Benefits of a Computer Education
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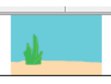
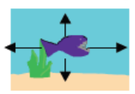
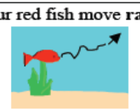
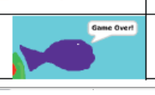
Abstract

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.

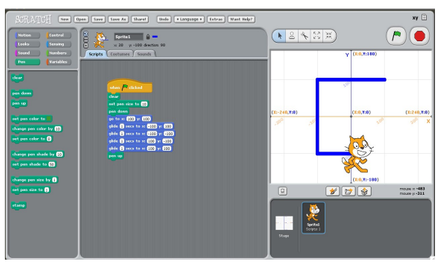
Background and Procedure

By using Scratch, a program developed by MIT, the students of Cardinal Forest Elementary School were taught basic computer science skills and problem solving techniques. Each week, Crystal Noel and I developed curriculum to be taught during the Thursday class sessions. Using the knowledge gained through the lessons, the children became more familiar with computer science and were eventually able to create their own programs. In order to measure the additonal benefits of computer science education, a survey was distributed at the beginning and end of the year, as well as an end of the year assessment.. The surveys measured the students' interest in the Scratch program and computer science, as well as their social growth. The assessment measured the knowledge retained by the students in certain computer science and math areas.

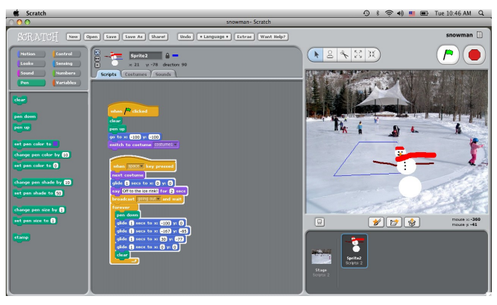
Cardinal Forest students working on Scratch.

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"? 	

Rubric for the Fish Game Project



Screenshot of Shapes Project



Screenshot of Winter Project

One first grader shows his individual game design.

Description of Projects:

Shapes Project:

In order to give students a basic understanding of how the Scratch language works, a project was developed to teach them basic computer science techniques such as creating sprites (the characters used in Scratch), uploading a background, and moving their sprites in a coordinate plane. As an introduction to coordinate planes, our team spent several weeks using number lines to teach the students about movement using ordered pairs. Once the children had finally grasped the concept of coodrinate planes, we began working on the Shapes Project. The Shapes Project required students to manipulate their sprite so it would move around all four quadrants in the shape of a square. They learned moving methods, such as 'go to' and 'glide,' that would be useful for future projects.

Winter Wonderland Project:

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 were introduced to the concept of broadcasting, which allows sprites to communicate with each other. To introduce broadcasting to 1st and 2nd graders, Crystal and I knew we needed a very simple definiton with real life examples. So, 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 with their actions. This project also incorporated older lessons, such as 'glide,' and so it tested ability to implement what they've already learned and apply it to something new.

Fish Game Project:

In the Fish Game project, the students 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 basic methods used in games, such as how to move a sprite with the keyboard, how to keep score using variables and what a random number is. The Fish Game gave the students skills they would need to create their own games.

Individual Game Designs:

The last project for the year gave the students a chance to design and create their own game. The students spent the first several weeks working on problem-solving activities where they created a rubric to break a problem up into steps. Then, the students, as a class, brainstromed some game ideas. The games were then narrowed down to four choices: an animated story, a Mario game, a Pac Man game, and a Dodgeball game. Each student picked one of the four games and then each game group met together and discussed what they wanted their game to look like. Each student created their own individual project, but they were able to ask thier group members for help with scripting and planning. Many of the students were able to finish the first parts of their games and they will be encouraged to continue working on the games at home over the summer.

Results and Conclusion:

The surveys, assessments and observations showed several general trends in benefits to young students. The surveys showed that a majority of the students had an increase in interest in computer science. Class observations led to two conclusions about students' behaviors and how they benefitted from the computer science program. Outgoing and talkative students learned the importance of being quiet and listening to directions. This was shown particularly through observations of the second grade class; the class was initially very loud and directions had to be repeated frequently. As the year went by, the class grew quieter and was able to accomplish more in one class period because of the decrease in repetition of directions. Observations of quiet students showed that they became more open with their fellow classmates and learned to share their knowledge, despite it being outside of their comfort zone. Therefore, the Scratch computer program gave its students a chance to work on vital social skills that could easily be translated to their other core classes.

The Scratch program at Cardinal Forest Elementary School provided students much more than an opportunity to learn some basic computer science skills. The students also worked on social skills, such as teamwork and listening to directions. These social skills will assist the students in becoming more productive learners, which will translate into their other classes, as well as all future classes. While it was difficult to measure the benefits of computer science on these young students, it was shown through observations and surveys that, in general the more extroverted students learned to quiet down while the quieter students learned to open up more to their classmates. Furthermore, many students made new friends through their teamwork in Scratch, discovered an interest in computer programming and and gained a better understanding of problem solving methods, and math and computer science concepts. Hopefully, Cardinal Forest Elementary School will continue to implement the Scratch program for their students, as it provides more benefits than simply giving the students an introduction into the world of computer science.