

Introduction to 3D Engineering Through Scale Models

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Abstract Scale miniatures can be a gateway to learning engineering skills for 3D modeling Children grades three through nine participated in a half-day, week-long summer camp for gifted and talented children designed to inspire their creativity and artistic expression The scale miniatures class was seventy-five minutes per day for four days and forty-five the fifth day By the last day, each child had created and decorated both a 1:24 scale dollhouse for a dollhouse and a 1:144 scale roombox, and printed a 3D creation of their design or choice This session shares construction of the 1:24 dollhouse, tips on working with gifted and talented children, and P-12 resources for 3D printing.

Keywords 3D, engineering, middle grades, architecture, beginning design

Introduction

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Methodology

Children in grades 3-8 were enrolled in a gifted and talented summer camp. Children were given free choice of either two seventy-five minute classes or one three-hour class each day. The children enrolling to Art of Miniatures were involved in 3D design and production of scale models. The scale models consisted of one 1:24 laser-cut kit produced by Robin Betterley (<https://www.robinbetterley.com/>) for the National Association of Miniature Enthusiasts (<https://miniatures.org/>), one 1:144 hand-cut kit from Amy Rauch (<https://miniatures.org/board>, 2nd Vice-President), and models produced in all scales for 3D printing using a Formlabs2 resin printer. The daily schedule was as follows:

MONDAY

Agenda:

- I. Introductions
- II. Scale Models
- III. Conversions and charts- hand out papers, show web site, discuss scale
- IV. Introduce the Casita Bonita, its history, NAME
- V. Begin construction of Casita – write name on base (side with Betterley’s name)
 - a. Dry fit
 - b. In three sections, glue together each section
 - c. Attach to base
 - d. Allow to dry overnight
- VI. Introduce 3D modeling
 - a. Balloon demonstration
 - b. Paper/pencils/markers for video on stairs—students create
- VII. Go to GH 213
 - a. Show short video introduction to TinkerCad
 - b. Open Tinkercad – if time --

TUESDAY

- I. Work in lab with TinkerCad
 - a. Build tutorials 1-3
 - b. Build tutorial dollhouse #4
- II. Introduce Thingiverse
 - a. Digital copyright (creative commons copyright)
 - b. Allow students to explore thingiverse for “dollhouse”
 - c. Save models to jump drive along with info
- III. Introduce the Betsy Ross room
 - a. Paint casita interior cream
 - b. Paint casita windows white
 - c. Construct and paint Betsy Ross room and fireplace white
 - i. Measure exterior walls and floor for the paper cutouts
 - d. Paint casita windows turquoise
 - e. Paint casita ground khaki
- IV. **if time, use the stain pens on Betsy Ross items as needed

WEDNESDAY

- I. In GH 213 for construction of item for 3d print
 - a. Display turbine models and discuss project briefly
 - b. Display dollhouse chair model and painted chair (sprue/support and orientation)
 - c. Students may search thingiverse or create own item
 - d. Save student work to jump drive
- II. If time, return to GH 209 and complete the interior of Betsy Ross

THURSDAY

- I. Complete 3d Model for printing
 - a. Save to thumb drive, transfer to Lesia computer
 - b. Show video on Formlabs printer
- II. Take class upstairs by 10am and 11:35am
 - a. upload print (Class #2, save to drive and show printer)
- III. Return to GH 209
 - a. Show picture Amy’s furniture
 - b. Students design and build furniture for casita
- IV. Painting and finishing
 - a. Paint Casita exterior
 - b. Assemble Betsy Ross interior
 - c. Mix terra cotta with snowtex for exterior casita
- V. Ask for speakers for class presentation (2 students – 1 from each class)
 - a. Ask each to write down a word to represent their experience from class this week. Include to ppt for Friday.

FRIDAY

- I. 45 minute class!
- II. Glue on exterior finishing to Casita
- III. Complete Casita and Betsy Ross
- IV. Return 3D Models to students

Discussion

Students successfully created a 1:24 adobe dollhouse. The dollhouse would contain 1:288 scale furniture. Some students successfully scaled miniature furniture from Thingiverse to fit their dollhouse. Other students

successfully created furniture from wooden “leftovers” and supplied scrap material for upholstery. The creation of both 3D scaled and findings-based furnishings supported conceptual learning of three-dimensional space relationships and engineering design. Students further successfully created a 1:44 room box complete with furnishings and upholstery and a 3D design modification from Thingiverse. Based on anecdotal information, the class was highly successful in encouraging students toward pursuit of engineering and 3D production.

References

<https://www.robinbetterley.com/>, accessed June 20, 2017.

<https://formlabs.com/>, accessed July 1, 2017.

<https://miniatures.org/>, accessed January 18, 2018.

<https://www.thingiverse.com/>, accessed December 10, 2017.

<https://www.tinkercad.com/>, accessed January 2, 2018.