Makerspace in Pre-Kindergarten Education

Engaging Computational Thinkers while Enhancing Cognitive and Physical Skills

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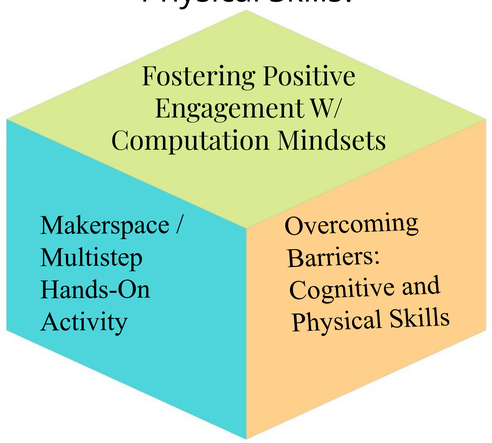
How Can We Successfully Engage Pre-K Students in 3D Printing While Enhancing Cognitive and Physical Skills?



3D Modeling and Printing Process

3D Modeling and Printing Process	How Pre-K students can participate in the process based on developmental limitations?
Create a 3D model using Tinkercad. Usually the mouse is used to create the model.	Pre-K students have limited knowledge on how to use a mouse. Using a mouse would be separate lessons for the pre k students. To modify creating the model using the mouse the students will use the scribble tool to create their model. After using the scribble tool they can turn their creation from the scribble tool into a 3d model.
Download .stl file from Tinkercad.	The students can not read yet so they would not be able to follow the directions on what they need to click on the save the file. The students can participate through inserting the usb and typing their name to save the file.
Import.stl file into slicing software	The students can assist through clicking the mouse after the facilitator moves the mouse to the correct spot.
Adjust 3d printing settings (infill, raft, supports.)	The students have little to no knowledge on what the infill, raft, and supports are. The facilitator will show visuals and give the students choices to help make the decisions about the 3d settings.
Put the new file onto the sd card	The students can assist by clicking the mouse
Load the sd card into the 3d printer	The students can insert the sd card
Load the filament into the printer	The students can place the end of the filament to the facilitator and observe the facilitator load it.
Start the print	The students can press the button to start the printer
Monitor the Print	Due to the limited attention span of pre-K students they can observe the printer for 3 minutes. Then look through things printed by the 3d printer. Then observe the last 3 minutes.

Goals / Objectives Alignment

Makerspace Philosophy Learning Goals	Pre-K Objectives	K-8 Digital Learning: ISTE Standards
Socio/intellectual potentials of making and maker-centered activities.	Social Emotional Objectives: 2c. Interacts with peers 3a. Balances needs and rights of self and others	Students communicate clearly and express themselves creatively. 6a. Students choose the appropriate platforms and tools for meeting the desired objectives of their creation or communication. 6b. Students create original works or responsibly repurpose or remix digital resources into new creations.
Individual and collective learning opportunities afforded through making.	Cognitive Objectives 11a. Attends and engages 11c. Shows flexibility and inventiveness in thinking.	Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others. 3a. Students plan and employ effective research strategies to locate information and other resources for their intellectual or creative pursuits. 3b. Students evaluate the accuracy, perspective, credibility and relevance of information, media, data or other resources.
From an education perspective, observing the more cognitive and character-building of maker space experiences.	Cognitive objective: 12a: Makes connections 14a. Thinks symbolically	Students leverage technology to take an active role in choosing, achieving demonstrating competency in their learning goals. Students articulate and set personal learning goals, develop strategies to achieve them and reflect on the learning process itself to improve learning outcomes.
Encouraging self-directed learners, focus on problem solving, iterating, taking risks and seeing failures and unexpected results as learning opportunities.	Cognitive Objective 11c. Solves Problems Social Emotional Objective: 1. Manages feelings	Students develop and employ strategies for understanding and solving problems in ways that leverage the power of technological methods to develop and test solutions. 5c. Students break problems into component parts, extract key information, and develop descriptive models to understand complex systems or facilitate problem-solving. 4a. Students know and use a deliberate design process for generating ideas, testing theories, creating innovative artifacts or solving authentic problems. 4b. Students select and use digital tools to plan and manage a design process that considers design constraints and calculated risks. 4d. Students exhibit a tolerance for ambiguity, perseverance and the capacity to work with open-ended problems.
Social learning space to build on each others' strengths and interests and persist in difficult tasks with multiple personalities, thoughts and ideas.	Cognitive Objective 11c. Solves Problems 11b. Persists	Students use digital tools to broaden their perspectives and enrich their learning by collaborating with others and working effectively in teams locally and globally. 7c. Students contribute constructively to project teams, assuming various roles and responsibilities to work effectively toward a common goal. 7d. Students explore local and global issues and use collaborative technologies to work with others to investigate solutions.
Exploring working virtually and in the real world together on projects and ideas that constantly develop into research studies.		Students use digital tools to broaden their perspectives and enrich their learning by collaborating with others and working effectively in teams locally and globally. 7a. Students use digital tools to connect with learners from a variety of backgrounds and cultures, engaging with them in ways that broaden mutual understanding and learning. 7b. Students use collaborative technologies to work with others, including peers, experts or community members, to examine issues and problems from multiple viewpoints.
Building confidence within students	Social Emotional: 1c. Takes care of own needs appropriately	1a. Students articulate and set personal learning goals, develop strategies for leveraging technology to achieve them and reflect on the learning process itself to improve learning outcomes.

Lesson Design

Pre Lesson

- Lessons about 2D and 3D vocabulary
- Engage in 2D and 3D Art and Explain similarities and Differences
- Create and Explore with Tinkercad.
- Explore Printers
- Cognitive Objectives
  - Attends and Engages
  - Thinks Symbolically

Lesson

Day 1

- Read The Grouchy Ladybug
- Create a 2D design of a Lady Bug
- Discuss the 2D design of a Lady Bug

Day 2

- Second Read of the Grouchy Lady Bug
- Discuss their 2D Designs
- Create lady bugs on the computer and print them
- Discuss the ladybugs that print out

Day 3

- Ask: What can you do with a computer? What do you think you can do with a 3D printer? Chart the students answers.
- Students will create a ladybug on Tinkercad.
- Then engage in the 3D printing process.

Post Lesson

- Compare the 2D design printed with the printer to the 3D design printer with the 3D printer.
- Ask the students: How are they the same and How are they different? Ask the students to describe how they created and printed using the 3D printer.
- Ask what is a 3D printer and compare it to what they thought the 3D printer was?
- What else do you think you could make with a 3D printer?

Experience / Outcomes

- Students easily were able to use the Tinkercad scribble function.
- Students had little to no knowledge of the vocabulary word "3D" but they were able to connect 3d printing to a regular printer.
- Students thinking for the primary use of computers was games
- After bringing the students in, a conclusion was made that students needed more background information on computers and printers.
- The final lesson will break down the students learning about computers to help the students take their time and really learn the vocabulary and process.