Delaware Valley School District

PLANNED INSTRUCTION

A PLANNED COURSE FOR:

Advanced CAD Applications

Grade: 11 & 12

Date of Board Approval: 2019

Delaware Valley School District

PLANNED INSTRUCTION

Title of Planned Instruction: **Advanced CADD Applications**

Subject Area: Technology Education **Grade Level:** 11 & 12

Course Description: This class will be a culmination of the previous three mechanical drawing courses. The purpose of Advanced CADD Applications is to allow students to develop a mastery level of our CADD software and CNC machines and experience how they are applied in the 21st century workplace. In this class students will work on more advanced and in-depth projects, using the software learned in mechanical drawing levels I and II. They will also get to further their experience with our; 3D printer, plotter/vinyl cutter and 3D laser scanner by creating professional grade products from them. Students will be introduced to Autodesk 3D Studio Max, which is a drawing, and design program that creates virtual environments like those found in video games and computer generated animation. Their environments will be able to be virtually viewed on our zSpace machine. They will be applying the skills that they have learned through real world problem solving projects brought to the students by DVSD employees and/or local industry.

Time/Credit for the Course: 1 semester, ½ credit, 1 period per day

Curriculum Writing Committee: Tom Moran

Delaware Valley School District

<u>Marking Period 1</u> – Overview with time range in days:
Use of Autodesk 3D Studio Max, Advanced Autodesk Inventor Skills and Safe and Efficient Use of the 3D Printer, 45 Days

Marking Period 1 Goals:
Understanding of:

- Applying basic 3D Studio Max procedures and tools
- Creating an architectural element with 3D Studio Max from a sketch
- Knowing how to draw more complex shapes in 3D Studio Max
- Using 3D Studio Max to render and animate models
- Transferring a 3D Studio Max file to the zSpace machine for viewing.
- Running a mechanism simulation in Inventor Professional
- Detecting part collision in mechanism simulations in Inventor Professional
- Building working prototypes using the 3D printer.

<u>Marking Period 2</u> – Overview with time range in days:
Safe Use of the Roland Plotter/Vinyl Cutter, 3D Scanner, and Mastery Level Use of the 3D Printer. Implementation of Advanced Problem Solving Project, Mastery Level Competence of Engineering and Design Software 45 days

Marking Period 2 Goals:
Understanding of:

- Using AutoCAD or other design based software (Adobe Illustrator) to create a drawing to drive the vinyl printer/cutter
- Programming the vinyl printer/cutter
- Using the vinyl printer/cutter to create a product safely
- Completion of advanced problem solving project posed by local industry (Grey Towers Project) or a DVSD employee using skills, software and machinery (3D printer, 3D scanner, vinyl printer/cutter) learned in all Mechanical Drawing classes to this point.

Delaware Valley School District

Unit 1

Big Idea #1

Technological design is a creative process that anyone can do which may result in new inventions and innovations.

- Essential Question:
  - How would you explain and apply technological design and problem solving methods in the development of inventions and innovations?

- Concepts
  - Technological design & problem solving utilizes a series of steps that take place in a well-defined sequence.

- Competencies
  - Utilize computer-aided engineering design software to solve advanced, real-world technological problems.

Big Idea #2

Technological literacy is the ability to use, assess and manage technology around us.

- Essential Question:
  - What is the importance of technological literacy?

- Concepts
  - Technological literacy is required for all citizens in a democratic society for shared decision-making

- Competencies
  - Use current technological systems efficiently, identify undesirable results, then design, produce, test and utilize engineering analysis to optimize solutions.

Delaware Valley School District
Curriculum Plan

Unit 1: **Time Frame:** 15-20 Days

Standards: Pennsylvania Common Core State Standards for Science and Technology and Engineering Education

Standards Addressed (Number only- See Appendix for Description)
3.4.10.C1**,** 3.4.12.C2

Anchor(s) or Adopted Anchor(s):
S11.A.2.1, S11.A.2.2

Overview: Effective use of Autodesk 3D Studio Max

Focus Question: How can we use Autodesk 3D Studio Max to create virtual objects and environments?

Goals: Students will be introduced to Autodesk 3D Studio Max. They will learn how to use the software to create virtual environments. They will complete the software tutorials to learn how to use the software. Then convert 3D Studio Max files to be viewed on the zSpace machine.

Objectives:

1. Students will learn how to apply basic 3D Studio Max procedures and tools (DOK 4)
2. Students will know how to create an architectural element with 3D Studio Max from a sketch (DOK 4)
3. Students will be able to draw more complex shapes in 3D Studio Max (DOK 1)
4. Students will gain the knowledge to use 3D Studio Max to render and animate models (DOK 1)
5. Students will convert 3D Studio Max files to be viewed on the zSpace machine (DOK 2)

Core Activities and Corresponding Instructional Method:

1. Watch the Essential Skills videos and complete the Introducing the Autodesk Max Interface tutorials. These videos and tutorials are supplements that come with the software.
    a. Demonstration: tutorials, commands, and procedures
    b. Hands-on: tutorials

2. Complete the Getting Started with Viz 2008 tutorials. These tutorials are supplements that come with the software.

a. Demonstration: tutorials, commands, and procedures
b. Hands-on: tutorials

3. Do the Building an Architectural Model from Concept Sketch tutorials. These tutorials are supplements that come with the software.
    a. Demonstration: tutorials, commands, and procedures
    b. Hands-on: tutorials

4. Students will complete the Materials tutorials. These tutorials are supplements that come with the software.
    a. Demonstration: tutorials, commands, and procedures
    b. Hands-on: tutorials

5. Students will complete the Animating tutorials. These tutorials are supplements that come with the software.
    a. Demonstration: tutorials, commands, and procedures
    b. Hands-on: tutorials

6. Students will be able to convert a 3D Studio Max file so that it can be viewed in the virtual environment of the zSpace machine.
    a. Demonstration: tutorials, commands, and procedures
    b. Hands-on: tutorials

Assessments:

Diagnostic:
Oral response during discussion
Formative:
Student progress and understanding of tutorials
Summative:
Tutorials

Extensions:
These tutorials will be completed on a self-paced timeline (but will be graded on a mandatory timeline to keep slower students from falling behind). If an advanced student finishes the tutorials early they may move on to the next set of tutorials.

Correctives:

Individual instruction and demonstrations will be given to students having difficulty

Materials and Resources:

Autodesk 3D Studio Max, 3D Studio Max online tutorials (Internet), computers

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Unit 2

Big Idea #1

Technological design is a creative process that anyone can do which may result in new inventions and innovations.

- Essential Question:
  - How would you explain and apply technological design and problem solving methods in the development of inventions and innovations?

- Concepts
  - Technological design & problem solving utilizes a series of steps that take place in a well-defined sequence.

- Competencies
  - Utilize computer-aided engineering design software to solve advanced, real-world technological problems.

Big Idea #2

Technological literacy is the ability to use, assess and manage technology around us.

- Essential Question:
  - What is the importance of technological literacy?

- Concepts
  - Technological literacy is required for all citizens in a democratic society for shared decision-making

- Competencies
  - Use current technological systems efficiently, identify undesirable results, then design, produce, test and utilize engineering analysis to optimize solutions.

Delaware Valley School District

Curriculum Plan

Unit 2: **Time Frame:** 10-15 Days

Standards: Pennsylvania Common Core State Standards for Science and Technology and Engineering Education

Standards Addressed: (Number only- See Appendix for Description)
3.4.10.C1**,** 3.4.12.C2

Anchor(s) or Adopted Anchor(s):
S11.A.2.1, S11.A.2.2

Overview: Running a mechanism simulation and detecting part collision in Inventor Professional

Focus Question: How can students use advanced functions like mechanism simulation and collision detection to analyze the functionality of their project

Goals: Students will know how to analyze interference between moving parts when they simulate the virtual movement of their assemblies

Objectives:

1. Students will be able to drive their assembly's constraints to simulate motion (DOK 2)
2. Students use collision detection and analyze interference to diagnose (DOK 4)

Core Activities and Corresponding Instructional Method:

1. Introduce and demonstrate the necessary tools and functions to drive constraints
    a. Demonstration: software tools
    b. Hands-on: practice use of tools on examples

2. Simulate the movement of the mechanism
    a. Hands-on: use software and functions to drive and simulate mechanism

Assessments:

Diagnostic:

Oral response during discussion

Formative:

Student progress and understanding of advanced software tools

Summative:

The proper simulation of the virtual mechanism on the computer

Extensions:

Students that achieve the proper simulation will be able to move on and work with more advanced tools such as material stress analysis and creating a rendered animation.

Correctives:

Individual instruction and demonstrations will be given to students having difficulty

Materials and Resources:

Latest Inventor software and Computers

Delaware Valley School District

Unit 3

Big Idea #1

Technological design is a creative process that anyone can do which may result in new inventions and innovations.

- Essential Question:
  - How would you explain and apply technological design and problem solving methods in the development of inventions and innovations?

- Concept
  - Technological design & problem solving utilizes a series of steps that take place in a well-defined sequence.

- Competencies
  - Employ engineering design and problem solving skills to solve complex technological challenges.

Big Idea #2

Technological literacy is the ability to use, assess and manage technology around us.

- Essential Question:
  - What is the importance of technological literacy?

- Concept
  - Technological literacy is necessary for a productive 21st century skilled workforce.

- Competencies
  - Design, produce, test and analyze systems that use technological resources for the purpose of improving on existing technologies to impact individual lives, societies, our world, and the environment.

Delaware Valley School District

Curriculum Plan

Unit 3: **Time Frame:** 10 Days

Standards: Pennsylvania Common Core State Standards for Science and Technology and Engineering Education

Standards Addressed: (Number only- See Appendix for Description)
3.4.10.C1**,** 3.4.10.C2, 3.4.12.C2, 3.4.12.C3

Anchor(s) or Adopted Anchor(s):
S11.A.2.1, S11.A.2.2

Overview: Students will build a working prototype using the 3D Printer software and Artec Eva Lite 3D scanner to drive the 3D printer.

Focus Question: How can students use advanced rapid prototyping techniques, software and machines to make a working prototype of a product

Goals: Students will be able to create a properly functioning prototype using a 3D scanner and printer

Objectives:

1. Students will learn how to use the 3D scanner and printer software to import, scale, orient, set-up and process their STL files which will drive the 3D printer and make their mechanism. (DOK 1)
2. Students will know how to set-up the 3D printer to receive the STL file so it can be built and run build. (DOK 1)
3. Students will understand how to clean the support material off of their part/s using hand tools and the parts cleaner. (DOK 1)
4. Students will assemble their parts to test for form, fit, and function. (DOK 2)
5. If parts do not assemble correctly, they will learn how to analyze problems. (DOK 4)
6. Students will be able to assess the failing parts and reengineer them in Inventor so they can be rebuilt. (DOK 4)

Core Activities and Corresponding Instructional Method:

1. Use the 3D Scanner and Printer software to prepare STL file for build
    a. Demonstrate: software
    b. Hand-on: program part into software

2. Set up 3D printer and build part
    a. Demonstrate: 3D printer set-up
    b. Hands-on: students will set-up and build part in 3D printer

3. Clean off support material
    a. Demonstrate: cleaning process
    b. Hands-on: students clean their parts

4. Students will assemble their parts
    a. Hand-on: project assembly

5. Students will reengineer and rebuild any parts that are improperly engineered
    a. Demonstrate: editing process and tools in Inventor
    b. Hand-on: edit, rebuild and reassemble parts (repeat until form, fit and function is correct)

Assessments:

Diagnostic:

Oral response during discussion

Formative:

Student understanding of the 3D scanner and printer software and hardware

Summative:

Test the functionality of the student's prototype

Extensions:

Advanced students that properly create their prototype early can use the software and 3D scanner and printer to design and build a more elaborate product

Correctives:

Individual instruction and demonstrations will be given to students having difficulty

Materials and Resources:

Inventor software, Artec Eva Lite 3D Scanner, 3D printer software, 3D printer consumables (trays, model material, support material), hand tools and parts cleaner compound for support material removal, 3D printer and computers

Delaware Valley School District

Unit 4

Big Idea #1

Technological design is a creative process that anyone can do which may result in new inventions and innovations.

- Essential Question:
  - How would you explain and apply technological design and problem solving methods in the development of inventions and innovations?

- Concept
  - Technological design & problem solving utilizes a series of steps that take place in a well-defined sequence.

- Competencies
  - Utilize computer-aided engineering design software to solve advanced, real-world technological problems.

Big Idea #2

Technological literacy is the ability to use, assess and manage technology around us.

- Essential Question:
  - What is the importance of technological literacy?

- Concept
  - Technological literacy is necessary for a productive 21st century skilled workforce.

- Competencies
  - Design, produce, test and analyze systems that use technological resources for the purpose of improving on existing technologies to impact individual lives, societies, our world, and the environment.

Delaware Valley School District

Curriculum Plan

Unit 4: **Time Frame:** 12-15 Days

Standards: Pennsylvania Common Core State Standards for Science and Technology and Engineering Education

Standards Addressed: (Number only- See Appendix for Description)
3.4.10.C1**,** 3.4.10.C2, 3.4.12.C2, 3.4.12.C3

Anchor(s) or Adopted Anchor(s):
S11.A.2.1, S11.A.2.2

Overview: Students will use drawing software to create a design (graphic) of their choice, use Roland Printer/Vinyl Cutter driver software to program the machine then print and cut the design using the plotter/cutter.

Focus Question: How can students use software and CNC technologies to easily and safely create signage.

Goals: Students will know how to safely use the Roland Printer/Cutter

Objectives:
1. Students will know how to use AutoCAD or other design based software (Adobe Illustrator) to create a drawing to drive the Roland Printer/Cutter (DOK 4)
2. Students will be able to program the Roland Printer/Cutter using the driver software (DOK 4)
3. Students will acquire the skills and experience necessary to properly and safely create a product with the Roland Printer/Cutter (DOK 4)

Core Activities and Corresponding Instructional Method
1. Use design based software or AutoCAD software to create a design to be engraved
    a. Demonstrate: Drawing tools in design software. Students will already have sufficient experience with AutoCAD from Mechanical Drawing I. No demo of that software needed.
    b. Hand-on: students will use the techniques they learned during the demonstration to draw their design

2. Program the Roland Printer/Cutter
    a. Demonstrate: programming process using driver software

   b. Hands-on: program the printer/cutter

3. Safely print and cut their design
   a. Demonstrate: procedures for safe set-up and operation of the printer/cutter.
   b. Hands-on: students will use the Roland Printer/Cutter.

Assessments:

Diagnostic:

Oral response during demonstrations

Formative:

Student progress and understanding of design and driver software.

Summative:

Safe and proper use of the tools software and hardware and the quality of the student's design

Extensions:

Students that finish their projects early can complete a second more detailed design.

Correctives:

Individual instruction and demonstrations will be given to students having difficulty

Materials and Resources:

Design software, AutoCAD, and Roland driver software, computer, design (logo, sign…) vinyl and Roland Printer/Cutter

Unit 5

Big Idea #1

Technological design is a creative process that anyone can do which may result in new inventions and innovations.

- Essential Question:
  - How would you explain and apply technological design and problem solving methods in the development of inventions and innovations?

- Concept
  - Technological design & problem solving utilizes a series of steps that take place in a well-defined sequence.

- Competencies
  - Utilize computer-aided engineering design software to solve advanced, real-world technological problems.

Big Idea #2

Technological literacy is the ability to use, assess and manage technology around us.

- Essential Question:
  - What is the importance of technological literacy?

- Concept
  - Technological literacy is necessary for a productive 21st century skilled workforce.

- Competencies
  - Design, produce, test and analyze systems that use technological resources for the purpose of improving on existing technologies to impact individual lives, societies, our world, and the environment.

Delaware Valley School District

Curriculum Plan

Unit 5: **Time Frame:** 30 Days

Standards: Pennsylvania Common Core State Standards for Science and Technology and Engineering Education

Standards Addressed: (Number only- See Appendix for Description)
3.4.10.C1**,** 3.4.10.C2, 3.4.12.C2, 3.4.12.C3

Anchor(s) or Adopted Anchor(s):
S11.A.2.1, S11.A.2.2

Overview: Completion of advanced problem solving project posed by local industry (Grey Towers Project or other) or a DVSD employee. Students will use skills, software and machinery learned in all Mechanical Drawing classes to this point

Focus Question: Can students use the skills they have obtained up to this point in Mechanical Drawing to successfully complete a comprehensive problem-solving project

Goals: Students will use all their skill and knowledge of mechanical drawing software and hardware to solve everyday real world technological problems.

Objectives:

1. Allow students to critically think, problem solve, and create an advanced problem solving project posed by local industry (Grey Towers Project) or a DVSD employee by using skills, software and machinery learned in all mechanical drawing classes to this point. (DOK 4)
2. This project will be used to reinforce what students have learned in all aspects of the mechanical drawing curriculum. (DOK 1)
3. Students will also be able to independently research and learn any advanced procedures they may not have already learned (DOK 3)

Core Activities and Corresponding Instructional Method

1. Students will be going to Grey Towers to measure the current out-building to be drawn.
    a. Hands-on: measure building

2. Create electronic drawings using Revit software, print out drawings using the HP plotter and build scaled model in 3D printer of Grey Towers building
    a. Hand-on: create and print drawings and build model

3. Deliver drawings and model, review with Grey Towers project architects and project managers for potential edits
    a. Hand-on: edit drawings and model, and deliver final drawings to Grey Towers

4. Use existing technologies to build/draw problem solving project for other local industry or DVSD staff member.
    a. Hand-on: complete project.

Assessments:

Diagnostic:
Oral response during demonstrations

Formative:
Student progress and understanding Autodesk software, plotter and 3D printer

Summative:
Quality of the completed project

Extensions:
Students that finish their projects early can complete a second, more advanced problem-solving project for another staff member.

Correctives:
Individual instruction and demonstrations will be given to students having difficulty

Materials and Resources:
Autodesk software, HP Designjet plotter, 3D printer and consumables, computers, and plotter paper

Primary Textbook(s) Used for this Course of Instruction

-There are no textbooks used in this class

Appendix

Standard Area - 3.4: Technology and Engineering Education
Organizing Category - 3.4.C: Technology and Engineering Design
Grade Level - 3.4.10.C: GRADE 10

Standard

3.4.10.C1: Apply the components of the technological design process.
3.4.10.C2:
Analyze a prototype and/or create a working model to test a design concept by making actual observations and necessary adjustments.
3.4.10.C3:
Illustrate the concept that not all problems are technological and not every problem can be solved using technology.

Standard Area - 3.4: Technology and Engineering Education
Organizing Category - 3.4.C: Technology and Engineering Design
Grade Level - 3.4.12.C: GRADE 12

Standard

3.4.12.C2: Apply the concept that engineering design is influenced by personal characteristics, such as creativity, resourcefulness, and the ability to visualize and think abstractly.
3.4.12.C3: Apply the concept that many technological problems require a multi-disciplinary approach.

Anchors

S11.A.1
Reasoning and Analysis
Anchor Descriptors
S11.A.1.1 - Analyze and explain the nature of science in the search for understanding the natural world and its connection to technological systems.
S11.A.1.2 - Identify and analyze the scientific or technological challenges of societal issues; propose possible solutions and discuss implications.
S11.A.1.3 - Describe and interpret patterns of change in natural and human-made systems.

S11.A.2
Processes, Procedures, and Tools of Scientific Investigations
Anchor Descriptors
S11.A.2.1 - Apply knowledge of scientific investigation or technological design to develop or critique aspects of the experimental or design process.
S11.A.2.2 - Evaluate appropriate technologies for a specific purpose, or describe the information the instrument can provide