Exemplary Planning Commentary: Technology Engineering Education

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1a. Central focus of the segment

The central focus of this learning segment is communications through technical drawings and using Autodesk Inventor. I am teaching this content so that learners can read, interpret, and create technical drawings while becoming competent using Autodesk Inventor.

1b. Connecting lesson plans to concepts, technical skills, and engineering design

Standards for Technological Literacy 12- Students will develop the abilities to use and maintain technological products and systems. Benchmark N- Troubleshoot, analyze, and maintain systems to ensure safe and proper function and precision. Benchmark P- Use computers and calculators to access, retrieve, organize, process, maintain, interpret, and evaluate data and information to communicate. Standard 12 Benchmark N will address technical skills and problem solving strategies. Students will be practicing technical skills by using Autodesk Inventor to model parts accurately and create precise technical drawings. They will utilize problem solving strategies to troubleshoot mistakes as they work. Standard 12 Benchmark P will address technical skills. Learners will use computers to access Autodesk Inventor to model parts and create technical drawings.

Standards for Technological Literacy 17- Students will develop an understanding of and be able to select and use information and communication technologies. Benchmark Q- Technological knowledge and processes are communicated using symbols, measurement, conventions, icons, graphic images, and languages that incorporate a variety of visual, auditory, and tactile stimuli. Standard 17 Benchmark Q will address conceptual understanding. Learners will be taught concepts about communicating through technical drawings. They will learn things such as; the reasons that technical drawings are created, the information on a technical drawing, the importance of dimensioning, the rules of dimensioning, the reason for needing section and auxiliary views, and what section and auxiliary views look like. Next Generation Science Standard HS-ETS1-4. Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.

Standard HS-ETS 1-4 will address technical skills and conceptual understanding. Learners will be taught concepts about why technical drawings are created and the relevant information, criteria and constraints, that they communicate. Students will be practicing technical skills by using Autodesk Inventor to simulate parts accurately and create technical drawings that are annotated with relevant criteria and constraints.

Lesson 1 Objectives
1. Learners will be able to identify 4 different pieces of information on a technical drawing.
2. Learners will be able to explain 2 reasons for creating technical drawings.
3. Learners will be able to model parts in Autodesk Inventor by reading technical drawings within a tolerance of .003 in^3.

Objective 1 will address conceptual understanding by helping learners understand what information a technical drawing communicates. Objective 2 will address conceptual understanding by teaching learners what the purpose of technical drawings are and connecting their relevance in the real world. Objective 3 will address technical skills by helping learners develop skills in Autodesk Inventor through practice and giving them practice reading technical drawings.
Objective 3 will also address problem solving strategies by having learners troubleshoot and determine the most efficient ways to make parts accurately in Inventor.

Lesson 2 Objectives
1. Learners will be able to explain the reason for dimensioning standards on the unit quiz
2. Learners will be able to identify 4 rules of dimensioning on the unit quiz
3. Learners will be able to create technical drawings for the parts they model in Autodesk Inventor. Objective 1 will address conceptual understanding by teaching learners the reason for following dimension rules and giving them context from the real world. Objective 2 will address conceptual understanding by teaching learners the rules of dimensioning and giving them the chance to apply them to their own drawings. Objective 3 will address technical skills by providing the opportunity for students to practice creating technical drawings. Objective 3 will also address engineering design thinking by having the learners determine the most effective system to annotate and dimension a technical drawing.

Lesson 3 Objectives
1. Learners will be able to explain the reason for adding a section view
2. Learners will be able to explain the reason for adding an auxiliary view
3. Learners will be able to create technical drawings that show a section view
4. Learners will be able to create technical drawings that show an auxiliary view

Objective 1 and 2 will address conceptual understanding by teaching learners the reason for needing alternative views to show complex parts. Objective 3 and 4 will address technical skills by giving learners the opportunity to practice using alternative views when creating a drawing of a complex part.

1c. Explaining how lessons build on each other

The focus of Lesson 1 is for learners to understand the importance of technical drawings and the information that is presented on a technical drawing. They will then apply that knowledge by reading technical drawings of parts and modeling those parts in Autodesk Inventor. Lesson 2 will expand on Lesson 1 by specifically talking about the information on a technical drawing. It will begin with the reasons for adding dimensions and annotations to technical drawings and then discuss certain rules and guidelines on how they should be added. The students will apply these concepts by creating technical drawings of new parts they model in Inventor. Lesson 3 will build on Lesson 1 and 2 by taking their knowledge of the information on a technical drawing and their knowledge of how to place this information on a technical drawing and show them how it can be applied for a more complex part. Lesson 3 will teach the reasons for needing additional and alternative views on a drawing for more complex parts. It will show them how those views are created and where they are put then the learners will be able to apply this by adding additional views to a technical drawing of a more complex part that they modeled in Autodesk Inventor.

2a. Summary of students’ prior knowledge

All learners used AutoCAD to create 2-dimensional technical drawings during previous units of this course. They know simple concepts of 3-view technical drawings, orthographic projections, line types, and basic dimensioning practices. Students were introduced to Autodesk Inventor during a prerequisite course that they took in grade 9. They are capable of modeling simple parts, doing basic assembly functions, and creating technical drawing files in Autodesk Inventor. However, the learners in this class range from grades 10 to 12. Some of them are recalling knowledge and skills from less than a year ago while some are recalling knowledge and skills from three years ago. They are still learning how to model parts accurately and efficiently, and create drawings that are complete and correct. I have one learner that has an IEP he requires frequent reviewing of content, he usually needs extra time to complete assignments, and he benefits from one on one instruction. I have another learner that is on a 504 plan. This student can complete all assignments on time but requires frequent checks for understanding, frequent reminders to stay on task, and additional waiting time when asked questions. I have another learner that is gifted and can complete all assignments in 50-75% of the time that it takes most learners.

2b. Summary of student assets
My learners live in a large suburban area and about 30% receive free or reduced price lunch. Of my learners around 80% are male and around 90% are white. 98% of the school speaks English fluently, none of my learners are English language learners. Athletics are a major part of the culture at this school, a majority of my learners are student-athletes. All my learners have chosen to take this course above other electives in other subject areas. About half the learners are currently enrolled in other technology education classes in addition to this one. Seven of my learners, including the gifted learner, participate in the VEX robotics club as an extracurricular activity. I have at least two learners whose parents work at a local branch of a national manufacturing company as engineers. Most of my students are on an education plan that is focused on college preparation. This course is a part of the Engineering Career and Technical Education Sequence, so most of the learners plan to attend college for engineering or another STEM related field. However, some learners plan to attend technical or trade school and begin working in industry or plan to join the military. Being able to read, understand, create technical drawings, and use Autodesk Inventor will help learners in future engineering courses in the high school sequence, will be a foundation for students planning to attend college for a STEM related field, and will be important for learners starting to work in industry. Also, engineering thinking and problem-solving skills obtained during this learning segment will help learners entering any field including any branch of the military. All learners are preparing to take the National Occupational Career Technical Institute CAD workplace ready exam.

3a. Selecting learning activities based on prior knowledge and other assets

The learners all have experience using Autodesk Inventor to model parts and create drawings from a previous course as well as some basic knowledge of technical drawing from previous units in this course. They are already capable of modeling parts in Inventor, so I do not need to spend a lot of time demonstrating how to use the program. This allows me to expand their knowledge of technical drawing and help them understand the real-world relevance and application of communicating through technical drawings. All learners are currently taking or planning to take other courses in the Engineering Career and Technical Education sequence. Using Autodesk Inventor, reading technical drawings, and creating technical drawings will help students be successful in other courses in that sequence. Most learners have expressed interest in entering the engineering field, other STEM fields, or learning an industrial trade. During each lesson, I plan to give at least one real-world example that shows where the knowledge could fit into a real-world situation. These examples will demonstrate to the students that the new content and skills they are learning are relevant to what they might do in the future.

Examples are also an effective way to represent the information being taught. Gary Borich, author of Effective Teaching Methods, states that to gain the complete concept of a topic learners must go beyond learning facts and rules, they must see examples of where the information applies or doesn’t apply. When teaching about technical drawings the students may learn about the facts and rules but not fully understand them. A learner might know that on a drawing, a hole needs to be dimensioned with a diameter and a depth. However, if you explain that when a machinist drills this hole, he or she needs to know the drill bit size to use and how far to drill down, the learner will understand the rule as a larger concept. The learner will understand why the dimensioning rule exists and why when creating a technical drawing the rules matter. To take the same example even further, you can say that the product is a medical device used in the emergency rooms. Now the learner will understand that not putting the correct information on a drawing could be the difference between life and death. Using examples takes the students thinking out of the classroom and into the real world. It gives them the context and helps them make connections about their own learning (Borich 2014).


3b. Selecting learning activities for the whole-class and individuals

My instructional strategies are appropriate for the whole class because I will begin each lesson with a real-world example that demonstrates the new knowledge and skills are relevant. This way before I help them recall prior knowledge or introduce any new knowledge, everyone in the class will be thinking about how this is relevant to their own lives. For example, during the anticipatory set for Lesson 1 I plan to ask the learners how many parts there are in a car. After allowing them to guess I will tell them that there are about 30,000 parts and for each part someone must
create a technical drawing for each one. This way every learner will be thinking about who uses technical drawings as I begin the lesson. During each lesson, I will have examples of technical drawings that show the concepts I am teaching and I will also explain them using the correct vocabulary and technical terms. Along with each lesson the learners will be assigned a set of parts to model and create technical drawings of. This will help meet the needs of visual, auditory, and kinesthetic learners. The learner that has an IEP will be given extra time to turn in the assignments and I will encourage him to come in during free periods or after school for one on one instruction. I will also sit him next to a more gifted learner so that if he needs to ask questions during work time, he won’t need to wait for me to come over. The learner with a 504 plan will sit close to the front of the room so that I can consistently check for understanding and remind him to be on task. I will also post all the examples along with notes on Google Classroom because class notes are a part of his accommodations. When the gifted learner finishes the assignments ahead of everyone else, I will give him additional parts to practice modeling and creating drawings of.

3c. Addressing preconceptions, errors, misunderstandings

A common preconception is that a technical drawing is required to have three orthographic projections or views. I will address this issue in Lessons 1 when I talk about the information shown on a technical drawing and that all the correct information can be shown in only one or two projections. I will address this again in Lesson 2 when I mention that some parts can be fully dimensioned in just two views. I will address this in Lesson 3 when I begin talking about complex parts that may need additional views to give all the information. A common error is made when dimensioning or annotating a round object. Learners will dimension them quadrant to quadrant or quadrant to center with a line dimension, including extension and dimension lines. I will be covering this in Lesson 2, where I will show Dimensioning Examples 2-4 of round features that are correctly and incorrectly annotated. Correctly with a leader line and annotated with a diameter for a circle and a radius for an arc. A common misunderstanding is believing that every view must have every dimension to be correct. I will address this in Lesson 2 when I show Dimensioning Example 1 and discuss that a linear dimension can be put on two different views but it should only be put on one of the views to fully dimension the drawing.

4a. Identifying the language function

Language Function: Learners will be able to identify 4 different pieces of information on a technical drawing.

4b. Learning activities enabling practice with the language function

This can be found in Lesson 1 Objective 1. Learners will practice this language function three times during Lesson 1. During steps 6 and 7 of the procedure, I will show them examples of technical drawings and they will identify the different pieces of information based on the examples. During step 8 of the procedure, students will be modeling parts in Inventor based on technical drawings and will be identifying information they need to know to do so. During step 9 in the procedure, I will recall the learning objectives in form of a question and ask learners to identify what information is on a technical drawing.

4c. Additional language demands

Vocabulary from the entire Learning Segment: Orthographic projection- (or orthogonal projection) is a means of representing a three-dimensional object. Pictorial drawing- a view of an object as it would be seen by an observer who looks at the object either in a chosen direction or from a selected point of view.

Dimensions- a measurable extent of some kind, such as length, breadth, depth, or height.
Annotation- a note of explanation or comment added to a text or diagram.
Designer/Engineer- the person that created the technical drawing
Title- the name of the part or product.
Part Number- Identifier of where the part falls in the sequence of the product
Volume- the amount of space that a substance or object occupies.
Date- The day, month, and year a drawing was created.
Discourse from Lesson 1: During Lesson 1, we will look at Technical Drawing Example 1 and 2 as a class and the students will be identifying different pieces of information that they can gather from reading the drawing and sharing with the class. They will also be modeling parts in Inventor based on technical drawings and practicing identifying the information necessary to do so. During the closing of Lesson 1 when I review the objectives in the form of essential questions, I will ask the learners to identify different pieces of information that can be gathered from reading a technical drawing.

Visual Representation from the entire Learning Segment: Throughout the learning segment the learners will create ten different technical drawings that will act as examples for what information should be placed on a technical drawing

4d. Supporting student language use

During Lesson 1, we will look at examples of technical drawings together that show the different types of information that exist on a technical drawing, these examples will be shared with learners for reference later. During this learning task, we will be using the vocabulary terms as we discuss the examples and we will be looking at a visual representation as a class. They will show orthographic projections, pictorial drawings, dimensions, annotations, and a title block. Also during Lesson 1, I will emphasize the information in the title block; designer/engineer, title, part number, volume, and date and tell them to use these as a guide when creating their own technical drawings. During Lesson 2, we will discuss the correct ways to add dimensions and annotations to drawings. I will share with them examples of correct and incorrect ways to show dimensions and annotations, they will also have access to these for future reference. We will again be using vocabulary and symbols to discuss the visual representation.

5a. Assessing student learning

Learners understanding of concepts will be assessed informally several times throughout the lesson. I will call out for predictions or guesses, answers to questions, and to review knowledge. I plan to ask for volunteers as well as call individuals by name randomly throughout group instruction. I also plan to review objectives at the end of each day out loud by phrasing them ask questions and calling on learners to answer. I will assess learner’s technical skills informally by walking around, observing, and being available for assistance to learners during work time. Also, at the end of each period I plan to do a quick progress check to see how far learners have gotten on the assigned parts and drawings and to check if anyone is struggling with them. I will informally assess engineering design and problem-solving strategies by walking around and observing the processes that learners use to model parts and create drawings.

Formally, learners conceptual understanding, technical skills, and engineering design and problem-solving strategies will be assessed through their completed technical drawings of Inventor Parts 1-10 using the rubric. The rubric measures on a scale of 1 to 5, 5 meaning they demonstrated the conceptual understanding, technical skills, and engineering design and problem-solving strategies and 1 meaning they did not. It breaks the technical drawing into four categories; part accuracy, dimensions and annotations, layout, and title block. Part accuracy measures their Inventor modeling abilities. Dimensions and annotations, measures the understanding of when and how to add dimensions and notes to drawings. Layout measures their understanding of and ability to choose the correct views and add the correct line types to a drawing. Title block measures their ability to complete a drawing with all necessary information. Other formal assessments include a Module Quiz that is written and measures conceptual understandings and a Unit Exam that is practical measures technical and problem-solving skills.

5b. Adapting lessons

When assessing learners informally, I plan to ask for volunteers so that all students have the opportunity to participate. However, I also plan to call specific individuals by name so that learners that cannot think as fast or learners that lose focus more easily are also given the opportunity to participate. I plan to call on each learner at least once during each lesson and give extra wait time to learners that are slower to make connections. During work time, I will also spend more time observing learners that are underperforming and my two learners with specific needs. I also plan to have my learner with a 504 plan sit close to me so that I can check for understanding and review knowledge consistently.
throughout the lesson. I will encourage my learner with an IEP to come in after school to receive one on one instruction and review knowledge learned during class. This will also give me a deeper assessment of what he does and does not understand. Formally, I will assess all the drawings individually with the rubric and point out specifically what is correct, what is incorrect, and what should be added or fixed to improve it.