WE, THE PEOPLE –
An Interdisciplinary Unit of Study

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Technology used:

- **Various online interactive math sites and manipulatives**
- **Tinkercad**
- **3D printers**
- **Ipods and Ipads for pics and presentations (30 hands app)**

With the transition to common core standards, the depth and complexity of mathematics standard has started to take toll on many of our students. While most were able to solve routine, textbook based questions, majority of students were not able to meet the cognitive complexity of the new standards. We started to look at the ways that we can help students approach those levels in which students can creatively apply their knowledge to solve non-routine, authentic problems , mastering the standards at their intended cognitive complexity.

Our school maps the curriculum through interdisciplinary units of study, in which academic subjects are integrated to maximize student's time a transfer of knowledge. While this was routinely done with social studies and language arts, and often science, math was truly the last bastion of isolated subject area teaching. Granted, we integrated math into science and social studies, but we have not ventured into using math as a primary source of inquiry.

The 5th grade math standards in the geometric measurement strand provided an opportunity to try a new approach. These standards

asked students to understand concepts of volume, from basics to application of knowledge to non-routine life problems.

In this grade level, we developed the unit of study called We, the People… The unit explored promises of fair society and how we lived up to those promises by research into civil rights. We decided to extend the unit by asking students to create their own city of the future, using exciting new 3D printing technology, connecting it to existing unit as students also developed "laws" for their new city.

TASK:

Create a city of the future.

Each team is assigned one city building. When put together, these buildings will create a city of the future, in which all people will have an opportunity to live in piece and have the services that they need.

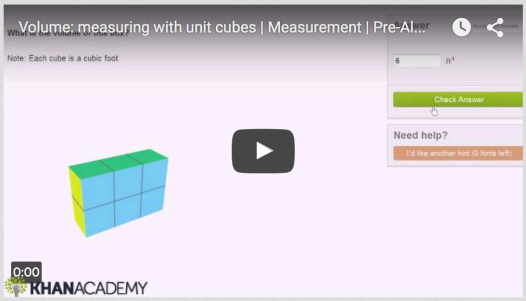
The task of each team is to :

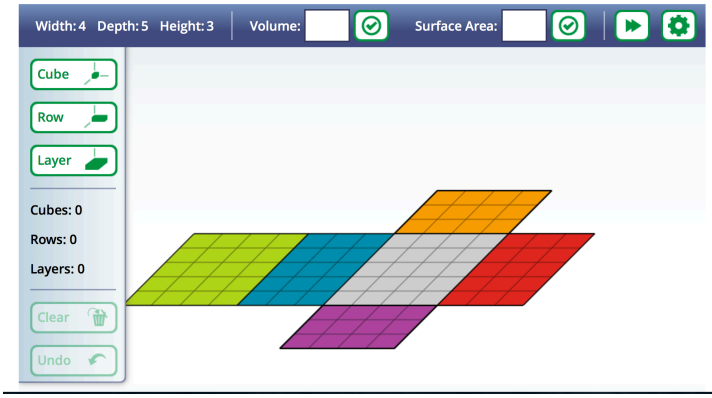
- create blueprints of their building based on specs
- draw four options scaled as a blueprint to present to the city board
- scale to try a scaled model using clay or play dough
- finalize design using Tinkercad (scaling required)
- print buildings in 3D to create a 24 building city

The unit began by students using online tools to explore the basic concepts of volume. Students logged on to the web site and used a variety of games, while teachers reinforced knowledge in small groups. Here are some tools used: Khan Academy, Annenberg Geometry, Virtual Manipulatives

Measuring Volume with Unit Cubes

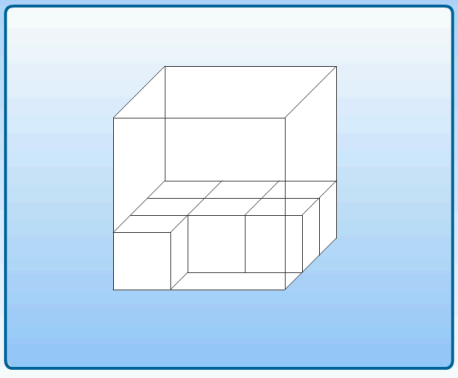
Volume: measuring with unit cubes: Volume is usually measured in cubic feet (or inches, or centimeters, etc). Let's practice counting cubic feet in order to find the volume.





Find the Volume of a Rectangular Prism

Let's take a look at a cube again. In fact, let's look at the same cube as in the Surface Area section, with side length 3. Explore the sugar cube animation.



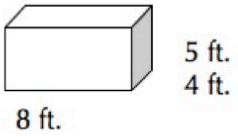
How many unit cubes did it take to form the bottom layer?

_____ cubes

At the end of the day, students were given a common formative assessment to determine where they were in respect to the standard. We used the following problem from the ilustrativemathematics.org.

Cari is the lead architect for the city's new aquarium. All of the tanks in the aquarium will be rectangular prisms where the side lengths are whole numbers.

a.
Cari's first tank is 4 feet wide, 8 feet long and 5 feet high. How many cubic feet of water can her tank hold?



b. Cari knows that a certain species of fish needs at least 240 cubic feet of water in their tank. Create 3 separate tanks that hold exactly 240 cubic feet of water. (*Ex: She could design a tank that is 10 feet wide, 4 feet long and 6 feet in height*.)

c. In the back of the aquarium, Cari realizes that the ceiling is only 10 feet high. She needs to create a tank that can hold exactly 100 cubic feet of water. Name one way that she could build a tank that is not taller than 10 feet.

This assessment's results were used to determine the student teams. Students were assigned to teams based on the complexity of problems they were to solve. While the 5th grade standard asks for volume of rectangular prisms, some of our students were ready to explore this standard with more complexity. Therefore, building specs were used as differentiation tools. Below are examples of 4 buildings and their specs

BUILDING 1 - HOSPITAL

The hospital is made of two buildings shaped as rectangular prisms, connected by an enclosed rectangular prism walkway. The two buildings are not the same size.

Minimum length of each building is 20 meters
Maximum length of each building 50 meters

Minimum width of each building is 20 meters
Maximum width of each building is 40 meters

Minimum height of each building is 50 meters
Maximum height of each building is 100 meters

The walkway cannot be longer than 50 meters and has to be at least 10 meters of the ground and is completely enclosed

The area in which the building will stand is 12,000 meters squared

The perimeter of the land is 440 meters

BUILDING 2 - SCHOOL

The school is made of 3 rectangular prisms. The second level is 3/4 of the first level; the third level is 3/4 of the second level.

Minimum length of the building is 50 meters
Maximum length of the building is 100 meters

Minimum width of the building is 10 meters
Maximum width of each building is 20 meters

Minimum height of each building is 25 meters
Maximum height of each building is 35 meters

The area in which the building will stand is
7,200 meters squared

The perimeter of the land is 360 meters

BUILDING 3- MALL

The shopping mall is made up of 4 smaller rectangular prism buildings surrounding the central parking area. Buildings are connected by a ground level walkways that are completely enclosed and in a shape of rectangular prisms. Buildings can, but do not need to be, same.

Minimum length of each building is 30 meters
Maximum length of each building 50 meters

Minimum width of each building is 20 meters
Maximum width of each building is 40 meters

Minimum height of each building is 20 meters
Maximum height of each building is 30 meters

Connecting walkways are 20 meters long, 15 meters wide and 15 meters high. They are opened to buildings so that people can walk through from building 1 to building 4.

BUILDING 4- LUXURY CONDOS

Luxury condo complex has condos and parking spaces. It is made of a cylinder shaped tower, connected by a walkway to the rectangular prism tower. Parking garage, in the rectangular tower, is opened on three sides and below the condos. The top of the building has triangular prism gym and spa. It can be on top of either of the buildings.

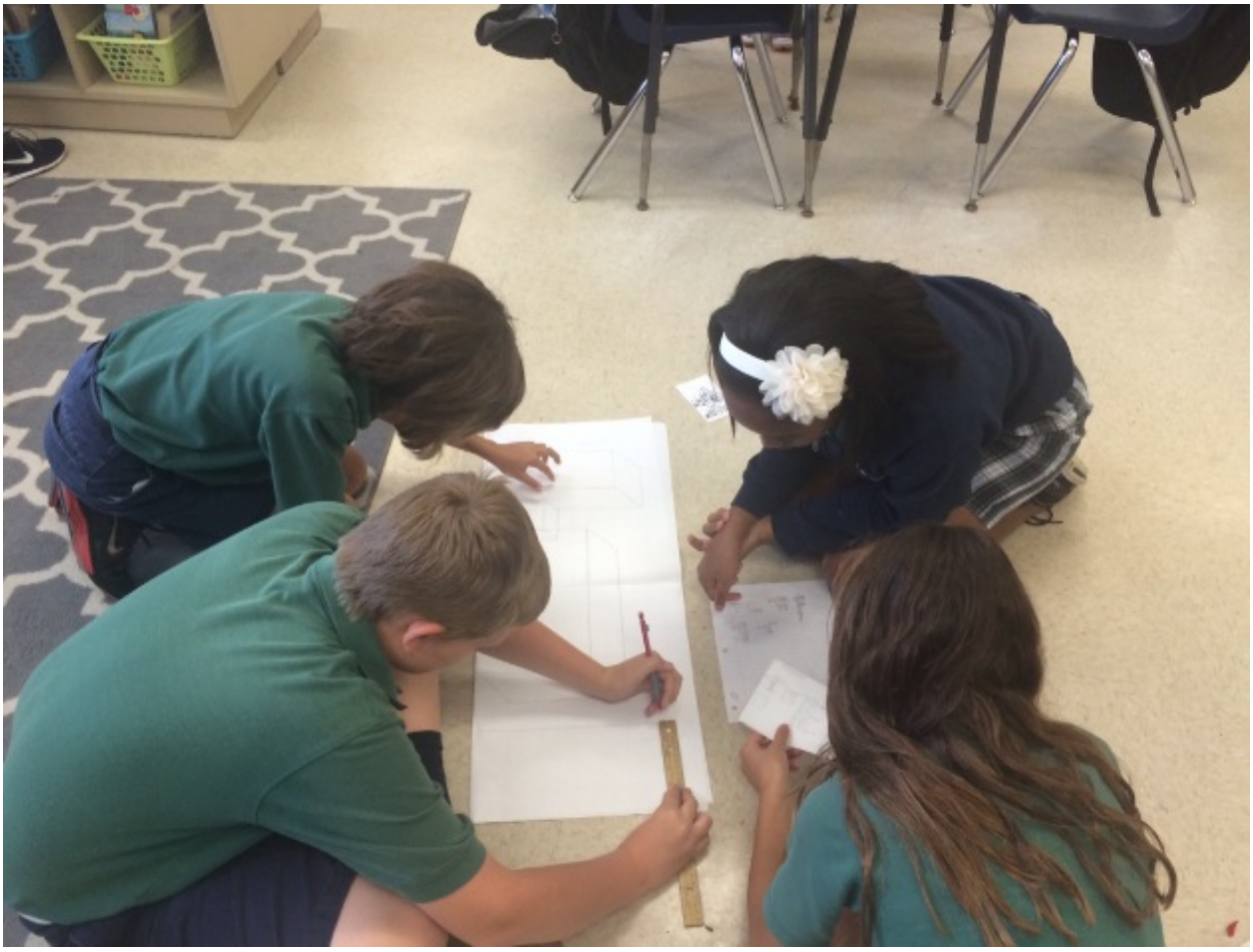
Minimum length of the rectangular building is 100 meters
Maximum length of the rectangular building is 200 meters

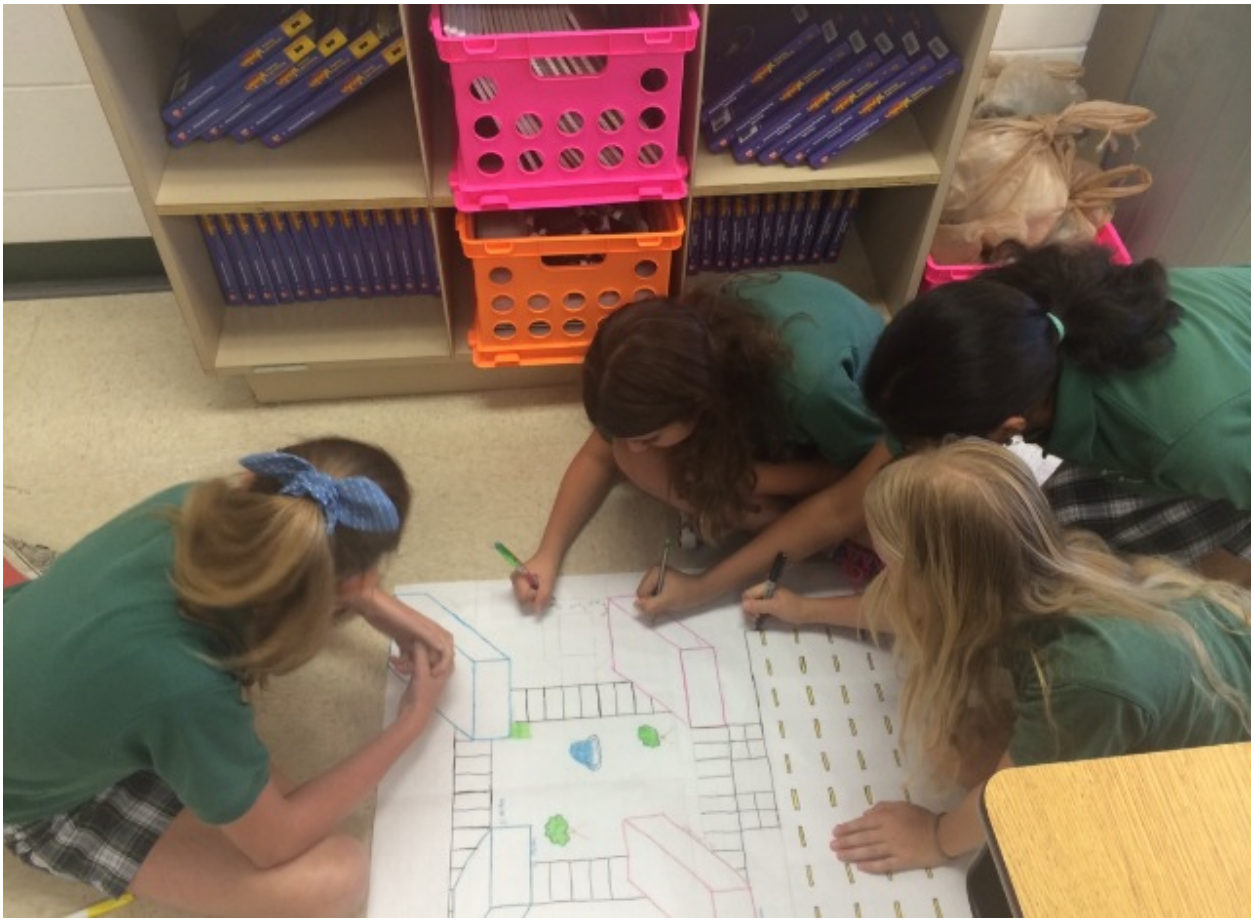
Minimum width of the rectangular building is 50 meters
Maximum width of rectangular building is 75 meters

Minimum height of rectangular building is 100 meters
Maximum height of rectangular building is 200 meters

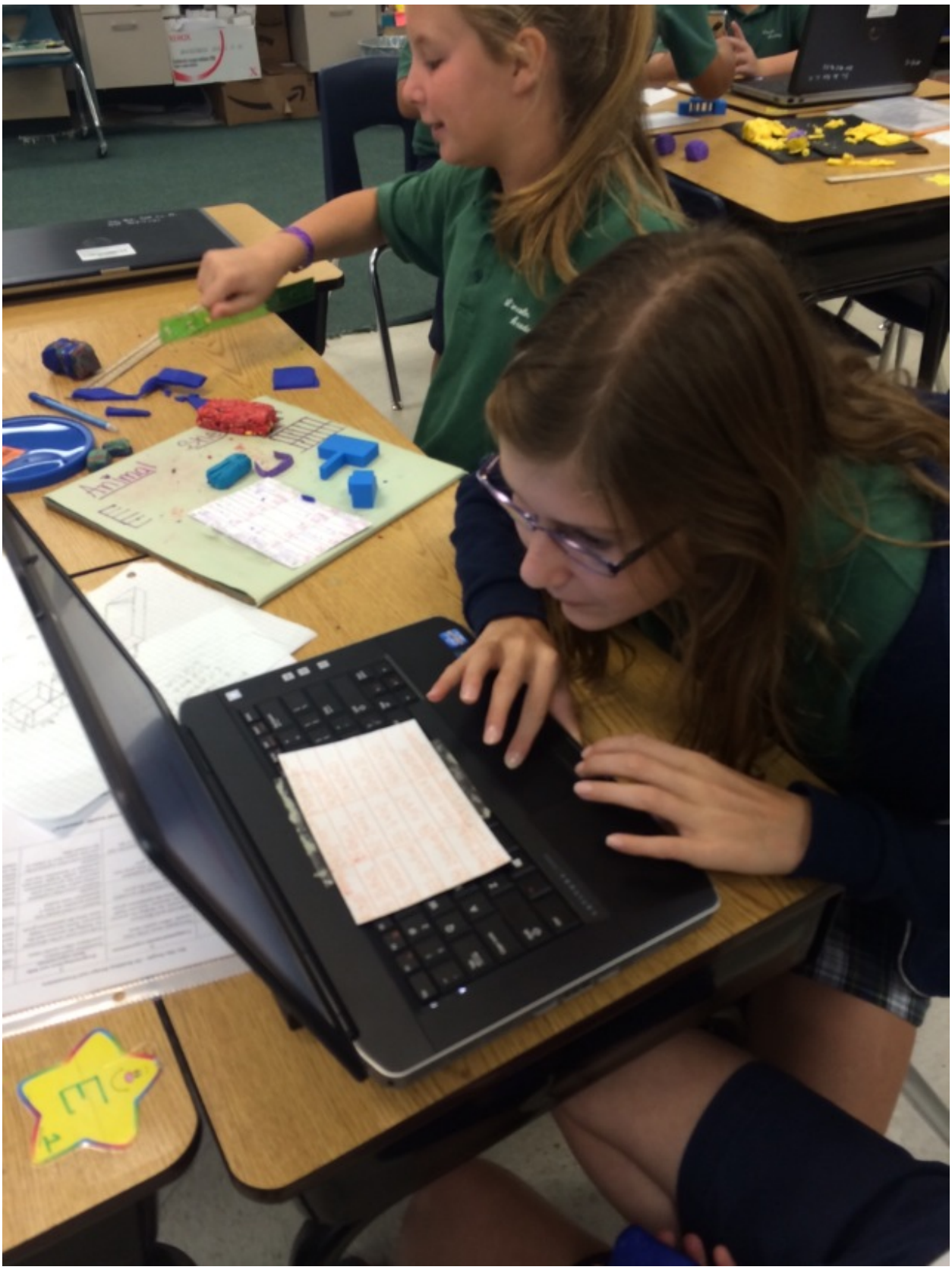
To complete this task, students had to

1. Create blueprints based on specs

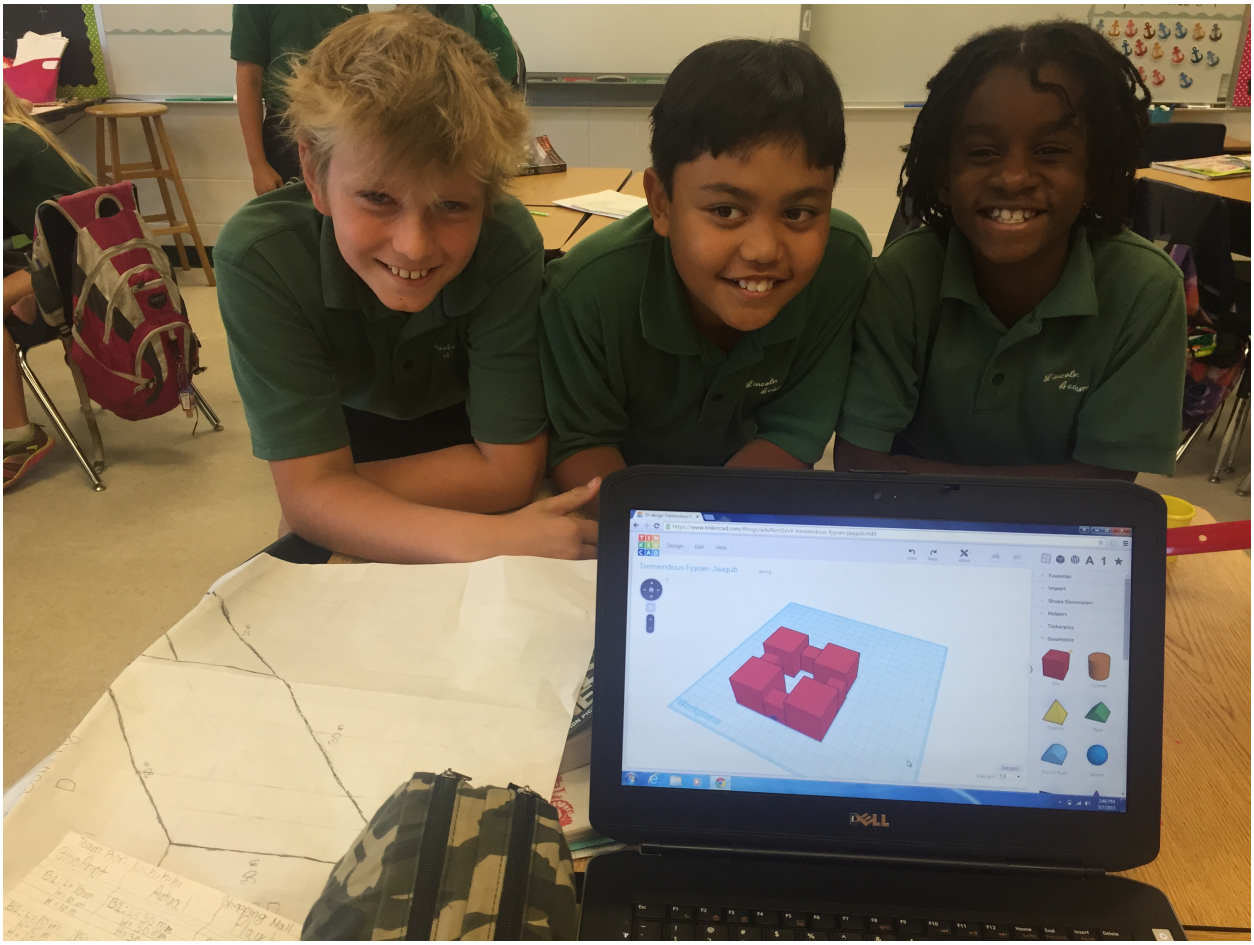


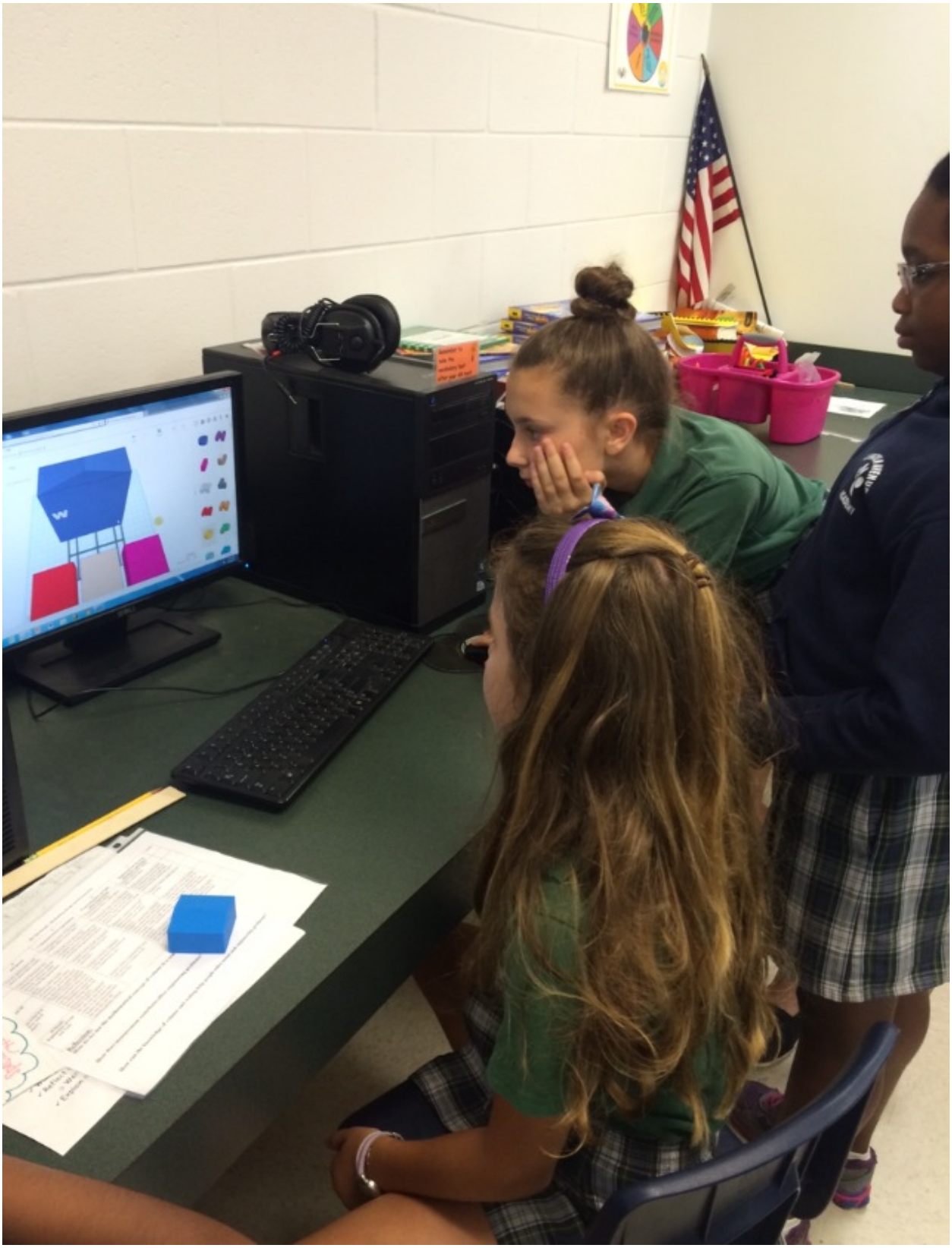


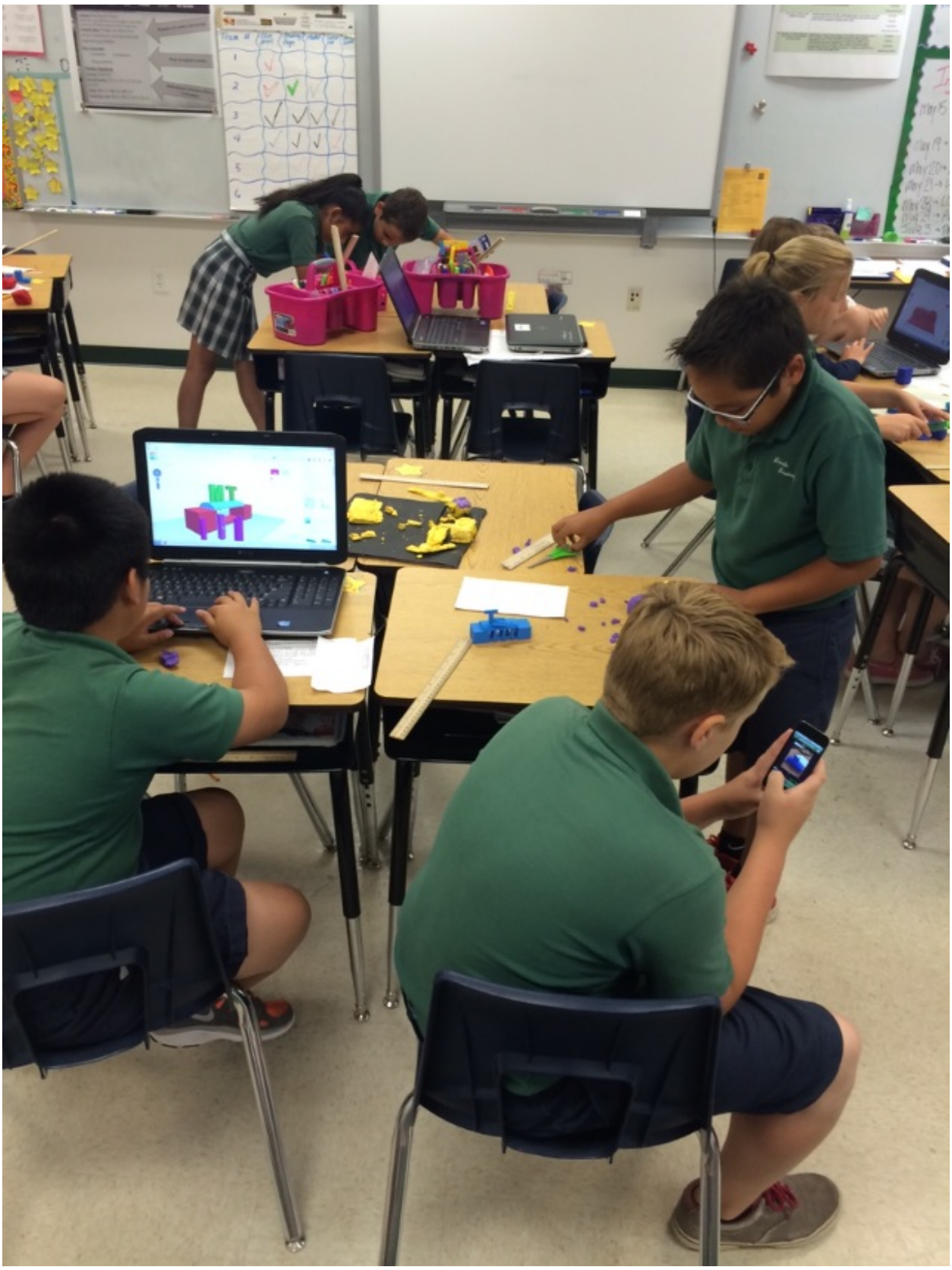
2. Scale the model by teacher's specifications to create an accurate play dough model of the building (scaling to the dimensions of the dry erase white board with the grid). Students were allowed to use their interactive learning tools to help them design and scale.



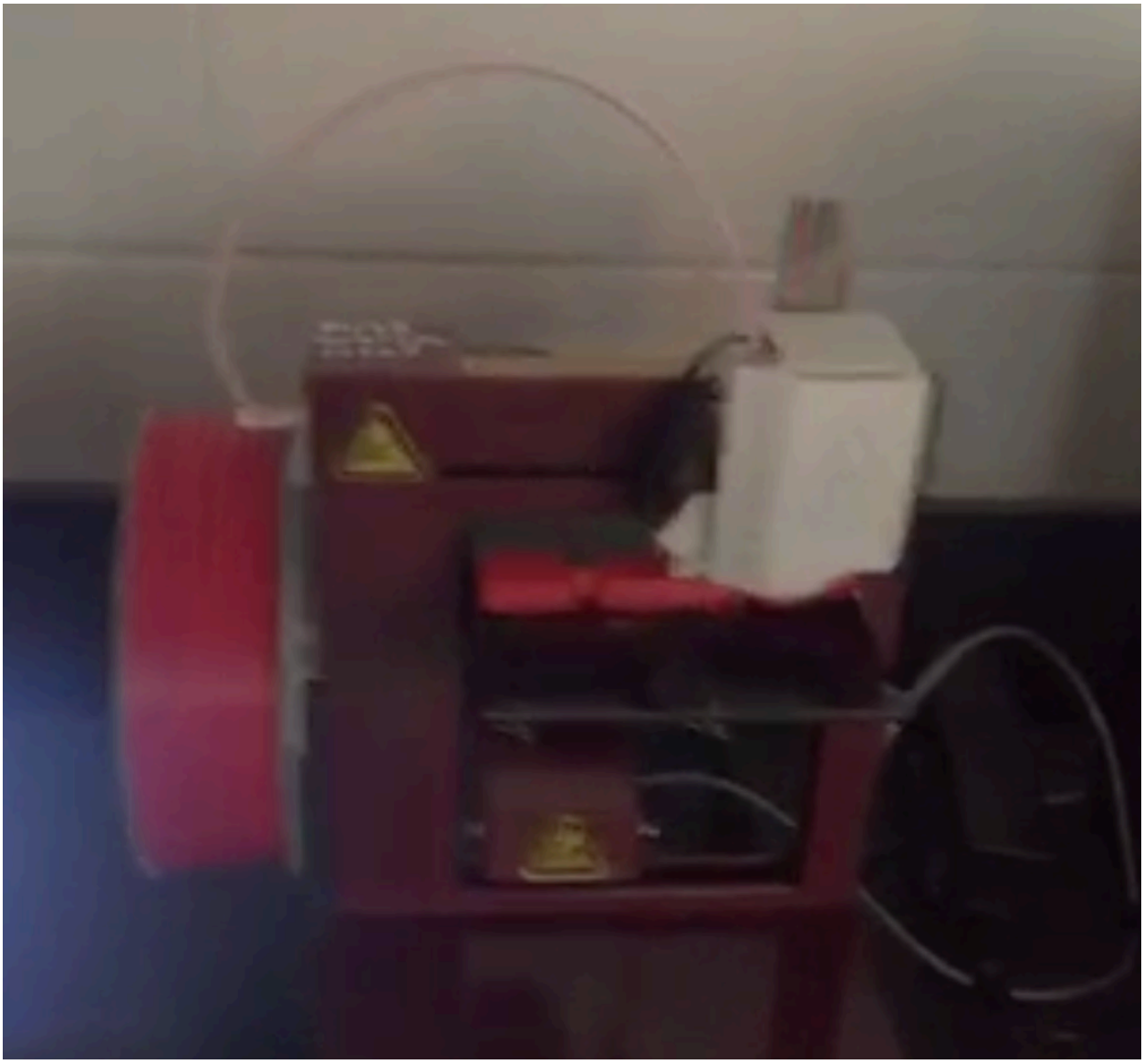
3. Design their building in a free source Tinkercad software (had to be rescaled again ☺) that generated 3 D printer files. The software has a grid and geometric shapes. Students had to create a model with correct scaled dimensions

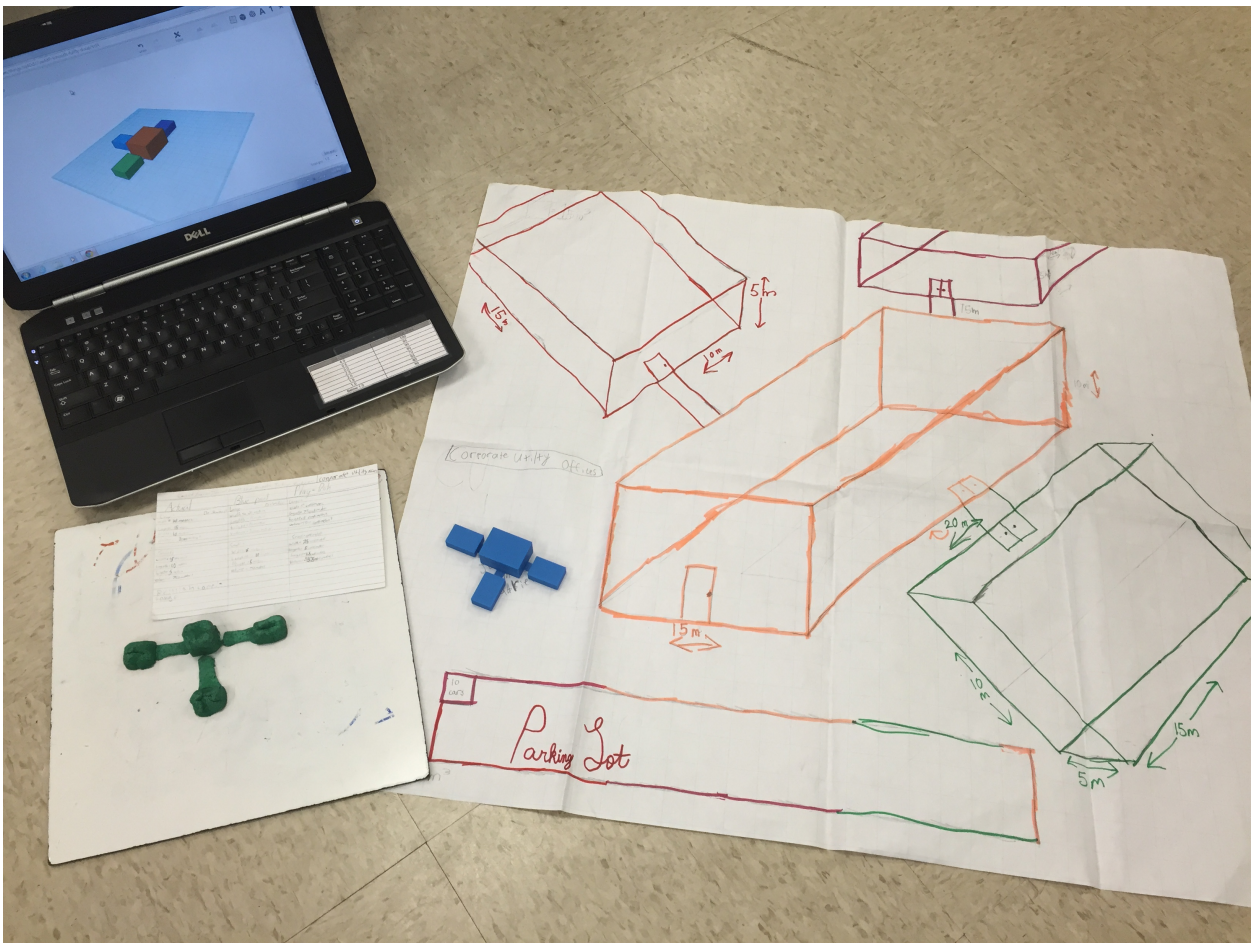






The buildings were 3 D printed





After modifications , students printed and created their city

At the conclusion of the unit, students were given common assessment using different performance tasks from illustrative math and a standard-based task from the Florida formative assessment bank.

Result: 100 % of students were on proficiency level. Students also completed reflection in which majority expressed that they feel comfortable and confident with the skill.