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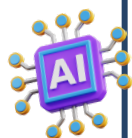
LESSON PLAN

TITLE:
Exploring Filament Painting with 3D Printing

GRADE LEVEL: 9TH GRADE TO 12TH GRADE

STEAM AREAS: ARTS, TECHNOLOGY, ENGINEERING

MATERIALS NEEDED:
- Access to a 3D multi-color printer;
- Clipper or similar software;
- Filament in various colors;
- A computer with HueForge software;
- Slicer software (e.g., Clipper)
- Example 2D images.

OBJECTIVES:
At the end of this lesson, students will be able to:
- Identify the process and principles of filament painting in 3D printing;
- Utilize HueForge to convert 2D images into 3D printed images;
- Understand the process of adding and calibrating new filaments in 3D printers;
- Perform filament swaps during the print process.

PROCEDURE:

Step 1 (Introduction to 3D Printing and Filament Painting): Begin the session by welcoming the students and giving an overview of what they will learn. Introduce the concept of 3D printing and its applications in various industries. Emphasize the advanced function of "filament painting" as a unique aspect of 3D printing. Explain the capabilities of HueForge in transforming 2D images into multicolored 3D prints using the differentiated color layering technique.

Step 2 (Understanding 3D Printing with Filament Color Blending): Describe how a 3D printer creates prints using a filament, emphasizing the importance of the filament's light transmission capability. Explain the phenomenon of color blending through the filament's light transmission property and how HueForge utilizes this to create multicolored 3D prints.

Step 3 (Software Setup and Configuration): Shift the focus to the software setup process. Explain how to configure Clipper or other multi-color-capable 3D printers. Provide students with a comprehensive step-by-step guide on adjusting slicer parameters, such as print speed, layer height, and infill density. Show students how to navigate the filament library to select the appropriate colors for their prints.

PROCEDURE:

Step 4 (Hands-On 3D Printer Setup): Give a hands-on demonstration of setting up the 3D printer for filament painting. Highlight specific settings, such as the first layer height (0.16mm), overall layer height (0.08mm), and infill pattern. Answer any queries students might have at this point.

Step 5 (G-Code Alteration for Filament Painting): Move to the G-Code alteration for filament painting. Show students how to slice the G-Code and add 'm600' commands for each required filament swap. Instruct students on saving the modified G-code. Guide them to perform each step themselves, specifying the necessity of pausing the print at a certain layer to swap out the filament.

Step 6 (In-Depth Exploration of HueForge): Introduce HueForge in a more detail-oriented manner. Let students explore the software's varied folders, tools, and options. Showcase how to adjust variables such as layer height, base layer, detail size, width, and height in HueForge for a seamless 3D printing experience.

Step 7 (Color Switching and Calibration with HueForge): With the direct engagement of students, perform a color switching operation with a HueForge-imported STL file. Guide them through the steps of how to add a layer change at the desired height and use the M600 command for filament change. Explain the concepts of color calibration in HueForge, enabling students to adjust the transmission distance manually.

Step 8 (Student Projects and Hands-On Practice): Let students independently work on minor projects where they convert an image of their choice into a 3D STL file through HueForge, applying the filament painting approach learned. Monitor their progress, assist where necessary, and provide regular feedback on their performance.

Wrap up the session by summarizing key takeaways, addressing any final questions, and encouraging students to explore advanced 3D printing techniques further. Provide additional resources for self-study and future projects.

Have a great learning activity!

ASSESSMENT:

- Students will be evaluated based on their active participation in the hands-on session, the successful conversion of a 2D image into a 3D printed image, and a brief written reflection about the practical learning process involved in the lesson.

REFERENCES:

- HueForge getting started guide: Filament painting with your 3D printer (https://www.youtube.com/watch?v=ua3DoRlmN-c
- How to Paint with a 3D Printer Using HueForge (https://www.tomshardware.com/how-to/hugeforge-paint-with-3d-printer)

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