Benefits of Computer Education

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Abstract

Computer science has become a more integral part of everyday life as technology advances. By teaching children computer science at a young age, they are able to better understand their technology-infused world. Because of its importance, a computer science program that uses the programming language Scratch was developed to educate students at Cardinal Forest Elementary School. This project focused its research on whether the computer science education benefited students in ways other than simply gaining knowledge of computer programming.

1 Introduction

Does an education in computer science actually benefit young children? Perhaps they would be better off spending their time learning more about their core subjects. In order for computer science classes to be worth a young student's time, they should provide the child with something more than just a beginner's knowledge of computer programming. The goal of this research project was to investigate exactly how young students benefit from a computer science education and whether a certain type of child benefits more. For example, some children are very shy and prefer to work by themselves, while others are more talkative and willing to ask their classmates for help. Does a computer science program help the shy children learn the value of getting help from their peers, or maybe the talkative children benefit more because they learn the importance of listening to the teacher's directions?

To answer these questions, I have worked with first and second graders at Cardinal Forest Elementary School who participate in a computer science education program. My partner, Crystal Noel, and I developed curriculum for the two classes and taught a thirty minute lesson each week. Throughout the duration of the program, I observed changes in the children's learning behaviors and I developed a survey to be completed by the program's mentor, Mr. Allard.

2 Background

2.1 Technology and Children

Because technology plays a dominant role in children's lives, it is important for them to gain an understanding about computers. Even at a young age, most children have been exposed to a vast amount of technology- technologies such as television, video games and computers. Therefore, it makes sense to also give children a computer science education, so they can begin to integrate their education into their everyday lives and better understand the technology around them. Learning about technology can also benfit in young minds in other ways. For example, as students become more fluent in technology and create their own 'computer culture,' the students eventually realize that in order to create more advanced projects, they need to work together and ask for help. [2]

The focus of the research project is to determine the benefits of a computer education for children; recent studies have signified a strong possibility that there are other benefits that come from a computer education other than simply becoming more fluent in technology. Computer education takes advantage of the 'spiral of learning' in which students are encouraged to become creative thinkers as they imagine, create, play, share, reflect and imagine again. [4] By developing a computer science education program for the students at Cardinal Forest Elementary School, the students should benefit in multiple areas of their core curriculum.

2.2 History of the Cardinal Forest Scratch Program

Greg Gates, a student who graduated from TJ last year, created the Cardinal Forest Scratch program last year with the help of the computer director at

Cardinal Forest Elementary School, Mr. Allard. Gates set out to determine whether teaching elementary school students computer science was possible and he concluded that children became more technically savvy as the year progressed and they also became more interested in computer science, and technology in general.[3] Crystal and I have helped continue the Cardinal Forest Scratch program, and we each chose different research topics to study during the program.

2.3 The Scratch Programming Language

In order to teach the children computer science, a kid friendly programming language needed to be chosen. Greg and Mr. Allard chose to use Scratch, a visually based programming language developed by MIT that allows children to drag and drop sections of code to build their programs. [5] Mitchel Resnik, one of the developers of Scratch, has done extensive research on computer education and he has concluded that children learn most effectively through a "spiral" of imagining, creating, playing, sharing, reflecting and imagining again. The Scratch program language was created as a way to help students incorporate the spiral learning effect. The students can imagine a program and then easily build it with the Scratch programming language. The methods and visuals in Scratch are particularly useful for creating games and multimedia presentations, so children are able to have more fun with computer programming. Students are able to share their projects online through the Scratch website, fostering even more imagination and creativity as students see what others have done. [4]

3 Developmental Sections

3.1 Lessons

By using Scratch, the students of Cardinal Forest Elementary School were taught basic computer science skills and problem solving techniques. Each week, curriculum was developed to be taught during the Thursday class sessions. Using the knowledge gained through the curriculum, the children became more familiar with computer science and were able to manipulate the methods available in Scratch. Following is an overview of the projects that students completed.

3.1.1 Shapes Project

In order to give students a basic understanding of how the Scratch programming language works, a project was developed to incorporate their knowledge of creating sprites (the characters used in Scratch), uploading a background, and moving their sprites in a coordinate plane. Because first and second graders have not yet learned negative numbers, much less coordinate planes, Crystal and I spent several weeks using number lines to teach the students about movement coordinate planes. Once the children had finally grasped the concept of ordered pairs, we began working on the Shapes Project. The students first uploaded the coordinate plane background and manipulated their sprite to get it to move around all four quadrants in the shape of a square. The students learned the difference between the'go to' method, which immediately transports the sprite to the x-y location, and the glide methods, which moves slowly giving the illusion that the sprite is gliding. Once the students created the square, they learned how to manipulate the pen methods, which allowed the sprite to draw its path as it moved. A rubric was created and given so the students could see what they had accomplished. (see Figure 1.)

3.1.2 Winter Wonderland Project

Crystal and I decided that the next logical step was to teach the students how to further manipulate a sprite by having it interact with other sprites and the background. The Winter Wonderland Project challenged the students to upload a sprite and edit it, giving it a second costume. The students also learned how to switch between backgrounds and we introduced the concept of broadcasting, which allows sprites to communicate with each other. In order to introduce the concept of broadcasting to 1st and 2nd graders, Crystal and I knew we needed a very simple explanation with real life examples. We designed an activity in which two children worked together to create a smiley face. One child had to draw the head as the other child was faced away from the board. Once the first child was done drawing the head he had to 'broadcast' that he was finished, so that the second student knew to turn around and finish the face by adding eyes and a mouth. The students then understood that their sprites would broadcast to the background to let it know they were done moving. Because this project incorporated lessons, such as glide, it tested their ability to incorporate what they've already learned

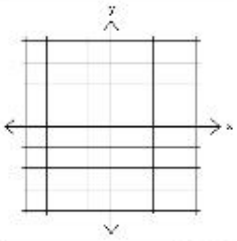
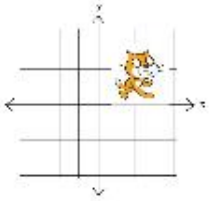
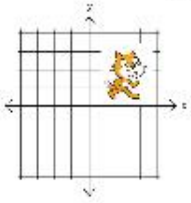
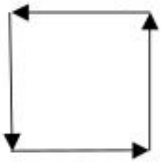
Task	Check?
Stage: 	
Does Kitty **start** at x: 100 y: 100? 	
Does Kitty **end** at x:100 y:100? 	
Does Kitty use **4 steps** to move in a square? 	
Bonus: Does Kitty **draw** the square as he moves? 	
Bonus: Does the square that kitty has drawn **disappear** when you start the program over again?	

Figure 1: Rubric for the Shapes Project

and apply it to something new. (See Figure 2.)

3.1.3 Fish Game Project

In the Fish Game project the students incorporated previous lessons, such as broadcasting, and used their skills to create an entertaining game. This project showed the students that computer science can be used to create interesting and fun programs that have a purpose. The Fish Game provided an opportunity for the students to learn how to move a sprite with the keyboard, how to keep score using variables and what a random number is. The Fish Game was basically a practice session so the students understood how to create a game. In the next phase of the program, the students will develop their own games and incorporate the skills they have learned. (See Figure 3.)

3.2 Measuring the Benefits of Computer Education

By using Scratch, a program developed by MIT, the students of Cardinal Forest Elementary School will be taught basic computer science skills and problem solving techniques. Each week, curriculum was developed to be taught during the Thursday class sessions. Using the knowledge gained through the curriculum, the children will become more familiar with computer science and will be able to create their own programs. The Scratch program should hopefully influence the student's progress in other academic aspects. In order to measure the amount of benefit the Scratch program has on the children, a survey was created and distributed to the students' teachers for completion. This survey (see Appendix A) measures the students learning style, learning ability, and personality. The survey will be completed again at several intervals during the year to see if any changes in the child have occurred.

4 Results

All types of children participated in the Scratch program this year. However, did a particular type of child benefit more from the program and what were those benefits? It is likely that shy students will benefit the most from Scratch because they will need to learn to work together and ask each other for help. These reserved students will need to go outside of their comfort zone if they

Part 1: Winter Wonderland Project Rubric

Step	Task	Check?
1	Stage: 	
2	Does your snowman have 2 costumes? 	
3	Does your snowman **start** at x:-100 y:-100? 	
4	Is the snowman wearing the costume that you drew for him?	
5	Does your snowman **glide** around the ice rink? 	
6	Does your snowman stay on the ice rink? 	
7	**Bonus:** Does your snowman glide around the ice rink forever?	

Figure 2: Rubric for the Winter Wonderland Project

Fish Game Rubric

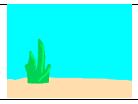
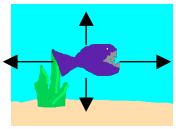
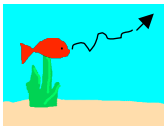
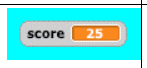
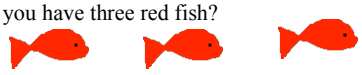
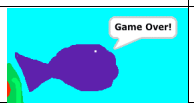
Step	Task	Check?
1	**Stage**: 	
2	Big Fish **Sprite**: 	
3	When you **press** the arrow keys, does the Big Fish move that way? 	
4	Red Fish **Sprite:** 	
5	Does your red fish move **randomly**? 	
6	Does your red fish **hide** when the Big Fish eats it?	
7	Does your red fish **show** in a different spot after it is eaten?	
8	Does your Big Fish change **costumes** when it eats the red fish? 	
9	Does your game keep **score**? 	
10	Do you have three red fish? 	
11	Does the Big Fish **say** "Game Over"? 	

Figure 3: Rubric for the Fish Game Project

want to finish their programs and learn the techniques needed to do so. As the computer class teaches these students the value of teamwork, hopefully they will apply this knowledge in their other classes and it will be evident that they are more open to working with others. Teamwork is a lifelong skill and it is never too early to learn it; if this Scratch program is able to help students benefit in the long run, it will be easier to convince other schools to implement computer courses in their curriculum. The more outgoing students will also benefit from the computer science program because they will learn that, instead of talking when the teacher's talking, they need to listen if they want to learn how to complete their program. As the students begin to understand the importance of listening to directions, they should be able to apply this knowledge to their other classes and they will learn more effectively. Furthermore, as computers become more integral to everyday life and younger children are required to manipulate technology, it is more important for children to learn more about technology. Using computer science, children can learn more about what makes their electronic devices work, and can also learn how to problem solve and manipulate coding to make their program do what they want it to.

4.1 Survey

In order to measure the benefits of the Scratch program, a survey was created and distributed to the teachers for of Session A students. Surevys were also filled out by the first grade students from Session B.

4.2 Observations

N/A

5 Conclusion

N/A

6 Appendix

6.1 Survey

Survey will be placed here

References

[1] Yasmin Kafai and Kylie Peppler, "Creative Coding: Programming for Personal Expression.

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[3] Greg Gates, "Elementary Education in a Technology Age, 2008.

[4] Mitchel Resnick, "All I Really Need to Know (About Creative Thinking) I Learned (By Studying How Children Learn) In Kindergarten.

[5] Andres Monroy-Hernandez and Mitchel Resnik,"Empowering Kids to Create and Share Programmable Media.

[6] Andres Monroy-Hernandez,"Scratch: a platform for sharing user-generated prgrammable media.