Madison Public Schools

Computer Integrated Manufacturing – Unit 1 – 3D Scanning & Rapid Prototyping

Unit Focus

Computer-integrated manufacturing (CIM) is an introduction to the use of computer techniques to integrate manufacturing activities. These activities encompass all functions necessary to translate customer needs into a final product. CIM usually starts with the development of a product concept then product design and specification with the final step revolving around automating the manufacturing process.

The content and skills learned throughout the course will be taught in 3 separate modules (units) followed by an all encompassing PBA. For each module, students will work collaboratively, at their own pace, following a guided instructional tutorial. The first three days of the trimester will be used for review of computer aided mechanical drawing and 3D printing skills.

In this module, students will learn about the rapid prototype processes used in Manufacturing. This will revolve around the concepts of additive prototyping, 3d scanning and computer Aided Drafting. Prototyping is part of the design process in which a functional solution is created and able to be tested. 3D scanning enhances this prototyping process by improving accuracy and complexity while reducing time. A PBA will have students conceptualize and create a theme based Chess game piece prototype.

Stage 1: Desired Results - Key Understandings

Standard(s)

Connecticut Goals and Standards
Computer Aided Drafting and Design: 12

- Apply conventional Computer Aided Drafting and Design processes and procedures accurately, appropriately, and safely. *CADD.02.01*
- Express a design of an object as a 3D model.*(A5) *CADD.02.07*

ITEEA - Standards for Technological Literacy
Technological Literacy: K-12

- Students will develop the abilities to apply the design process. *11*
- Students will develop the abilities to use and maintain technological products and systems. *12*
- Students will develop an understanding of and be able to select and use information and communication technologies. *17*

Transfer

T1 Explore and hone techniques, skills, methods, and processes to create and innovate
T2 Develop a product/solution that adheres to key parameters (e.g., cost, timeline, restrictions, available resources and audience).
T3 Work together on a common goal to meet deadlines through addressing challenges and problems along the way both individually and collectively.

Meaning

Understanding(s)

U1 Fabricating an object requires many steps including planning, drawing and revisions before the object can be manufactured.
U2 Prototyping is a major step in the design cycle of manufactured goods and has been greatly advanced with the advent and use of rapid prototyping processes.
U3 Utilizing reverse modeling in the conceptual design phase allows new designs to incorporate and improve upon characteristics of an existing part.

Essential Question(s)

Q1 What are the fundamental skills required for the construction of digital 3D objects?
Q2 How can 3D scanning help me create a model for a given problem?
Q3 When do I use 3d scanning to help create prototypes?

Stage 1: Desired Results - Key Understandings

NGSS/NSTA Science & Engineering Practices

NGSS Science & Engineering Practices: 9-12

- Develop, revise, and/or use a model based on evidence to illustrate and/or predict the relationships between systems or between components of a system. *SE.9-12.2.3*
- Develop a complex model that allows for manipulation and testing of a proposed process or system. *SE.9-12.2.5*
- Design, evaluate, and/or refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations. *SE.9-12.6.5*

Student Growth and Development 21st Century Capacities Matrix

Critical Thinking

- Synthesizing: Students will be able to thoughtfully combine information/data/evidence, concepts, texts, and disciplines to draw conclusions, create solutions, and/or verify generalizations for a given purpose. *MM.1.3*

Creative Thinking

- Imagining: Students will be able to conceive of a novel approach to create a text, performance, solution, application, or inquiry. *MM.2.2*

Collaboration/Communication

- Product Creation: Students will be able to effectively use a medium to communicate important information (findings, ideas, feelings, issues, etc.) for a given purpose. *MM.3.2*

Acquisition of Knowledge and Skill

Knowledge

K1 Reverse Modeling allows CAD programs to create a three-dimensional virtual model of an existing physical part.

K2 Meshes are the main output of all 3D scanners, and the format commonly understood by 3D printers (STLs). A mesh represents the surface of a shape with a large number of triangles, connected edge to edge. Mesh models don't contain any information about the object, besides the position of the triangles that define the shape.

K3 Solid models hold information about how an object is designed, and this information is explicitly encoded into the model as features in a 'stack' of logical steps. In solid CAD, it's possible to change the dimensions for a single feature, and the rest of the model will update to accommodate the change.

Skill(s)

S1 Digitize a 3-dimensional object using a 3D Scanner.

S2 Convert an STL file into a workable file that will be manipulated in SolidWorks.

S3 Conceptualize and create a functional prototype intended to solve a problem.