agree that the document mentioned above may be made available immediately for worldwide access unless an embargo applies.

I retain all other ownership rights to the copyright of my work. I also retain the right to use in future works (such as articles or books) all or part of my work. I understand that I am free to register the copyright to my work.

REVIEW, APPROVAL AND ACCEPTANCE

The document mentioned above has been reviewed and accepted by the student's advisor, on behalf of the advisory committee, and by the Director of Graduate Studies (DGS), on behalf of the program; we verify that this is the final, approved version of the student's thesis including all changes required by the advisory committee. The undersigned agree to abide by the statements above.

Brandon H. French, Student

Dr. Molly Fisher, Major Professor

Dr. Molly Fisher, Director of Graduate Studies

TECHNOLOGY IN A GIFTED AND TALENTED MATH CLASSROOM: HOW IT IMPACTS STUDENTS' PROBLEM SOLVING AND MATHEMATICAL LEARNING

THESIS

A thesis submitted in partial fulfillment of the requirements for the degree of Master of Science in Education in the College of Education at the University of Kentucky

By Brandon Henry French

Lexington, Kentucky

Director: Molly Fisher

Lexington, Kentucky

2016

ABSTRACT OF THESIS

TECHNOLOGY IN A GIFTED AND TALENTED MATH CLASSROOM: HOW IT IMPACTS STUDENTS' PROBLEM SOLVING AND MATHEMATICAL LEARNING

Technology has advanced greatly over the past few decades and the surge in the industry has impacted the workplace. As a result, K-12 education has worked to integrate 21st century skills into curriculum. Many times this is through STEM classes. This study examined the impact technology had on gifted and talented students' achievement and creative construction. During a unit on Transformations, a control group received traditional instruction, while an experimental group received traditional instruction with an added technology component. A pre and posttest were given to both groups to measure student success with the geometry content. Results indicated that the technology component did not have a major impact on student achievement. Both the control and experimental group showed mastery of the standards and concepts. The technology component did increase students' use of correct content vocabulary.

KEYWORDS: gifted and talented, technology, STEM, creative construction, middle school

Brandon Henry French

April 1, 2016

TECHNOLOGY IN A GIFTED AND TALENTED MATH CLASSROOM: HOW IT IMPACTS STUDENTS' PROBLEM SOLVING AND MATHEMATICAL LEARNING

By

Brandon Henry French

Molly Fisher
Director of Thesis

Molly Fisher
Director of Graduate Studies

TABLE OF CONTENTS

LIST OF TABLES..……...…iv

LIST OF FIGURES……...……v

CHAPTER ONE.……1
Introduction……..1

CHAPTER TWO…….3
Literature Review…….3
Defining Technology Education……..3
Technology Impact on Attitude and Achievement……..5
Defining Gifted and Talented……14

CHAPTER THREE……...20
Methods and Results……...……...20
Participants…….....20
Procedures……..21
Scratch Technology Project……...23
Results ……...27

CHAPTER FOUR……..29
Discussion and Final Remarks …….….29
Research Questions Revisited……29
Implications for Teachers……..…30
Implications for Future Research……...31

APPENDICIES……...…..33
Raw Test Data……33
Pretest…….34
Posttest…….…….....36
Extended Posttest……...……42

REFERENCES……48

VITA……...51

List of Tables

Table 1, Final Scratch Project Overview……23

Table 2, Percentage of Correctness on Assessments…….……28

List of Figures

Figure 1, Number of Questions Answered Correctly……27

Chapter 1: Introduction

In the past decade technology has become an extremely profitable industry, resulting in an increased accessibility to technology devices, software, and applications and the expansion of technology into people's daily lives. This surge has changed most workplaces, and, consequently, the skills and knowledge entry level workers need. For professionals, like engineers and scientists, computer software has replaced hand drawings, traditional data collection, and analysis methods. For trade workers such as auto mechanics, a computer now diagnoses a car's problem with the simple click of a button; the mechanic doesn't even have to open the hood. These advances in technology have changed the way prospective employees view career fields. In the past, only a person with vast knowledge of all those car parts for different makes and models, someone who had learned from a mentor, would venture into the career of auto mechanic. Now, someone with base knowledge and an interest can get on the job training because the computer provides access to all that knowledge. In order to be prepared for this new technology-driven world, students need different skills and knowledge than they did decades ago.

High school students are being required to use various technology applications on a regular basis. More importantly, they need to gain the understanding of how that technology can be used in diverse subject areas and in real world jobs and careers. This will help them gain technological literacy, which means they go beyond just learning a specific version of a software (International Technology Education Association, 2000). It is likely the program they learn in a class will be outdated and replaced by a newer technology by the next school year. If students gain true technological literacy, they will

be able to apply what they have learned in the newest technology available. This is an ability that is critical for success in the real world where innovative technologies are continually emerging and one must stay abreast of them. In order for students to gain technological literacy, curriculum has to challenge students to conceptualize and produce. This is why Science, Technology, Engineering, and Math (STEM) education has been on the rise (as cited in Thompson, 2014; as cited in Allen, 2013).

STEM education is being pushed in schools to prepare students for real world problem solving. The focus is student use of technology, and studies have shown many positive impacts on both student attitude and achievement (Gulek and Demirtas, 2005; Lin and Jou, 2013; Wynn, 2013; Boyd & Ellis, 2013). Regardless of success, some educators remain skeptical about implementing technology because of potential disadvantages like student distraction and lack of interpersonal communication among students. There is clearly a need for more research on technology's impact on student learning, especially considering different demographics and types of students. This led me to develop this study specifically looking at the impact of technology on gifted and talented students' achievement and computational thinking. More specifically, I investigate the following research questions:

1. How does technology impact student achievement in the gifted and talented math classroom?
2. How does technology impact gifted and talented students' creative construction?

Chapter 2: Review of Literature

Defining Technology Education

The *Standards for Technological Literacy: Content for the Study of Technology* (2000, 2002, & 2007) broadly defines *technology* as:

> How people modify the natural world to suit their own purposes. From the Greek word *techne*, meaning art or artifice or craft, technology literally means the act of making or crafting, but more generally it refers to the diverse collection of processes and knowledge that people use to extend human abilities to satisfy human needs and wants. (2007, p. 2)

Essentially, technology can apply to any advancement humans make to solve problems or improve life, and humans have been doing this since prehistoric times. Creating tools and drawing pictures in caves to communicate were a catalyst for the evolution of human lifestyles. Later came the advent of the postal system, the printing press, and the phonograph, which all made communication faster and easier. People could transfer information to mass audiences and ensure messages weren't distorted, and when radio and television were invented, networks of information distribution became an industry that has since exploded. Consider the plethora of 24 hour news outlets and vast Internet new sources that exist. According to Devlin, Feldhaus, and Bentrem (2013), "There is significantly more information available to be consumed today than in past generations, and Millennials (the generation born between 1980 and 2000) have more ways to consume it than ever before" (p. 35). Because of this "explosion of social media, hand-held technology, and numerous ways for Millennials to get screen time," (Devlin et al., 2013, p. 34), teaching technological literacy is imperative. According to the *Standards for Technological Literacy: Content for the Study of Technology* (2000, 2002, & 2007), "Technological literacy is the ability to use, manage, assess, and understand technology" (International Technology

Education Association, 2000, p. 7). There are three standards that outline how students become technologically literate:

> Students will develop an understanding of the characteristics and scope of technology; 2. Students will develop an understanding of the core concepts of technology; 3. Students will develop an understanding of the relationships among technologies and the connections between technology and other fields of study. (2007, p. 23, 32, & 44)

These are the guiding criteria for incorporating technology into education. Teachers cannot simply use a projector or word processing software and call that technology implementation. Instead, teachers must ensure students develop an awareness and understanding of the purposes for which technologies are used in various fields of study. They need to understand what changes technology has caused in those fields as a result of new applications being introduced. In their study examining the technology use of beginning secondary science teachers, Bang and Luft (2013) asserted:

> The 21st century science classroom now contains nontraditional teaching tools, including laptops, personal digital assistants, and digital measuring devices. With the inclusion of this technology, there is often an assumption that these devices will automatically bring about revolutionary changes in teaching and learning processes. (2013, p. 118)

Teachers can't assume students will make connections and grasp understandings just from using a digital device; they have to be purposeful about teaching these. Students won't discover their way to technological literacy. Teachers must facilate the use of technology with discussions about the process. For instance, a student may learn how to use Google Sketchup in math class, but they need to gain the understanding of how that technology can be used in other subject areas and in real world jobs and careers. They also need to understand what technologies make up the

application of Google Sketchup because it will likely be outdated and replaced by a newer technology soon. Boyd and Ellis (2013) discuss ideas in an attempt to answer the question "What role might web 2.0 functionality, such as the Google SketchUp 3D Warehouse, play in teaching and learning?" They conclude, "We have little doubt that the Google SketchUp 3D Warehouse facility provides a realistic practical frame in which higher-order technical design teaching can be delivered" (Boyd & Ellis, 2013, p. 409). Their view is that teachers can use the Google Sketchup software to increase students' technological literacy, concluding that it can be used "to address an immediate educational need, the need to provide hands-on experience in eco-design education" (Boyd & Ellis, 2013, p. 412). Students can apply the knowledge and skills in future classes and experience what a career in eco-design might entail. In general, most literature conveys the idea that technology use in education needs to move beyond simply using a digital device; teachers need to fulfill the responsibility to teach technological literacy by creating curriculum that challenges students to conceptualize and produce (Boyd & Ellis, 2013; Devlin et al., 2013; Bang and Luft, 2013). This is when technology has a positive impact on students' learning.

Technology Impact on Attitude and Achievement

Promoting positive attitudes toward STEM. A review of literature supports that this push for technological literacy is increasing STEM education in schools. In "4 Keys to Designing the Classroom of the Future" Greg Thompson (2014) reviews ways that schools and students are using technology and how technology is reshaping education in positive ways. He points to specific teachers, information officers, and school technology officers, like Brebeuf

assistant principal Jen LaMaster, who is pushing for classrooms to become "collaborative spaces-a mediascape system where students are quickly able to share with students what they are doing" (as cited in Thompson, 2014, p. 20). LaMaster feels that:

> The combination of the classroom and the cloud becomes more and more important, because it's no longer all of us taking notes. We are using cloud-based documents to take collaborative notes. Final notes are posted. Any technologies that begin to merge cloud and classroom are going to be big in the future — that is why going 'multiscreen' seems to be more important when thinking about future design." (as cited in Thompson, 2014, p. 20)

In order for students to use technology to enhance their learning, schools must be equipped with the infrastructure to support digital devices. In today's world this means high speed Wi-Fi and stations for charging devices, rather than projectors and interactive boards. The focus of technology must be on students' use, not teacher presentation of material. One hands-on technology application is Robotics, which is increasing in popularity and promoting STEM education.

According to Kasi Allen (2013), "the presence of the robotics kit in the classroom, initially as a station for students to visit and experiment with, will cultivate an interest in learning more" and lead to writing programs, which is where students really learn math (p. 343). Allen explains the vast benefits of teaching Math through robotics, citing specific Common Core Math standards for 6th-8th grade and correlating hands-on tasks. Students are engaged and excited about learning math, but more importantly, they are becoming technologically literate. Allen (2013) claims that the Robotics competition can "[transform] students' and adults' views about STEM" (p. 344), quoting a FIRST student with seven years' experience as saying, "It's not just

about building a robot. It's about building engineers. It's about building people" (as cited in Allen, 2013, p. 345).

Positive impacts on student achievement. Many studies have researched the positive impact of technology use on students' learning. Gulek and Demirtas (2005) examined the impact of Harvest Park Middle School's laptop immersion program on students' grade point average, end-of-course grades, essay writing skills, and standardized test scores (p. 7). The students in the laptop program were compared with students in the school who were not in the program; student data was compared in sub-groups, including Gifted and Talented, special education, ethnicity, gender, and free and reduced lunch. Students used the laptops on a daily basis in class, and uses varied from class to class. Research, writing essays, and developing PowerPoint presentations were the most common uses, but students also used them for note-taking, website creation, poster design, and web-based project access. Gulek and Demirtas (2005) found that "measures collected after participation in the laptop program…[indicated] that students who did participate in the program tended to earn significantly higher test scores and grades for writing, English-language arts, mathematics, and overall Grade Point Averages (GPAs) (Gulek and Demirtas, 2005, p. 29). The data analysis from this study "provides evidence that participation in the laptop immersion program had a significant impact on student achievement (Gulek and Demirtas, 2005, p. 30). Essentially, what Gulek and Demirtas found was that students benefited from using laptops in school. That was in 2005. Currently, laptops are much more expensive than other devices, such as iPads and tablets. In addition, many schools have mobile labs and computer labs with advanced technology for students. The major take-away from the study is that "given the potential benefits that may come from learning in laptop settings, it is important that schools begin taking steps to create more equitable settings

with respect to technology access and skills" (Gulek and Demirtas, 2005, p. 30). Regardless of what technology it is or how students access it, it is important that students use technology in their daily learning experiences so they can become more technologically literate.

When students use technology for learning support, they are more motivated to participate, which can impact technological literacy. Lin and Jou (2013) used questionnaires and interviews to investigate the influence of a web application supported learning environment in classroom teaching and learning. The teachers developed a website for the subject that housed all relevant content, divided into six units. Learning activities included instruction, discussion, reflection, and practice sessions. After completing the subject work, all participants completed the questionnaires and answered questions in interviews. Results showed that the web application supported learning caused students to be more motivated to learn, so they participated more. Because of this, teaching became more successful. This technology based instruction didn't allow for student choice, being teacher created, and it still increased student motivation and participation. When students play a role in choosing the technology they use, their motivation and participation increase.

Wynn (2013) examined students' perceptions of technology when he began teaching college level classes after earning his Ph.D. When he planned his curriculum, he designed instruction around blogging, Twitter, and Facebook to meet the needs of the generation of digital natives he would teach. When class started, he was completely taken aback by students' lack of enthusiasm. He cites one student as saying, "The best thing a teacher can do is ask the students. All students learn differently. Some students are hands-on learners, while others learn better by hearing lectures. If a teacher asks the students in their class what they prefer and actually take the things said into consideration, they could probably get a lot accomplished" (Wynn, 2013, p. 24).

This prompted him to do some action research. He still offered the digital components of the class, but he also offered paper versions of all work. He then researched students' perceptions through three focus questions:

> 1. What do you believe is the perfect mix of technology in the classroom based on your experience?
> 2. What methods will keep you engaged in your courses?
> 3. What can your teachers do to find the ideal mix of technology to keep you engaged in the classroom? (2013, p. 24)

His findings showed that "technology is a valued addition to the classroom," and students "appreciated the variety, the flexibility, and the convenience of some technologies that [were] utilized in the classroom" (2013, p. 26). Students thought the blogging offered a chance to share insight and opinions, and that using Twitter and Facebook for discussions "[catered] to the students' desires to participate on these type of sites and [made] them look at school work in a different way" (2013, p. 27). Overall, he found that most students want technology in the classroom; "visual representations, blogs, YouTube, and Wiki pages are applications that students anticipate to provide visual illustrations and help students not only express themselves but also communicate their knowledge attainment to peers and teachers" (2013, p. 30). This study shows that using technology can positively impact students' attitudes toward learning; however, it is important that students have a choice in the technology they use so they feel confident and motivated. Sometimes a teacher can use a specific software or application to promote literacy in that area, yet still allow students choice. One specific program that has been shown to positively impact students learning is Google Sketchup. Students learn the same math concepts, but they also have choice.

Google Sketchup increases students' abstract and critical thinking. Everyday new software, programs, and devices are developed; these technological advancements have the capacity to increase student achievement. In 2008 Google released a newer, more user-friendly version of Sketchup made for easy implementation in classrooms. Since then, it has shown that it can positively impact student's thinking and academic performance (Erkoc, Gecu, and Erkoc, 2013; Toptaş, Çelık, and Karaca, 2012).

Many studies show that Google Sketchup can help students gain an understanding of the abstract concepts geometry presents. Erkoc, Gecu, and Erkoc (2013) studied the effects of this software on the mental skills of eighth graders by having one group of students draw 3D models on isometric paper while the other group used the software. Using a pre-test before the drawing and post-test after the drawing, they researched the following questions:

> 1. Is there a significant difference between the control group students' pretest and posttest scores of Mental Rotation Test?
>
> 2. Is there a significant difference between the experimental group students' pretest and posttest scores of Mental Rotation Test?
>
> 3. Is there a significant difference between the posttest scores of the control group and experimental group students of Mental Rotation Test, controlling for the effects of pretest scores of the groups? (Erkok et al., 2013, p. 1288).

They found that both the use of isometric paper and Google Sketchup increased students' mental test scores (Erkok et al., 2013, p. 1292). This shows that the technology is just as effective as the traditional approach. Teachers may wonder why they would use a technology if it doesn't prove to be better than the traditional method, but there are many reasons to use the new technology, including the mere aspect of choice for students. Some students will be engaged and motivated

to participate because of the chance to learn a new technology. Plus, students will have the chance to gain technological literacy.

Toptaş, Çelık, and Karaca (2012) conducted a similar experiment as Erkoc, et al. (2013) and found differing results. On a Differential Aptitude Test the control group and the experiment group (used Google Sketchup) scored similarly on pre-test, but on the post-test, the experiment group did better. The Mental Rotation Test had the same results, with the experiment group outperforming the control group on the post-test (Toptaş, Çelık, & Karaca, 2012, p. 131). What was different about the methods in the two studies was that Toptaş et al. (2012) had the experiment group do all the activities that the control group did, such as creating blueprints on paper, and then use the Google Sketchup to unfold the sides of a three-dimensional building to determine its two-dimensional plan as additional practice. The experiment group also used a website that rotates three-dimensional figures orthogonally and isometrically. This supplemental practice with technology proved to make an impact on their spatial thinking, shown through the increased achievement on the aptitude and mental rotation tests. This study shows that the methodology, or pedagogy, use in teaching affects the effectiveness of the technology. Erkok et al (2013) illustrate that Google Sketchup can be as effective as traditional methods; Toptas et al. (2012) show when used to supplement traditional methods, it has a bigger impact. Teachers considering using Google Sketchup in units for Geometry should consider these studies when planning lessons. Bolognese (2011) provides an example of the many ways to incorporate Sketchup into a unit, rather than just replace traditional activities in "Applying Mathematics through Floor Design."

Bolognese (2011) requires students to create the floor design of their dream house as part of a unit on conversion, area and volume calculations, and transformations on various curves.

Students first sketched blueprints by hand and got feedback from him; then, they used Google Sketchup to recreate their designs. He explains how the free program has many perks, including the way it shows multiple vantage points and how the segment, rectangular, circular, and arc tools allow students to easily construct many different areas. He points out that it reinforces the definition of polygon because inner regions change color when enclosed. It also detects when the students is creating perpendicular or parallel lines and color codes them (Bolognese, 2011, p. 32-33). Even while he asserts the advantages of Google Sketchup, he describes a unit that does not abandon traditional methods. He evens argues that an "important activity for students was to determine exactly what measurements were necessary in order to calculate the area and perimeter" (2011, p.33), which is a task students do the old fashioned way. Overall, this is an example of how to integrate technology and use sound pedagogy to make it as effective as possible.

Studies showing technology use has limitations. Some studies show that technology has a negative impact on learning by distracting students from the content. Wentworth and Middleton (2014) present the idea that using technology can result in a distraction for students. In the study, they explored the relationship between students' use of technologies and their academic performance; they surveyed students about their cell phone use, texting, computer use, how much they worked, how much they studied, current GPA, SAT scores, and predicted course grade. They found that:

> A stronger negative relationship existed between the amount of time spent on their computers per week and the amount of time spent studying. Thus, those participants who spent more time on their computer, compared to those who spent less time, had lower GPAs and spent less time studying. The reverse was also true, those participants who

> spent less time on their computer, compared to those who spent more time, had higher GPAs and spent more time studying. (Wentworth & Middleton, 2014, p. 310)

This study only looked at how students' use of technology outside of class affected their learning. The authors didn't survey how technology was used for learning in class, nor did the respondents specify how much computer time was spent on school work versus entertainment. Additionally, relying only on survey results could have skewed data-as this this research basically studied students' self-perceptions of technology use.

Lam and Tong (2012) studied the perceptions of technology use in classrooms. They studied two sets of future teachers. One set used computers in class in guided learning about software to use in teaching, while the other set attended a workshop on teaching and learning technologies and used their own devices to interact with teachers using UReply, a web-based student response system. Both sets completed a survey that measured their perceptions of technology use in education. Lam and Tong (2012) wrote:

> The present study revealed that use of digital devices was effective in enhancing motivation, the conduct of meaningful course-related interactions, active exploration of online information, and participation rates. Nevertheless, even for those who acknowledged the benefits of use of digital devices in class, some of them reported to have been distracted at times during the lecture. In fact, the teacher who was responsible for the course in the first study had also experienced occasional distress in maintaining attention among a number of students. (p. 393).

Distraction can be a problem at different levels. Students could seemingly be working on class content but still be disconnected to what's happening in class. They could be using their devices

to communicate or for entertainments. Other times, students can be completely on task, but be too focused on the technology application, with class content being secondary.

In their feature article "Teaching with Technology" Attard and Northcote (2011) provide insight into why technology may not be the best route for teachers to take in math classes. They explain how research into the use of ICTs (Information and Communication Technologies) in has shown that the ways teachers integrate technology into existing lessons can cause negative results (Attard & Northcote, 2011, p. 29). Attard and Northcote (2011) explain that technology, if not used correctly, can cause lessons/students to be focused on the technology, rather than learning math through the technology, stating, "There is a danger of the technology driving pedagogy, rather than pedagogy driving the technology. In other words, technology sometimes becomes the focus of the mathematics lessons instead of the mathematics itself" (p. 29). iPads and iPods can be great tools used to implement into the classroom, but they should not be the emphasis of lessons. Teachers must ensure that the mathematical content is driving the lesson. Students can easily get carried away with exploring a new application on these devices. That being said, students can be distracted in the same way without technology. Students can be so focused on the skill of taking notes that they aren't gaining understanding through the discussion. Students can be so focused on creating a project by hand (drawing, maps, posters, etc.) that they focus too much on the presentation of the product and not the content.

Defining Gifted and Talented

A review of literature on gifted and talented education reveals that there is not one universal definition. According to Barbara Clark (2008), current research, though, does provide a common framework for concepts including, *intelligence*, *giftedness*, *gifted individuals*, *talent*,

and *talented individuals*. The framework I choose to use in this study is by Barbara Clark (2008), which states:

> 1) All individuals inherit a genotype or genetic makeup that is unique to them and, with the exception of those with brain damage includes a brain that has vast potential for the development of intelligence; 2) The concept of intelligence is known to be dynamic. The opportunities provided by the environment have been found to enhance or inhibit the development of the brain's structure and function. This allows parents and educators to provide for the realization of human potential; 3) Individuals are quite different from each other and in their abilities, including the expressions of intelligence of which they're capable; 4) The concept of intelligence has expanded to include cognitive, affective, intuitive/creative, and physical motor/sensory expressions. High levels of intelligence may be identified in any of these areas; 5) Owing to its' dynamic nature and the importance of both genetic inheritance and environmental opportunity, intelligence can no longer be thought to be wholly in place at birth, innate and permanent. Experience in the process of individual development is critical to development; 6) It must be acknowledged that there are individuals who, through the interaction between their genetic endowment and environmental stimulation, have enhanced the development of their intelligence more than have others, and this enhancement has resulted in accelerated and advanced brain function. These are the individuals who are labeled "gifted"; 7) The importance of the dynamic nature of human development suggests that, if gifted individuals are to continue their intellectual development, they must be engaged in learning opportunities that challenge them and enhance their talents at their level of development or they will regress in whatever abilities and talents are not supported.

> Therefore, gifted individuals must have appropriate educational experience at the level of their ability and talent to be able to grow. (p. 52-53)

These basic concepts provide a foundation from which educators, parents, and students can begin to understand giftedness. Intelligence is a key facet in identifying giftedness. Clark's framework describes it as a round concept, rather than a one-dimensional measure. Intelligence is not just IQ and can be expressed in a number of ways, which reflects the different types of intelligences: cognitive, affective, intuitive/creative, and physical motor/sensory expressions. Another important concept within the framework is that in addition to genetics, experience is critical to development. Gifted individuals must have challenging learning experiences to grow and progress. This is the foundation I use for this study.

Within this framework, scientists and institutions have developed definitions of "giftedness" as a characteristic of certain individuals. Historically, giftedness has been defined in a number of ways. Witty (1940) believed that giftedness needs no referent to intelligence and can be described as possessed by those "whose performance is consistently remarkable in any potentially valuable area" (p. 516). Renzulli (1978) has long held the view that giftedness is not a quality, like a level of intelligence, but a behavior, characterized by above-average ability, creativity, or task commitment. In 1972 U.S. Commissioner of Education Sidney Marland defined gifted and talented children in a report, *Education of the Gifted*, to Congress on the status of the education of gifted and talented children:

> Gifted and talented children are those identified by professionally qualified persons who by virtue of outstanding abilities are capable of high performance. These are children who require differentiated educational programs and services beyond those normally

> provided by the regular school program in order to realize their contributions to self and society. Children capable of high performance include those with demonstrated achievement and/or potential ability in any of the following areas: 1) General intellectual aptitude, 2) specific academic aptitude, 3) creative or productive thinking, 4) leadership ability, 5) visual and performing arts. (p. 2)

In 2002 reauthorization of the Jacob K Javits Gifted and Talented Students Education Act provided the most current federal definition:

> The term "*gifted and talented*" when used in respect to students, children or youth, means students, children, or youth who give evidence of high achievement capability in areas such as intellectual, creative, artistic, or leadership capacity, or in specific academic fields, and who need services or activities not ordinarily provided by the school in order to fully develop those capabilities. (Title IX, Part A, Section 9101(22))

The National Association for Gifted Children (NAGC, 2010) believes that:

> Gifted individuals are those who demonstrate outstanding levels of aptitude (defined as an exceptional ability to reason and learn) or competence (documented performance or achievement in top 10% or rarer) in one or more domains. Domains include any structured area of activity with its own symbol system (e.g., mathematics, music, language) and/or set of sensorimotor skills (e.g., painting, dance, sports).

While the U.S. does have this federal definition, and the NAGC also has a nationally recognized definition, nearly every state has its own definition. While some states define giftedness based on a same-age comparison, others define it based on needs beyond what is offered in the regular classroom, and not all states require that school districts follow the state definition. According to

KRS 157.200, the state of Kentucky defines gifted and talented students as one type of exceptional children and youth:

> "Gifted and talented student" means a pupil identified as possessing demonstrated or potential ability to perform at an exceptionally high level in general intellectual aptitude, specific academic aptitude, creative or divergent thinking, psychosocial or leadership skills, or in the visual or performing arts.

Kentucky school districts then determine how they will service students. The school in this study is part of a school district that identifies and provides services to gifted and talented students in grades 4–12 in the following categories: General Intellectual Ability, Specific Academic Aptitude, Creativity, Leadership, and/or Visual and Performing Arts (art, drama, dance, music). Formal identification in the academic areas must include a minimum score of 9th stanine (96th percentile) along with at least two other pieces of evidence indicating gifted behaviors. The school or District Gifted and Talented committee makes the final formal identification decisions. Documentation may include: student work, behavioral checklists, anecdotal records, auditions and performances, parent questionnaire, teacher/specialist recommendations. Students in grades 4-8 with scores in the 9th stanine (96th-99th percentile) in all three areas of math, reading and general intellectual ability will be included in a rank order system for placement into the Accelerated Program, which consists of self-contained classes of formally identified gifted students.

Because there is no universal checklist for determining giftedness, where a student goes to school can determine how he or she will be identified and what services he or she will receive. In fact, many gifted students are never identified. According to the NAGC (2010), "some gifted children with exceptional aptitude may not demonstrate outstanding levels of achievement due to

environmental circumstances such as limited opportunities to learn as a result of poverty, discrimination, or cultural barriers; due to physical or learning disabilities; or due to motivational or emotional problems" ("Definitions of Giftedness," para 2). This disconnect between students' potential to achieve and their actual achievement has implications for schools as they design programs and services for gifted students. With the new focus on technology and 21st century skills, identifying traits of giftedness in Information and Communications Technologies has emerged as an another important area of identification.

Amhad, Mansor, and Karim (2014) studied talent development among the individuals who are gifted and talented in Information and Communications Technologies (ICT). They interviewed groups of respondents who have excelled in the field of ICT and collected qualitative data. The data was analyzed and structured based on Gagne Differentiated Model of Gifted and Talent (DMGT), namely Natural Abilities, Intrapersonal Catalyst and Environment Catalyst, and finally Development Process.

Their findings indicated that individuals gifted and talented in ICT should be identified as a unique talent. They found that schools should provide the identification criteria and methods to identify and develop the potential of this group of individuals who show promise in skills needed in the 21st century. Although this was just a pilot study, the implication are huge for education. As education strives to keep up with modern industries, it will have to examine expanding its areas of giftedness and talent. ICT is a dominant field in the workplace today, and it is important for students with related skills be given the opportunity to develop them to the fullest potential. Clearly this study needs to be replicated in order to determine traits of giftedness and talent in ICT. But is also seems that the definition of gifted and talented will continue to evolve.

Chapter 3: Methods and Results

Participants

Participants in the study were 40 students identified as gifted and talented in the Accelerated Program at a middle school in the southeastern United States during the 2015-2016 school year. To be in the Accelerated Program, students score in the 96th-99th percentile (9th stanine) in Reading, Math, and General Intelligence. Students are in 7th and 8th grade and take high school Geometry, which is a two-year advanced class (three-year advanced for 7th graders). At the end of the course students take a high school placement exam, and if they pass, they take Algebra II as freshmen (or 8th graders). The Geometry course taken in middle school does not count for a high school credit. The 40 participants were ages 12-14, with two being in 7th grade and 38 being in 8th grade. Seventeen students were female, and 23 were males. Various ethnic backgrounds were represented, including 36 white, 1 African American, 1 Asian, 1 Hispanic, and 1 Indian. A total of 20 students agreed to participate in this study in each class. Pseudonyms are used for participants in this study.

The classroom teacher is certified in secondary math education, grades 8-12, with an endorsement in Gifted and Talented education. This is her 8th year teaching and 5th year teaching Advanced Algebra and Geometry in the accelerated program. She uses direct instruction every day. After teaching students directly through modeling, she requires students to practice the skills and then assigns nightly homework. Students often practice in pairs and work cooperatively to solve difficult problems. There are few projects and no group work assigned to the students throughout the school year. My role was then to demonstrate how to use the Scratch application, and have the students create any type of project to display their understanding of transformations.

Procedures

The 40 students were in two class periods of Geometry. Class 1 acted as the control, having no technology introduced in the lesson. Class 2 received the same instruction from the classroom teacher, plus an additional technology component. All students took the same pre and posttests, as well as an extended posttest (see Appendix B C, and D). The pretest included five similar, but not identical, questions from the posttest. Question 1 was drawing a reflection. Question 2 was drawing a rotation. Question 3 was drawing a translation. Question 4 was naming the rule for a reflection. Question 5 was naming the rule for a translation. On the posttest there were 14 questions that required students to either draw a shape after being transformed, or write the rule of the given transformation. Eight questions required the students to draw a new figure: 4 reflections, 2 rotations, and 2 translations. Six questions required the students to write the rule when given an object that was transformed: 2 for reflections, rotations, and translations. The posttest also included an open-ended problem. Students chose one of the four transformations, reflection, rotation, translation, or dilation, and described how their transformation affected an object's shape, size, and location. After they chose a square, triangle, rectangle, or trapezoid, they had to graph that figure and name the quadrant it was located in and its coordinates. The student then had to do their chosen transformation to the figure they selected, and list the new coordinates and the quadrant it was then located in. Finally, the student then had to explain what happened to their figure and explain their reasoning. The extended posttest had the same type and number of questions as the posttest, but with different numbers.

The lesson content for this unit of study was transformations, including rotations, translations and reflections. Students' learning objective was to calculate the new coordinates

for a transformation when given initial coordinates. Common Core Standards for the unit included:

- CCSS.8.G.3 Describe the effect of dilations, translations, rotations, and reflections on two-dimensional figures using coordinate
- CCSS.8.G.4 Understand that a two-dimensional figure is similar to another if the second can be obtained from the first by a sequence of rotations, reflections, translations, and dilations; given two similar two- dimensional figures, describe a sequence that exhibits the similarity between them.

The pretest took place before the first day's lesson began. Students then received five class periods (sixty minutes per class) of instruction from the classroom teacher. First the teacher did an example on the whiteboard with dry erase marker. The students copied the example, working through the problem with her. Then students did several practice problems where they could ask for help. Upon completion of the unit, Class 1 then took the posttest; however, Class 2 then had five additional days to complete a project using Scratch. Scratch is used to program interactive stories, games, and animations and is a project of the Lifelong Kindergarten Group at the MIT Media Lab. As described on the website, "Scratch is a programming language and online community where you can create your own interactive stories, games, and animations—and share your creations with others around the world. In the process of designing and programming Scratch projects, young people learn to think creatively, reason systematically, and work collaboratively." Upon completion of the Scratch project, Class 2 then took the posttest. Two weeks after the conclusion of the unit, both classes completed the extended posttest.

Scratch Technology Project

Students were given an introduction to Scratch that showed them what it was and how it worked. Then, they explored different creations and generated ideas for their individual project. Because I wanted to measure creative construction, I did not put any parameters on the project. Instead, I told them that their product (i.e. game, quiz, cartoon, etc.) had to clearly show they mastered the concept of transformations. Students created many different projects over the course of the 5 days. These projects included explaining the idea of a rotation in relation to a basketball being shot, an information presentation on what transformations are using an xy coordinate plane, and a quiz requiring correct answers to advance. Table 1 shows a screenshot and a short description of the project created by a student. In addition, it also shows which transformation the student chose to create a Scratch project on.

Table 1

Final Scratch Project Overview

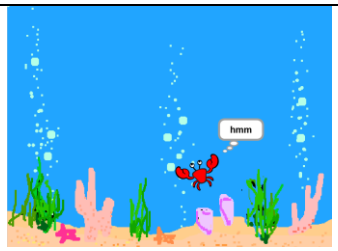
			Topic Addressed			
Student	Overview of Product	Screenshot	Transl.	Dilat.	Rotat.	Reflect.
1	This student's project showed what an everyday rotation can look like. But, they also showed how these would not be considered a "true" geometric rotation.				X	
2	This student demonstrated with a figure what each transformation looks like. But they had to get a question correct to move on.		X	X	X	X

Table 1 Continued

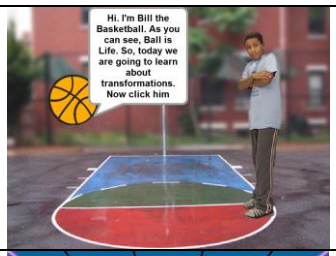
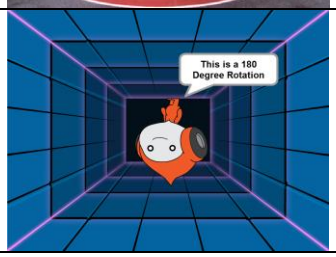
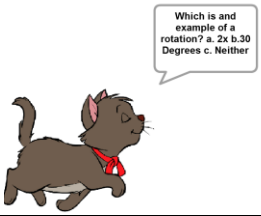
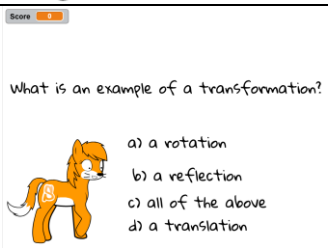
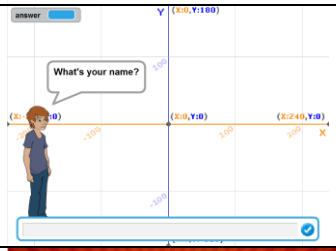
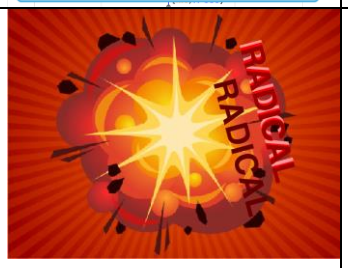
3	Demonstrated what transformations look like.		X		X	X
4	Demonstrated what transformations look like, and showed them on a graph.		X	X	X	X
5	Quiz on translations		X		X	X
6	Quiz on translations		X		X	X
7	Quiz using a coordinate plane.		X	X	X	X
8	Demonstration of different transformations. Not much detail.		X			X

Table 1 continued

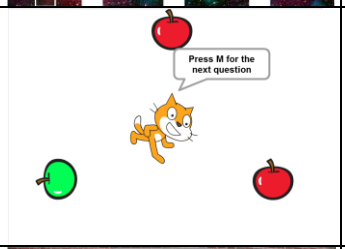
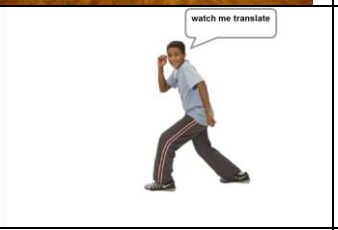
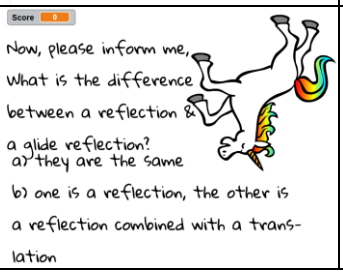
9	Showed a translation only.		X			
10	Constant moving item showing translations in a game.		X			
11	Quiz on transformations		X	X	X	X
12	Demonstration of all transformations, then check for understanding.		X	X	X	X
13	Skit and explanation of transformations on a coordinate plane.		X		X	X
14	Demonstration of selected transformations		X			X

Table 1 Continued

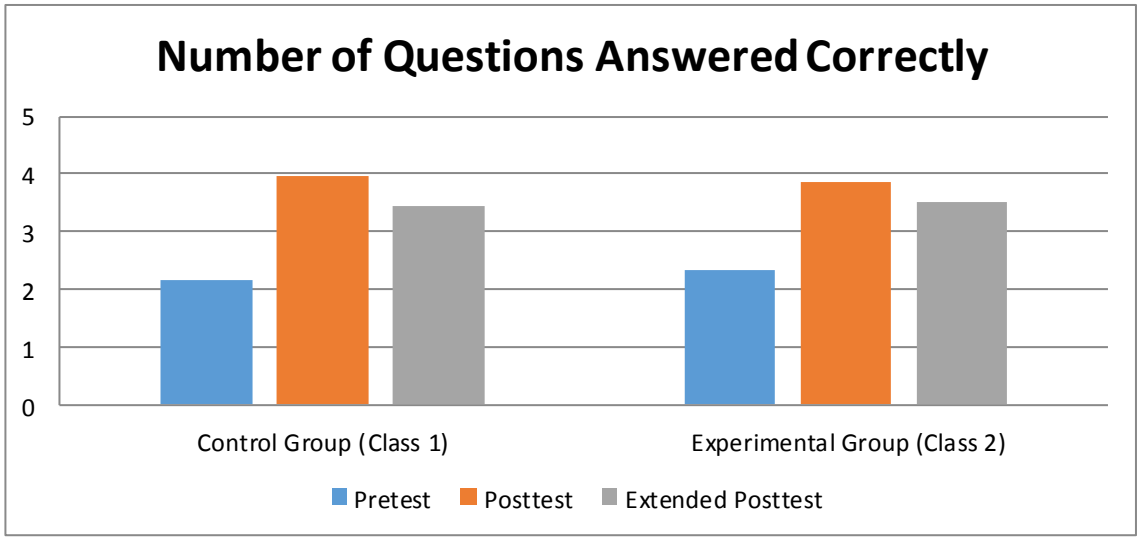
15	Game of selecting a transformation before the dinosaur goes extinct.		X	X	X	X
16	Demonstration of transformations.		X			X
17	Explanation of transformations, then quiz on selecting the correct transformation. Includes coordinate plane.		X	X	X	X
18	Game/Quiz of transformations.		X	X	X	X
19	Skit showing what a transformation is.		X			X
20	Quiz on most transformations.		X		X	X

Results

In order to analyze impact of the technology component on achievement, I compared the percentage increase from pretest to posttest to extended posttest between Class 1 and Class 2. Figure 1 shows the average number of correct questions for each class on each test. Table 2 shows a breakdown for each class of the percentage of correctness on each question on each test.

Figure 1

Number of Questions Answered Correctly



Analysis of correct responses on all tests shows that that both classes achieved at similar levels. Both classes increased from the pretest to posttest and then digressed slightly on the extended posttest. Class 1, the control group, got an average of 2.175 out of 5 questions correct on the

pretest and scored an average of 3.95 out of 5 on the posttest. This was an increase of 1.775 between the two.

Table 2

Percentage of Correctness on Assessments

	Pretest					Posttest					Extended Posttest				
Question #	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Class 1	35	5	95	17.5	65	85	30	100	80	100	65	15	100	65	100
Class 2	35	20	95	20	62.5	80	35	100	70	100	55	35	100	60	100

The average on the extended posttest was 3.45, which was a drop of .5 from the posttest. Class 2, the experimental group, scored an average of 2.325 on the pretest and 3.85 on the posttest. This showed an increase of 1.525 from pretest to post test, which was smaller than the control group. Their extended posttest showed an average of 3.5, which was only .3 lower than their posttest. This data shows that all the students mastered the standard, but it seems that there was no additional benefit of the technology component. After performing a t-test to determine statistical significance between the two classes, the *t*-value was calculated to be -0.05595, while the p-value was .477889. Knowing this, it can be determined that the difference between the two classes was not statistically significant.

Closer analysis of individual questions reveals that the experimental group may have benefited from the technology in a different way. The students in both groups showed a large increase from pretest to posttest on question 2, which dealt with rotational symmetry; however, the experimental group maintained a higher score through the extended posttest than the control group.

When reviewing the open ended questions, I looked specifically at the correctness of their drawing and the terminology they used when explaining their answers. Both the experimental and control group showed mastery of concepts on the drawing portion. 98% of the experimental group did the drawing portion correctly, and 96% of the control group did their drawing correctly. While both of these scores showed that nearly all students understood the concepts, the writing portion showed disparity. I looked for the following key words in their responses: translation, rotation, dilation, reflection, quadrants, and axis. 65% of students in the control group used at least one of those words in the written explanation in the open response portion. The other 35% adequately explained their transformation using slide, turn, flip, etc. In the experimental group 90% of the students used one of more of these words to describe their transformation. For example, in the open-ended question that asked students to "explain in a couple of sentences what happened to the figure," Sam, who was in Class 1 responded by saying, "I chose a triangle and flipped it over the x axis. It is now in the first quadrant because I just flipped it up." While that answer wasn't entirely incorrect, Mia, who was a student in Class 2, responded by saying, "After I rotated my trapezoid, it moved from quadrant one to quadrant three. That is because I chose a 180 degree rotation, which would rotate the figure into the quadrant that is diagonal from it."

Chapter 4: Discussion and Final Remarks

Research Questions Revisited

How does technology impact student achievement in the gifted and talented math classroom? Both the control group and experimental group showed mastery of standards and concepts. This confirms what Erkoc, Gecu, and Erkoc (2013) found to be true in their study of how Google Sketchup can help students gain an understanding of the abstract concepts geometry

presents. They found that both the use of isometric paper and Google Sketchup increased students' mental test scores. I found that both traditional learning and Scratch helped students master transformations.

How does technology impact gifted and talented students' creative construction? My results do not confirm what Toptaş, Çelık, and Karaca (2012) found when they ran a similar experiment with Google Sketchup. On a Differential Aptitude Test and Mental Rotation Test the control group and the experiment group (used Google Sketchup) scored similarly on pre-test, but on the post-test, the experiment group did better. Toptas et al. (2012) concluded that the supplemental technology helped students score higher on the posttests. I used similar methods, with all students getting the same traditional instruction and the experimental group getting the supplemental technology component. Although my study was short and dealt with less rigorous Geometric concepts, the supplemental technology component did have one positive effect on the experimental group. It increased students' use of correct content vocabulary. Students in the experimental group were 25% more likely to use the correct content vocabulary than the control group.

Implications for Teachers

This research can impact the way teachers use technology because it shows that teachers have to carefully plan out projects, considering 21st century skills and technology literacy. My study shows that technology can have little impact if the teacher does not choose the right timetable, concepts, and technology application for a project.

Other studies that were longer and more in-depth had more conclusive results (Erkoc, Gecu, and Erkoc, 2013; Toptaş, Çelık, and Karaca, 2012). Also, my short study should encourage teachers

to conduct their own action research within their classrooms. Their findings could help them improve their integration of technology into curriculum.

The other vital thing teachers can learn from this study is that technology is going to be a part of education, whether they are ready or not, and that in order to truly prepare students for the future, they need to embrace emerging innovations and try to integrate them in learning. Even when a technology component doesn't impact students test scores, like in my study, it can impact their thinking and attitude toward technology. Also, it can make learning more engaging.

Implications for Future Research

While the extended post-test was an effort to measure student knowledge retention, all assessments were still conducted in a fairly short period of time. In order to truly show significant long-term results, a longitudinal study with extensive technology use must be conducted. A year-long study using multiple measures of success would benefit research. The post test and extended posttest that I used measured creative construction with open response questions. While these do reveal students' thinking, real-world products made with technology applications would expose more aspects of thinking and how students applied that thinking. Planning the projects and designing the products requires true creative construction, and if students completed several projects over the course of the year, a progression of their creative construction abilities could be analyzed.

My research should also lead to further research on students' use of 21st century skills. My study shows that the depth of knowledge and level of critical thinking skills needed for the specific content can affect how effective the technology application is at assessing 21st century skills. Transformations was a unit of study that fit my time requirements, but the concepts

studied are not as challenging as most Geometry concepts. Transformations are straightforward and require algebraic thinking. The gifted and talented 8th grade students mastered Algebra and passed the high school Algebra placement exam in 7th grade. Future studies need to focus on more concepts that require higher level thinking and have a real-world application, such as a scaling project with ratios and proportions. Studies should be conducted in true project-based learning where the students solve real-world problems since this is the focus of 21st century skills.

Surveys of curriculum could also be helpful because it would reveal what technological literacy opportunities are available. Schools and districts vary greatly in their approach to integrate technology and in the amount of hardware and software they possess. Additionally, there is no common measure for technology literacy, so schools may rate themselves inaccurately if they self-assess. A survey could provide a detailed picture of the technology literacy landscape for school districts.

Appendix A

Experimental Class Data																		
	Pre-Test						Post-Test						Extended Post-Test					
Student	1	2	3	4	5	Total	1	2	3	4	5	Total	1	2	3	4	5	Total
1	0	0	1	0	0	1	0	0	1	0	1	2	0	0	1	0	1	2
2	0	0	1	0	0	1	1	0	1	0	1	3	1	1	1	0	1	4
3	0	0	0	0	1	1	1	1	1	1	1	5	1	1	1	1	1	5
4	0	0	1	0	1	2	1	0	1	1	1	4	0	0	1	1	1	3
5	0	0	1	0	1	2	1	0	1	1	1	4	1	0	1	1	1	4
6	1	1	1	1	1	5	1	1	1	1	1	5	1	1	1	1	1	5
7	0	0	1	0	0	1	1	0	1	0	1	3	0	0	1	0	1	2
8	1	0	1	1	0	3	1	0	1	1	1	4	1	0	1	1	1	4
9	1	0	1	0	1	3	1	0	1	1	1	4	1	0	1	0	1	3
10	0	0	1	0	0	1	0	0	1	1	1	3	0	0	1	1	1	3
11	1	1	1	1	1	5	1	1	1	1	1	5	1	1	1	1	1	5
12	0	0	1	0	1	2	1	0	1	1	1	4	1	0	1	1	1	4
13	1	1	1	0	1	4	1	1	1	1	1	5	0	0	1	1	1	3
14	1	0	1	0	1	3	1	0	1	1	1	4	1	0	1	1	1	4
15	0	0	1	0	0.5	1.5	0	1	1	0	1	3	0	1	1	0	1	3
16	0	0	1	0	1	2	1	0	1	0	1	3	0	1	1	0	1	3
17	0	0	1	0	1	2	1	1	1	1	1	5	0	0	1	1	1	3
18	1	0	1	1	1	4	1	1	1	1	1	5	1	1	1	1	1	5
19	0	0	1	0	0	1	0	0	1	0	1	2	0	0	1	0	1	2
20	0	1	1	0	0	2	1	0	1	1	1	4	1	0	1	0	1	3
Total Correct	7	4	19	4	12.5	2.375	16	7	20	14	20	3.85	11	7	20	12	20	3.5
Average	0.35	0.2	0.95	0.2	0.625		0.8	0.35	1	0.7	1		0.55	0.35	1	0.6	1	

Control Class Data																		
	Pre-Test						Post-Test						Extended Post-Test					
Student	1	2	3	4	5	Total	1	2	3	4	5	Total	1	2	3	4	5	Total
21	0	0	1	0	1	2	1	1	1	1	1	5	0	0	1	1	1	3
22	0	0	1	1	0	2	1	0	1	1	1	4	1	0	1	1	1	4
23	0	0	1	0	1	2	1	0	1	1	1	4	0	0	1	1	1	3
24	1	1	1	0	0	3	1	1	1	1	1	5	1	0	1	1	1	4
25	1	0	1	0	1	3	1	1	1	1	1	5	1	1	1	0	1	4
26	0	0	1	0	1	2	1	0	1	1	1	4	0	0	1	1	1	3
27	0	0	1	0	1	2	1	1	1	1	1	5	1	0	1	1	1	4
28	0	0	1	0	0	1	0	0	1	0	1	2	0	0	1	0	1	2
29	0	0	1	0	1	2	1	1	1	1	1	5	1	1	1	0	1	4
30	0	0	1	0.5	1	2.5	1	0	1	1	1	4	1	0	1	1	1	4
31	0	0	1	0	0	1	0	0	1	0	1	2	0	0	1	0	1	2
32	1	0	1	0	0	2	1	0	1	1	1	4	1	0	1	1	1	4
33	1	0	1	1	0	3	1	0	1	1	1	4	1	0	1	1	1	4
34	1	0	1	1	1	4	1	1	1	1	1	5	1	1	1	1	1	5
35	0	0	0	0	0	0	0	0	1	0	1	2	0	0	1	0	1	2
36	1	0	1	0	1	3	1	0	1	1	1	4	1	0	1	0	1	3
37	1	0	1	0	1	3	1	0	1	1	1	4	1	0	1	1	1	4
38	0	0	1	0	1	2	1	0	1	0	1	3	1	0	1	0	1	3
39	0	0	1	0	1	2	1	0	1	1	1	4	0	0	1	1	1	3
40	0	0	1	0	1	2	1	0	1	1	1	4	1	0	1	1	1	4
Total Correct	7	1	19	3.5	13	2.175	17	6	20	16	20	3.95	13	3	20	13	20	3.45
Average	0.35	0.05	0.95	0.175	0.65		0.85	0.3	1	0.8	1		0.65	0.15	1	0.65	1	

Appendix B

Geometry Name_____ ID: 1

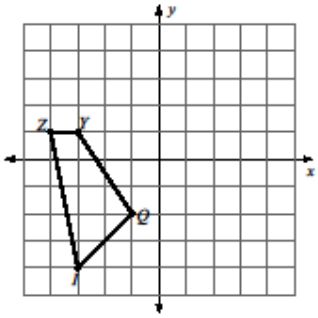
© 2016 Kuta Software LLC. All rights reserved.

Transformation PreTest

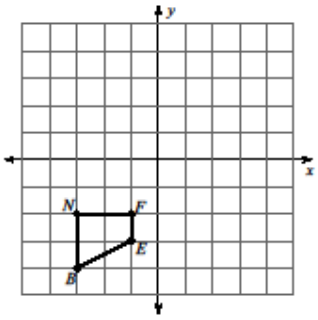
Date_____ Period____

Graph the image of the figure using the transformation given.

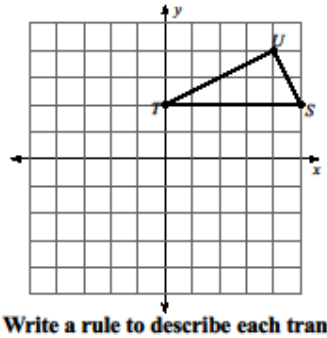
1) reflection across $x = -1$



2) rotation 90° counterclockwise about the origin

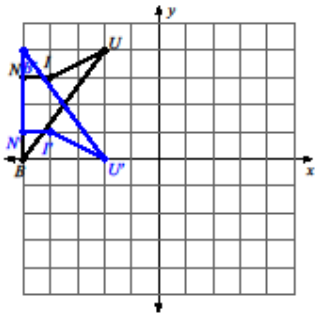


3) translation: 5 units left and 7 units down

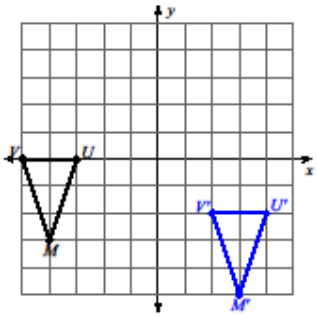


Write a rule to describe each transformation.

4)



5)



© 2016 Kuta Software LLC. All rights reserved. Made with Infinite Geometry.

Geometry Name_____ ID: 1

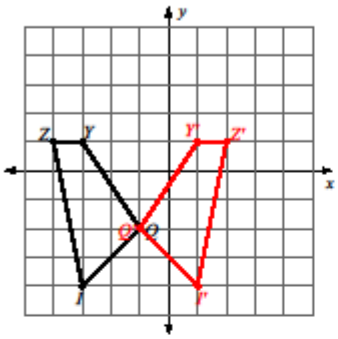
© 2016 Kuta Software LLC. All rights reserved.

Transformation PreTest

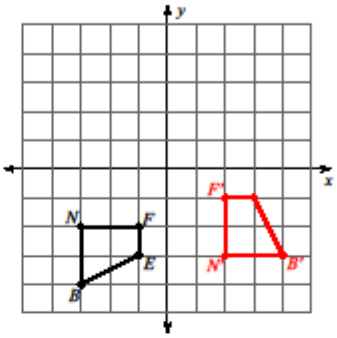
Date_____ Period____

Graph the image of the figure using the transformation given.

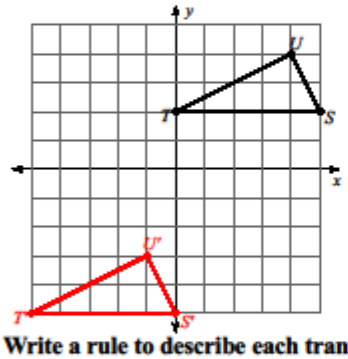
1) reflection across $x = -1$



2) rotation 90° counterclockwise about the origin

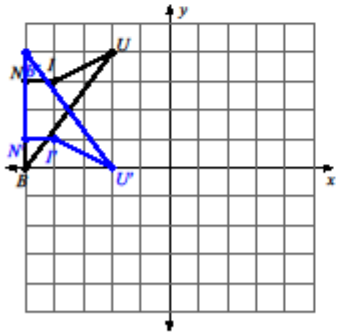


3) translation: 5 units left and 7 units down

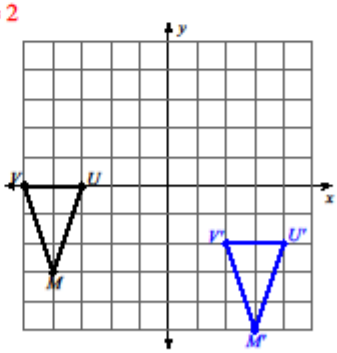


Write a rule to describe each transformation.

4) reflection across $y = 2$



5) translation: 7 units rig



© 2016 Kuta Software LLC. All rights reserved. Made with Infinite Geometry.

Appendix C

Geometry Name_____ ID: 1

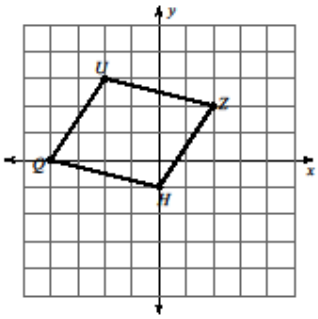
© 2016 Kuta Software LLC. All rights reserved.

Transformation Test

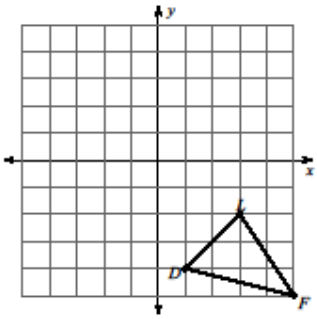
Date_____ Period____

Graph the image of the figure using the transformation given.

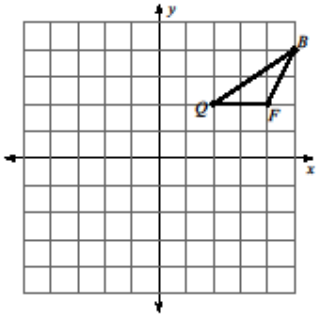
1) reflection across the x-axis



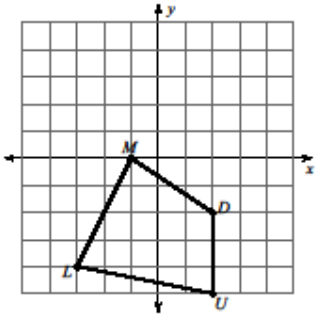
2) reflection across the y-axis



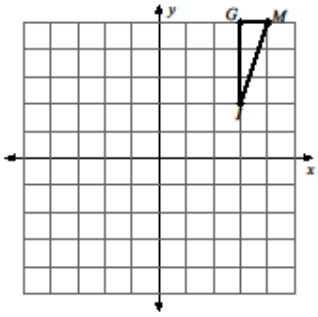
3) reflection across $x = 2$



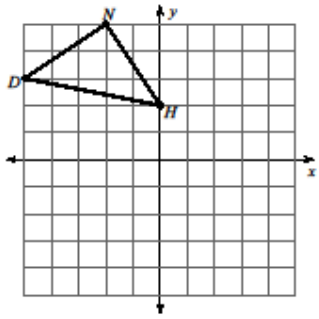
4) reflection across $y = -1$



5) rotation 180° about the origin

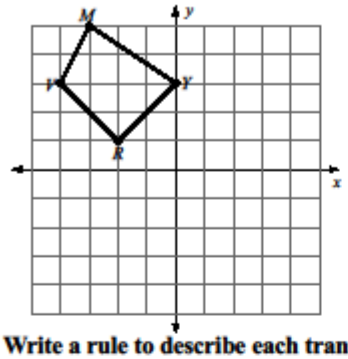


6) rotation 90° counterclockwise about the origin

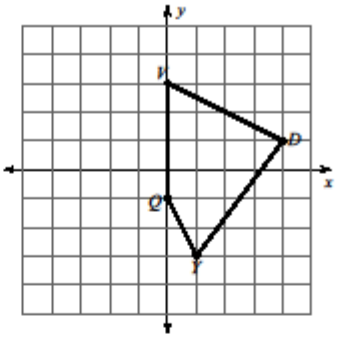


© 2016 Kuta Software LLC. All rights reserved. Made with Infinite Geometry.

7) translation: 3 units down

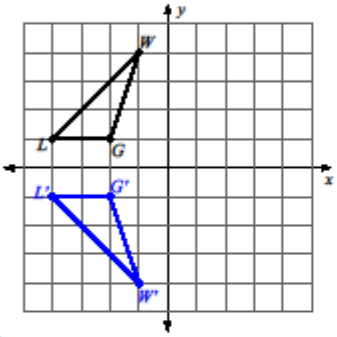


8) translation: 4 units left and 2 units up

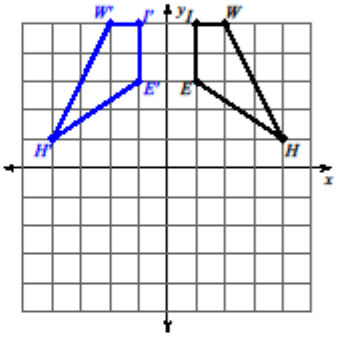


Write a rule to describe each transformation.

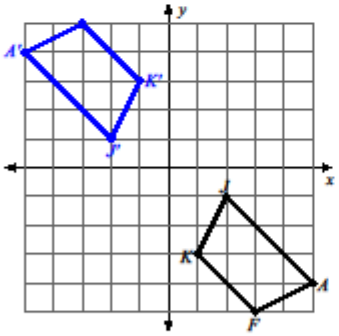
9)



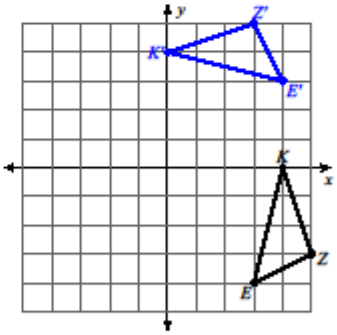
10)



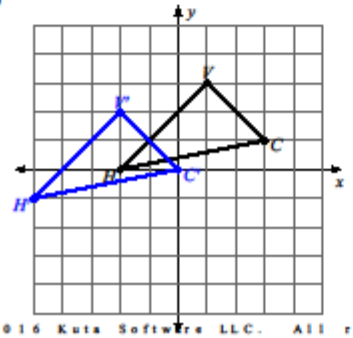
11)



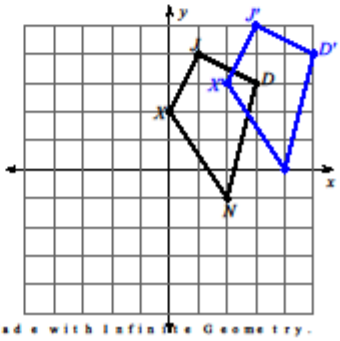
12)



13)



14)



© 2016 Kuta Software LLC. All rights reserved. Made with Infinite Geometry.

Geometry Name_____ ID: 1

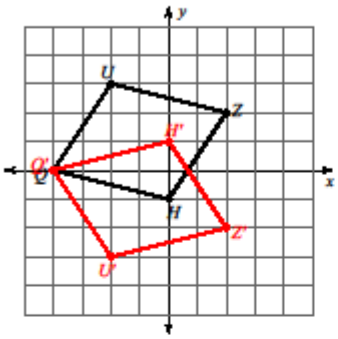
© 2016 Kuta Software LLC. All rights reserved.

Transformation Test

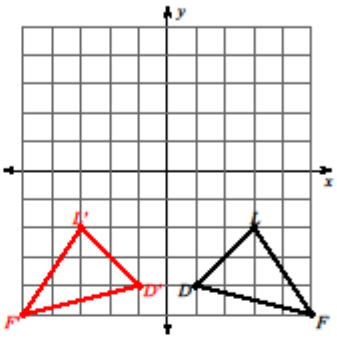
Date_____ Period____

Graph the image of the figure using the transformation given.

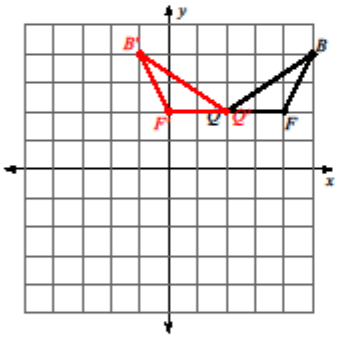
1) reflection across the x-axis



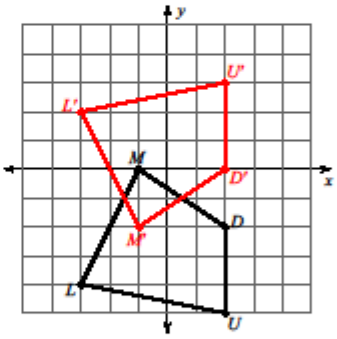
2) reflection across the y-axis



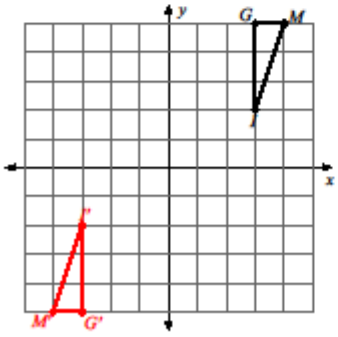
3) reflection across $x = 2$



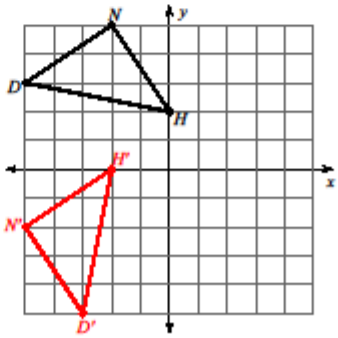
4) reflection across $y = -1$



5) rotation 180° about the origin

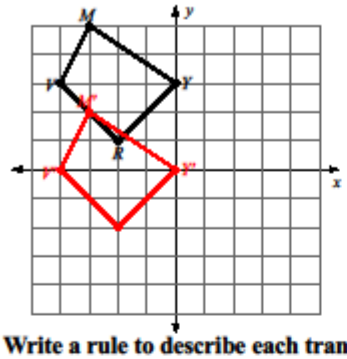


6) rotation 90° counterclockwise about the origin

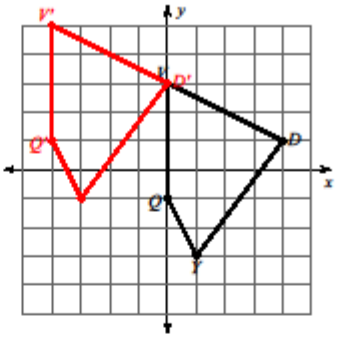


© 2016 Kuta Software LLC. All rights reserved. Made with Infinite Geometry.

7) translation: 3 units down

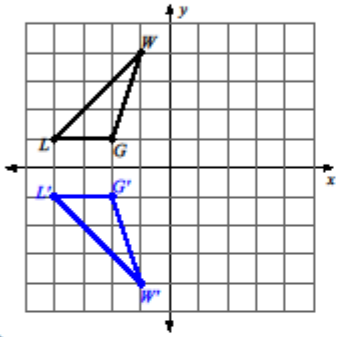


8) translation: 4 units left and 2 units up

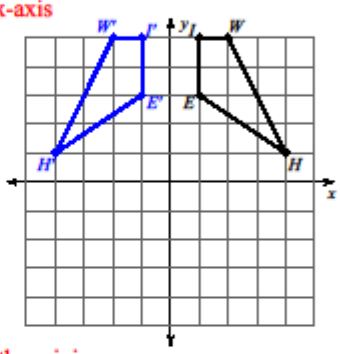


Write a rule to describe each transformation.

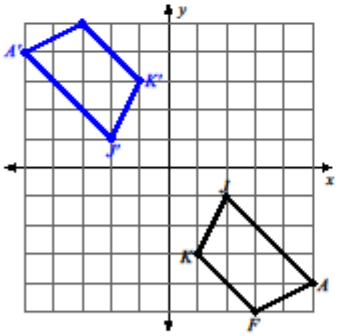
9) reflection across the x-axis



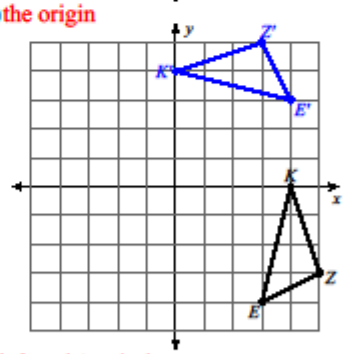
10) reflection across the



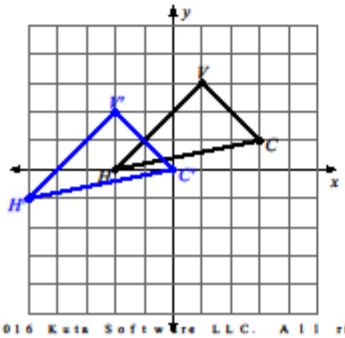
11) rotation 180° about the origin



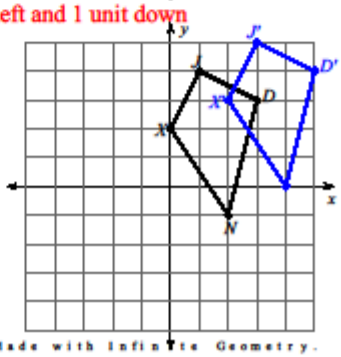
12) rotation 90° counterc origin



13) translation: 3 units left and 1 unit down



14) translation: 2 units ri



© 2016 Kuta Software LLC. All rights reserved. Made with Infinite Geometry.

1. Which type of Transformation will you choose?

Translation Dilation Rotation Reflection

2. How does _____ a figure affect the size, shape, and position of that figure?

3. Choose a figure below, and then plot the figure:

Rectangle Triangle Square Trapezoid

4. What are the coordinates (ordered pairs) of that figure?

5. In what quadrant is the figure located?

6. Transform the figure using the transformation you chose above.

7. What are the new coordinates (ordered pairs) of the transformed figure?

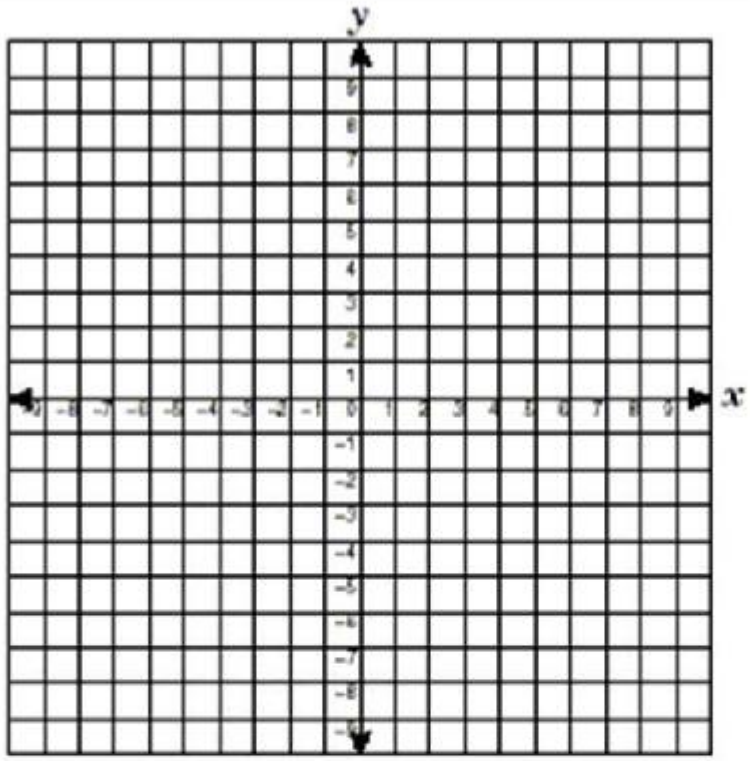
8. Explain in a couple of sentences what happened to the figure.

_____

_____

_____

_____


y
x

Appendix D

Geometry Name_____ ID: 1

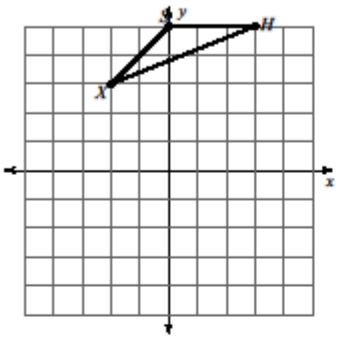
© 2016 Kuta Software LLC. All rights reserved.

Transformation Extended Post Test

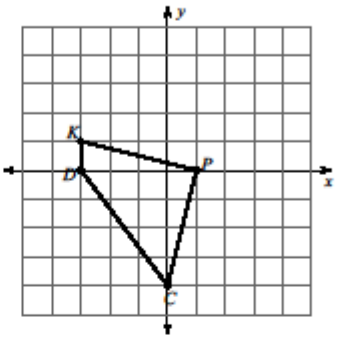
Date_____ Period____

Graph the image of the figure using the transformation given.

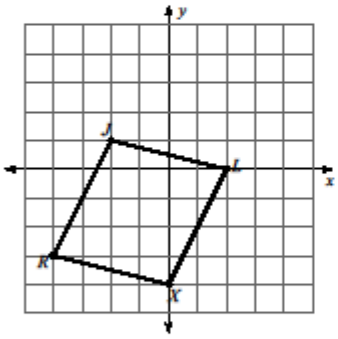
1) reflection across the y-axis



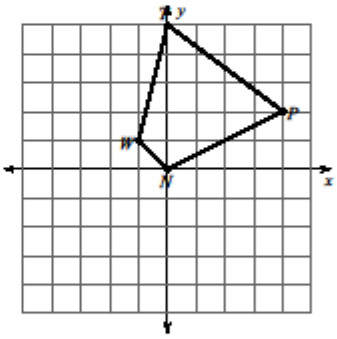
2) reflection across the x-axis



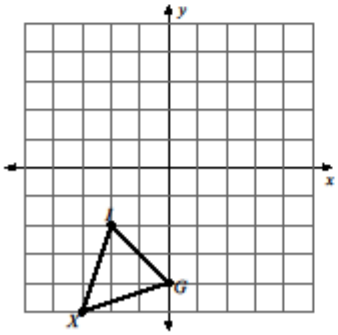
3) reflection across $y = -1$



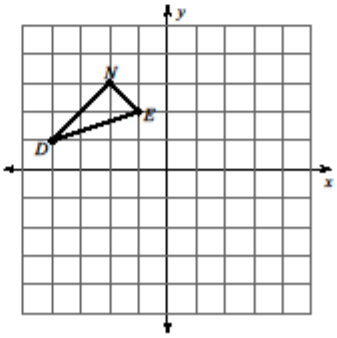
4) reflection across $x = 2$



5) rotation 180° about the origin

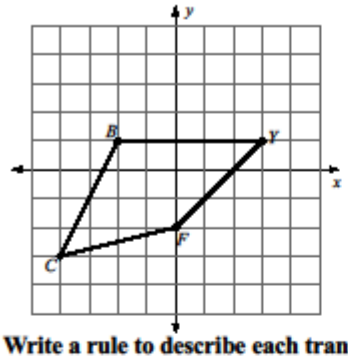


6) rotation 90° counterclockwise about the origin

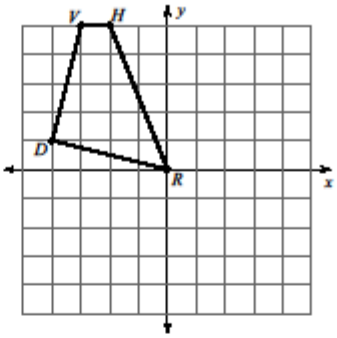


© 2016 Kuta Software LLC. All rights reserved. Made with Infinite Geometry.

7) translation: 2 units right and 2 units up

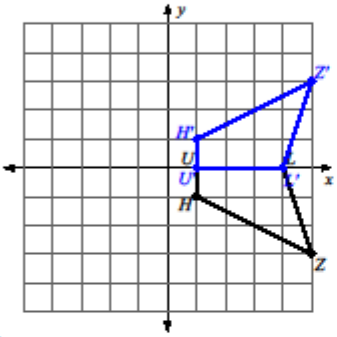


8) translation: 3 units right and 4 units down

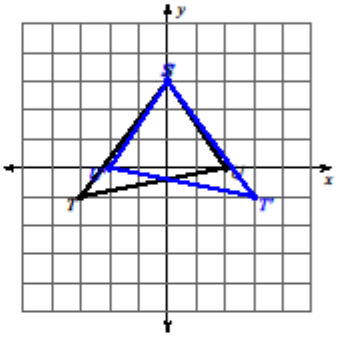


Write a rule to describe each transformation.

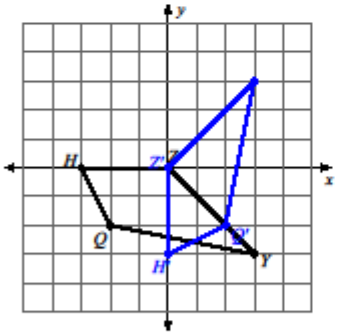
9)



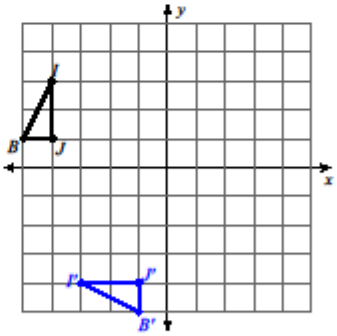
10)



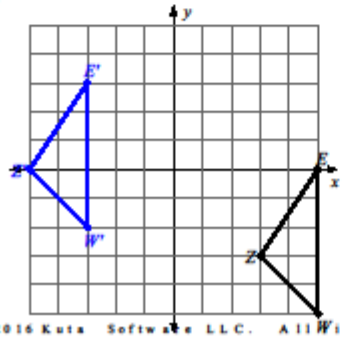
11)



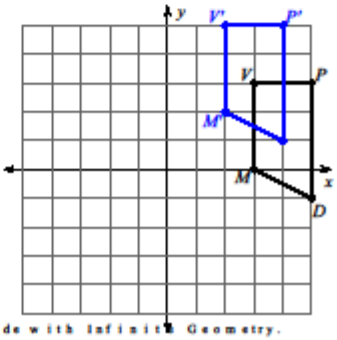
12)



13)



14)



© 2016 Kuta Software LLC. All rights reserved. Made with Infinite Geometry.

Geometry Name_____ ID: 1

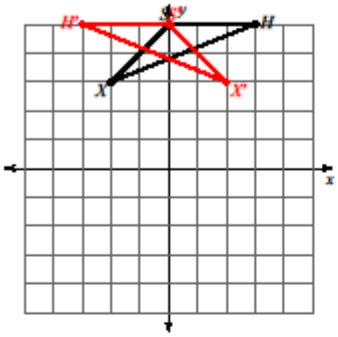
© 2016 Kuta Software LLC. All rights reserved.

Transformation Extended Post Test

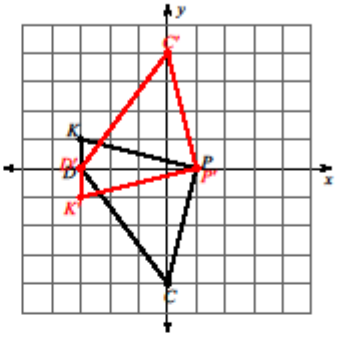
Date_____ Period____

Graph the image of the figure using the transformation given.

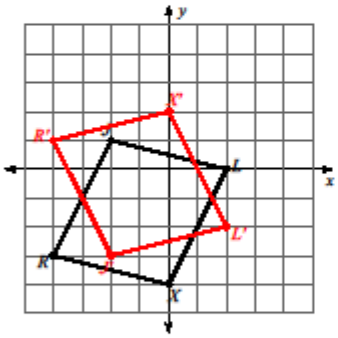
1) reflection across the y-axis



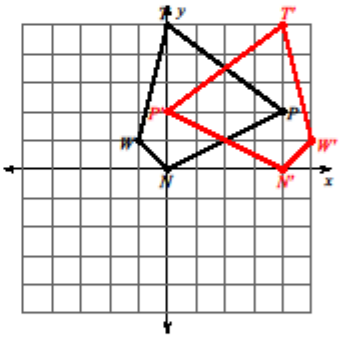
2) reflection across the x-axis



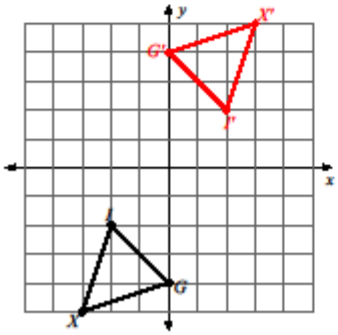
3) reflection across $y = -1$



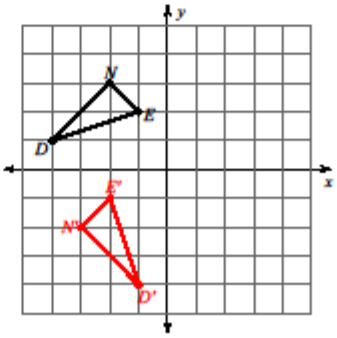
4) reflection across $x = 2$



5) rotation 180° about the origin

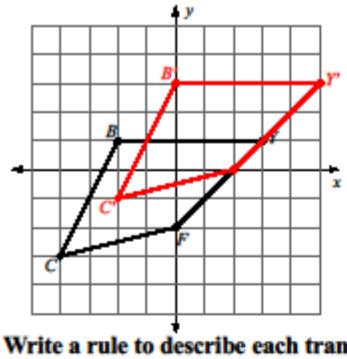


6) rotation 90° counterclockwise about the origin

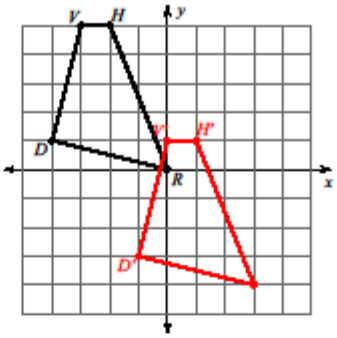


© 2016 Kuta Software LLC. All rights reserved. -1- Made with Infinite Geometry.

7) translation: 2 units right and 2 units up

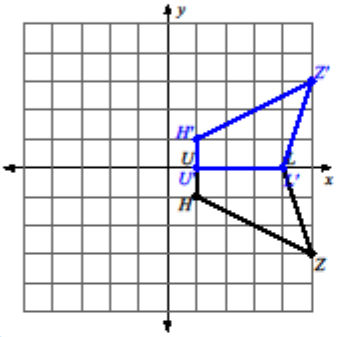


8) translation: 3 units right and 4 units down

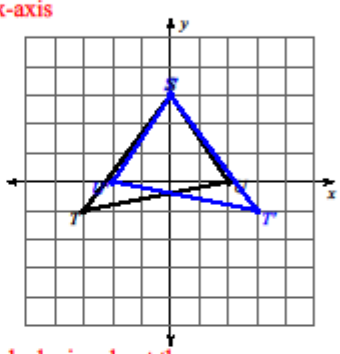


Write a rule to describe each transformation.

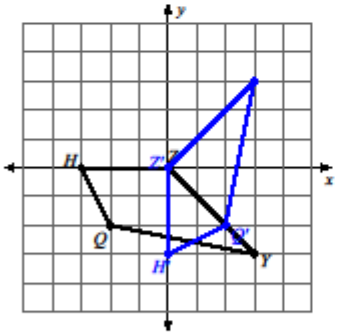
9) reflection across the x-axis



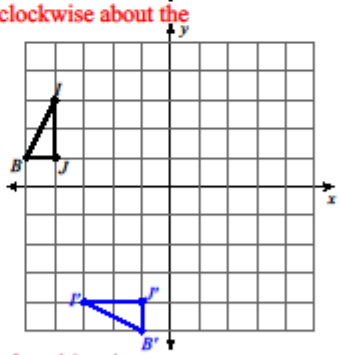
10) reflection across the



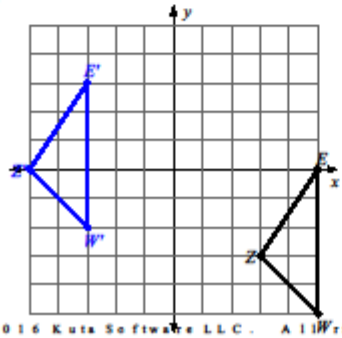
11) rotation 90° counterclockwise about the origin



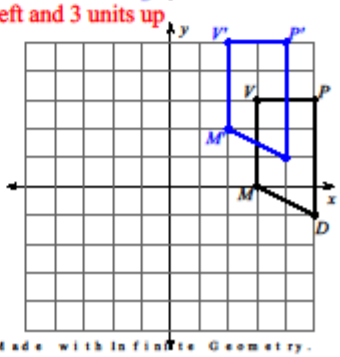
12) rotation 90° counterc origin



13) translation: 8 units left and 3 units up



14) translation: 1 unit lef



© 2016 Kuta Software LLC. All rights reserved. Made with Infinite Geometry.

1. Which type of Transformation will you choose?

Translation Dilation Rotation Reflection

2. How does _____ a figure affect the size, shape, and position of that figure?

3. Choose a figure below, and then plot the figure:

Rectangle Triangle Square Trapezoid

4. What are the coordinates (ordered pairs) of that figure?

5. In what quadrant is the figure located?

6. Transform the figure using the transformation you chose above.

7. What are the new coordinates (ordered pairs) of the transformed figure?

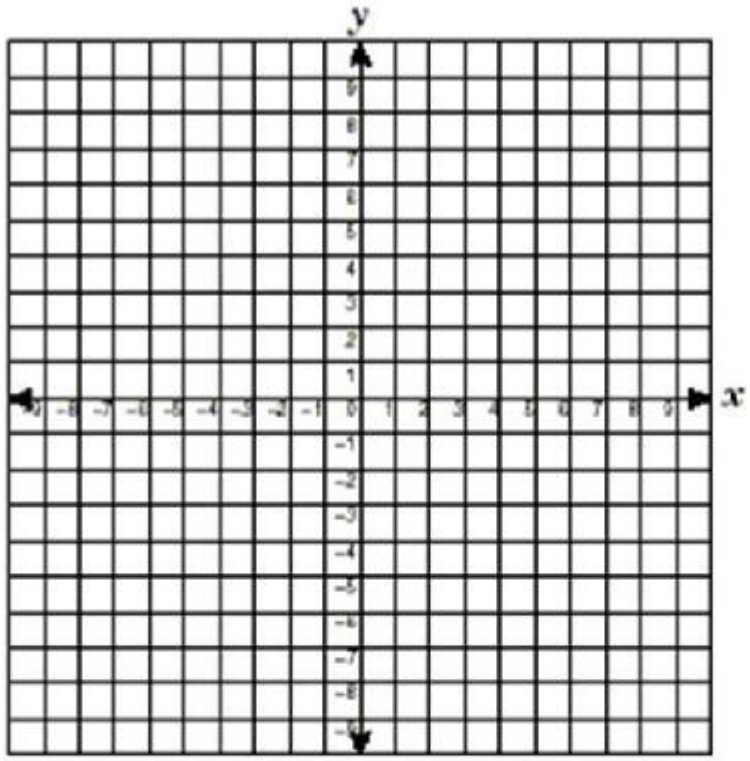
8. Explain in a couple of sentences what happened to the figure.

_____

_____

_____

_____


y
x

References

Ahmad, M., Badusah, J., Mansor, A. Z., & Karim, A. A. (2014). The discovery of the traits of gifted and talented students in ICT. *International Education Studies*, 7(13), 92-101.

Allen, K. C. (2013). Robots bring math-powered ideas to life. *Mathematics Teaching In The Middle School*, *18*(6), 340-347.

Attard, C., & Northcote, M. (2011). Teaching with technology. *Australian Primary Mathematics Classroom*, *16*(4), 29-31

Bang, E., & Luft, J. A. (2013). Secondary science teachers' use of technology in the classroom during their first 5 years. *Journal Of Digital Learning In Teacher Education*, *29*(4), 118-126.

Bolognese, C. c. (2011). Applying mathematics through floor plan design. *Ohio Journal Of School Mathematics*, (63), 32-36.

Boyd, W., & Ellis, D. (2013). Sketching up new geographies: Open sourcing and curriculum development. *Australasian Journal Of Educational Technology*, *29*(3), 403-415.

Clark, B. (2007). *Growing up gifted: Developing the potential of children at home and at school* (7th ed.) Columbus OH: Merrill.

Devlin, T. J., Feldhaus, C. R., & Bentrem, K. M. (2013). The evolving classroom: A study of traditional and technology-based instruction in a STEM classroom. *Journal Of Technology Education*, *25*(1), 34-54.

Erkoc, M. F., Gecu, Z., & Erkoc, C. (2013). The effects of using Google SketchUp on the

mental rotation skills of eighth grade students. *Educational Sciences: Theory and Practice*, *13*(2), 1285-1294.

Fayette County Public Schools. (2015) http://www.fcps.net/education-options/gifted-talented

Gulek, J., & Demirtas, H. (2005). Learning with technology: The impact of laptop use on student achievement. *Journal of Technology, Learning, and Assessment*, 3(2), 3–6.

International Technology and Engineering Educators Association (ITEA/ITEEA). (2000, 2002, and 2007). *Standards for technological literacy: Content for the study of technology*. Reston, VA: Author

Lam, P., & Tong, A. (2012). Digital devices in classroom--hesitations of teachers-to-be. *Electronic Journal of E-Learning*, 10(4), 387-395

Lin, Y., & Jou, M. (2013). Integrating popular web applications in classroom learning environments and its effects on teaching, student learning motivation and performance. *Turkish Online Journal Of Educational Technology - TOJET*, *12*(2), 157-165.

National Association for Gifted Children. (2010). *Redefining Giftedness for a New Century: Shifting the Paradigm*. Washington, DC: Author.

National Association for Gifted Children. (2016). Definitions of giftedness. *NAGC*. http://www.nagc.org/resources-publications/resources/definitions-giftedness

Renzulli, J. (1978). What makes giftedness? Reexamining a definition. *Phi Delta Kappan*, *60*, 180-184, 261.

Thompson, G. (2014). 4 Keys to Designing the Classroom of the Future. *T H E Journal*, *41*(9), 18-22.

Toptaş, V. v., Çelık, S. s., & Tugce Karaca, E. t. (2012). Improving 8th grades spatial thinking abilities through a 3D modeling program. *Turkish Online Journal Of Educational Technology*, *11*(2), 128-134.

Wentworth, D., & Middleton, J. H. (2014). Technology use and academic performance. *Computers & Education*, *78*306-311. doi:10.1016/j.compedu.2014.06.012

Witty, P. (1940). Some considerations in the education of gifted children. *Educational Administration and Supervision, 26,* 512-521.

Wynn, M. (2013). Student perceptions of technology in the classroom: A faculty and student collaboration. *Researcher: An Interdisciplinary Journal*, *26*(3), 21-33.

VITA

Brandon Henry French

EDUCATIONAL INSTITUTIONS

University of Kentucky, 2007-2012

Bachelor of Arts in Middle School Education, Math & Social Studies

University of Kentucky, 2014-2016

Master of Science, STEM Ed.

Instructional Computer Technology Endorsement

PROFESSIONAL POSITIONS HELD

Bate Middle School, Danville, Kentucky. 7th Grade Math Instructor. 2013-2014.

Woodford County Middle School, Versailles, Kentucky. 7th and 8th Grade Math Instructor. 2012-2013.

HONORS

Deans List,University of Kentucky, Fall and Spring 2011