Rebuilding an 18th Century Town: Math, 3D Printing, and Historical Empathy

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ABSTRACT
The Colonial Williamsburg building project has evolved over the past several years to become a staple in the first semester of 8th grade US history. The school is an independent school for girls in grades 6-12. The project is part of their preparation for their November trip to Virginia and Washington DC. The goal of the project is to reconstruct the significant buildings in 18th century Williamsburg in order to examine the architecture and social structure of the city in particular and the 18th century colonial world more broadly. In addition to the historical work, students get the opportunity to apply math concepts they have learned, practice map reading skills, and learn and play with Tinkercad and the 3D printer to create something of historical significance.

Keywords
History; 3D printing; math; colonial period

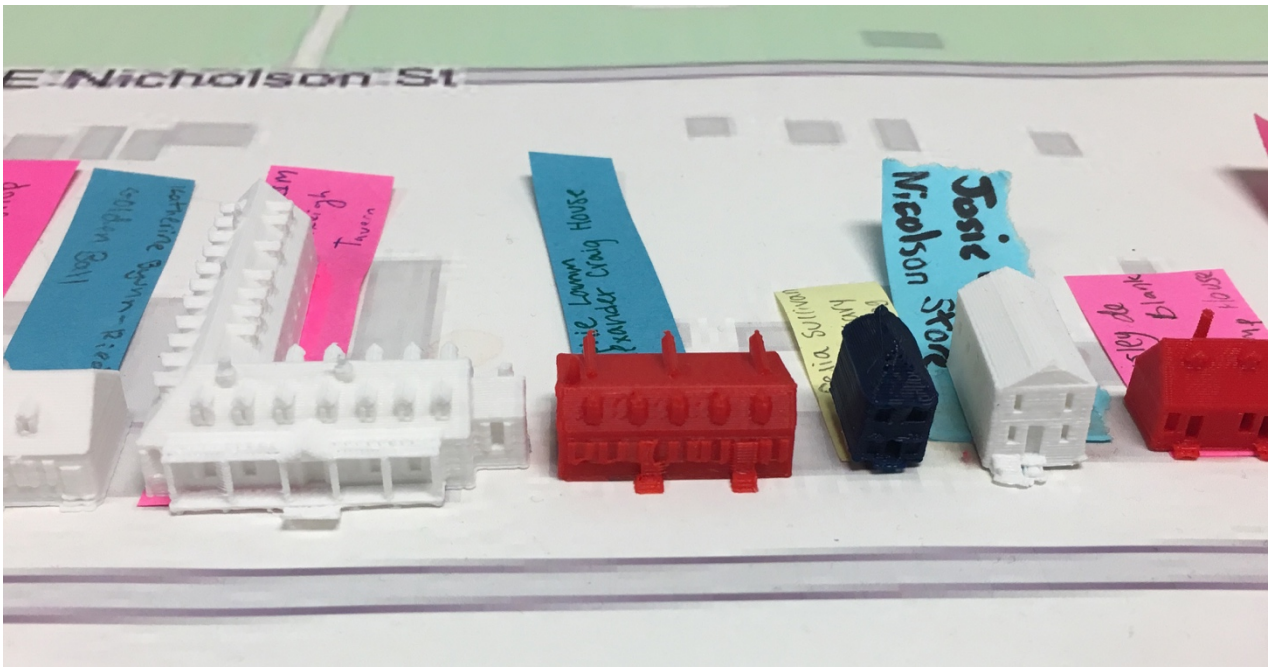

Image 1: Student Created Williamsburg Buildings (Scale 1 mm=1 foot)

2. DESCRIPTION

2.1 Description of your setting
I work in an independent girl's school for grades 6-12. The population is diverse in terms of background, and students have varied exposure to previous making experiences. I did the project in small classes (largest is 18 students). We have access to an extensive and well resources makerspace, but this project only used laptops (Inkscape and Tinkercad) and 3D printers. This project takes place in 8th grade United States History class (required for all students).

2.2 Description of the educational experience

Working from photographs, Google Earth, and research materials (from the Colonial Williamsburg research archive) students must determine the significant parts of "their" Williamsburg building and the scale in order to construct that building in Tinkercad. Students work with photos that include a one-foot square red piece of cardboard (see image 2)

Image 2:Red Square on steps of the Pasteur & Galt Apothecary Shop in Colonial Williamsburg

The cardboard allows them to determine the size of the building. The math for this part of the project takes place first in their math class, where they do the same exercise with buildings on campus. When they get to history they can do it from memory or get out their math notebooks to refresh their skills before they calculate the size.

The students used the measuring tools in Inkscape to scale the photo, and then to measure the buildings. In math they had done all the calculations by hand, so this introduced them to digital measuring techniques.

With measurements of key parts of the building done, they construct in Tinkercad using a scale of 1mm = 1 foot (which they love after having done some significant math to get the measurements from the photo).

They also find the building on Google Earth to discover what the roof and the sides look like, and they use that information to construct the rest of the building.

When finished, students print the buildings on the 3D printer (Replicator) scaled to 50% (which saves considerable time) and then place them on our map of Williamsburg (see image 1).

We finish with a discussion of the town, thinking about economics, class, the working nature of a walking city, and the people who are missing from the center of town. There are, for example, significant numbers of homes for the wealthy, but no clear evidence of where slaved would have lived.

Students visit their buildings on our trip to Williamsburg and reflect on their impressions in their journals. (see Image 3).

3. CONCLUSION

3.1 Results

Student reflections from the trip were positive. They visited the historic reconstruction as participants in the process, not just spectators. They talked to docents about the project and owned their knowledge in new ways. Their journal entries reflect some of this feeling. One student wrote, "Another thing we did was visit my building, the James Geddy house in Colonial Williamsburg. I think it is so cool how they were able to recreate the building in such details with such realistic actors. I learned a lot more about the owner, James Geddy. All in all, it was a great day!" Another was a bit hard on herself, although she clearly felt pride in her building. "I thought it was really cool to see my building in real life. I think I recreated my building well, though I messed up the windows on the sides."

Students also commented on the skills they had learned translating the photo to 3D. They were surprised at how complicated each step was, and how detail-oriented they had to be to create what they saw in the photos. This process allowed for a necessary review of multiple concepts from math as well as an examination of how people lived and built in the 18th century. Conversations around the lab consistently went back to the issues historians care about: why did they build in this way? Who lived and worked in these places? What can we learn from this lived environment? How did people interact in these spaces? Students were better able to imagine this different world and the people who lived there because they had created it themselves, albeit only as a model.

This project has evolved over the years. It started out as a 2D laser cut silhouette of each building. The 3D version works better to encourage students to develop spatial reasoning skills (important in girls who may not have had as much exposure to toys and activities like this as boys get in younger grades), understand map reading, and engage their imaginations.

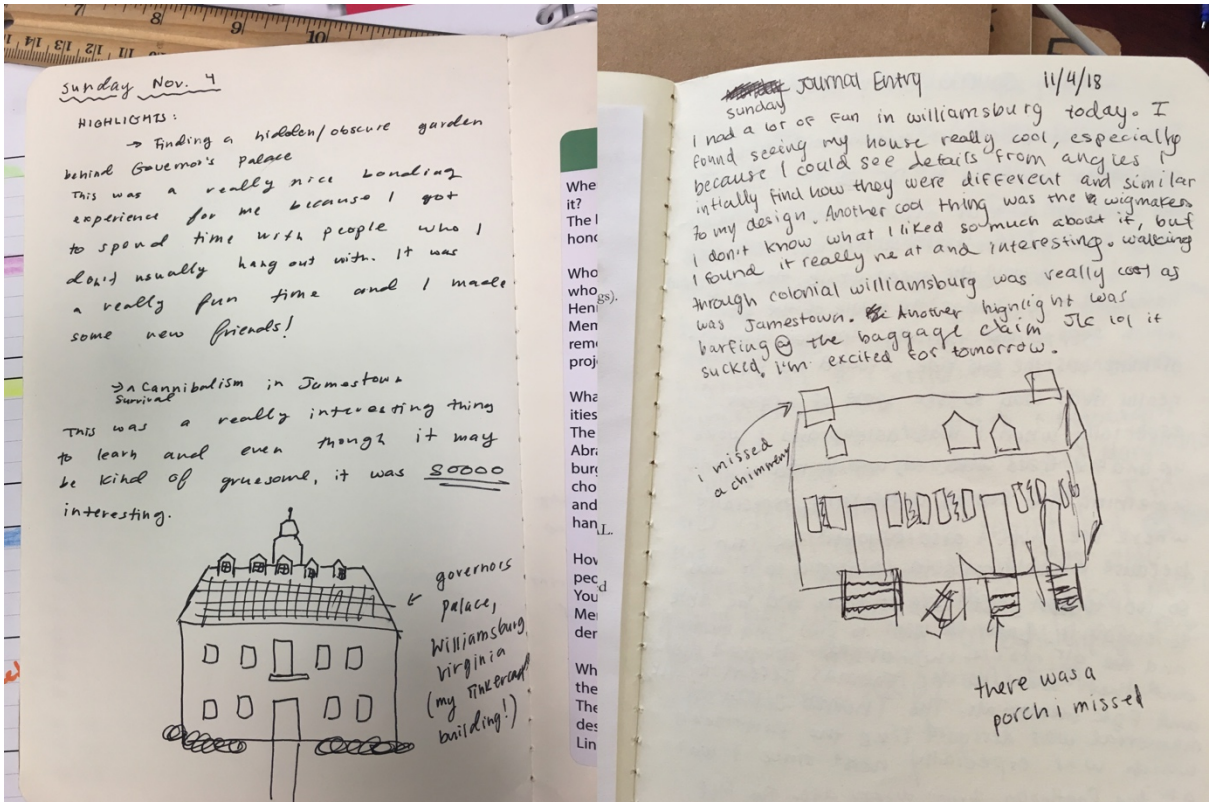

Image 3:Student travel journals from Williamsburg showing their buildings.

3.2 Broader Value

What can be learned from your experience and its value for other educators? What is the value from what you learned to the maker-centered/hands-on/digital fabrication learning communities? What is the key learning that you will share with the broader community at FabLearn?

The Williamsburg Building Project is specific to the circumstances of this class and this trip. But the process of building a set of related buildings from photographs could be used to study any number of lived environments from the past or present. Students could build their own model of their school, their town, or historically significant human settlements from the past. Such building activities introduce students to a wide range of ideas and technologies that open up other projects and historical eras to further discussion and exploration. The time and effort students put into the project shines through as they discuss "my building" on the trip and in the classroom. A visit to the real thing (or in this case the reconstructed real thing) augments the experience, but the project could be successfully conducted without this element. In that case I would encourage some kind of storytelling about the place and the buildings. This project also teaches close observation skills and requires students to read the photographs for significant details that will enhance their making process.

In essence, this project combines three things that I feel are essential to good learning in history: Hands on interaction with historical materials, creativity and individual practice, and student ownership of the learning (in this case through the artistic choices and the independent work each student needs to be successful).

3.3 Relevance to Theme

"What role does Maker Education play in a world with growing social and environmental challenges?"

Maker Education is one part of teaching students how they can play a role in making change in the world. Projects involving architecture, the lived environment, and the analysis of how human live in the world play a part in raising student awareness of the role people play in creating their own world. This is one step toward empowering students to change that world for the better.

4. BIO

Heather Allen Pang teaches history to eighth graders at Castilleja School, a grade 6–12 private school in Palo Alto, California, United States. She herself is a graduate of the all-girls school (class of 1984) and also serves as the school archivist. Castilleja's Bourn Idea Lab is very closely associated with Stanford University's Transformative Learning Technology Lab. Heather is in her third year as a fellow in the Bourn Idea Lab. Before joining the faculty at Castilleja, Pang taught at the University of California, Davis; Santa Rosa Junior College; and American River College. She holds a bachelor's degree in European history from Wesleyan University; a master of arts in teaching in European and American history from University of California, Davis; and a doctorate in American history from University of California, Davis.