Instructional Design Project

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ETEC 6440: Instructional Design II

Professor Medrano

Project Title

Training faculty and students to use the BOSS LS-2440

Step 1: Identify Instructional Goal(s)

Problem and Opportunity

The University of Redlands art department purchased a BOSS LS-2440 laser cutter to replace the old Epilog Legend laser cutter. Currently, I and two other faculty know how to create vector and raster images for the laser cutter, import them successfully into the software used to run the laser cutter (Lightburn), and operate the laser cutter.

I will design and implement a course to train faculty and students in the art department to create vector and raster images for the laser cutter, import them successfully into the software used to run the laser cutter (Lightburn), and operate the laser cutter.

Instructional Goal

The student will be able to use the BOSS LS-2440 to cut and etch various materials.

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General Overview of the Learners, Contexts, and Tools

The learners are faculty and students in the art department at the University of Redlands. There is a mix of graduate and undergraduate education. They should all be motivated to learn this new production technique, have college-level reading and comprehension skills, and possess a basic understanding of using computers including opening files and using removable storage media. Perhaps I can make ART159 a prerequisite or include this eLearning in ART159.

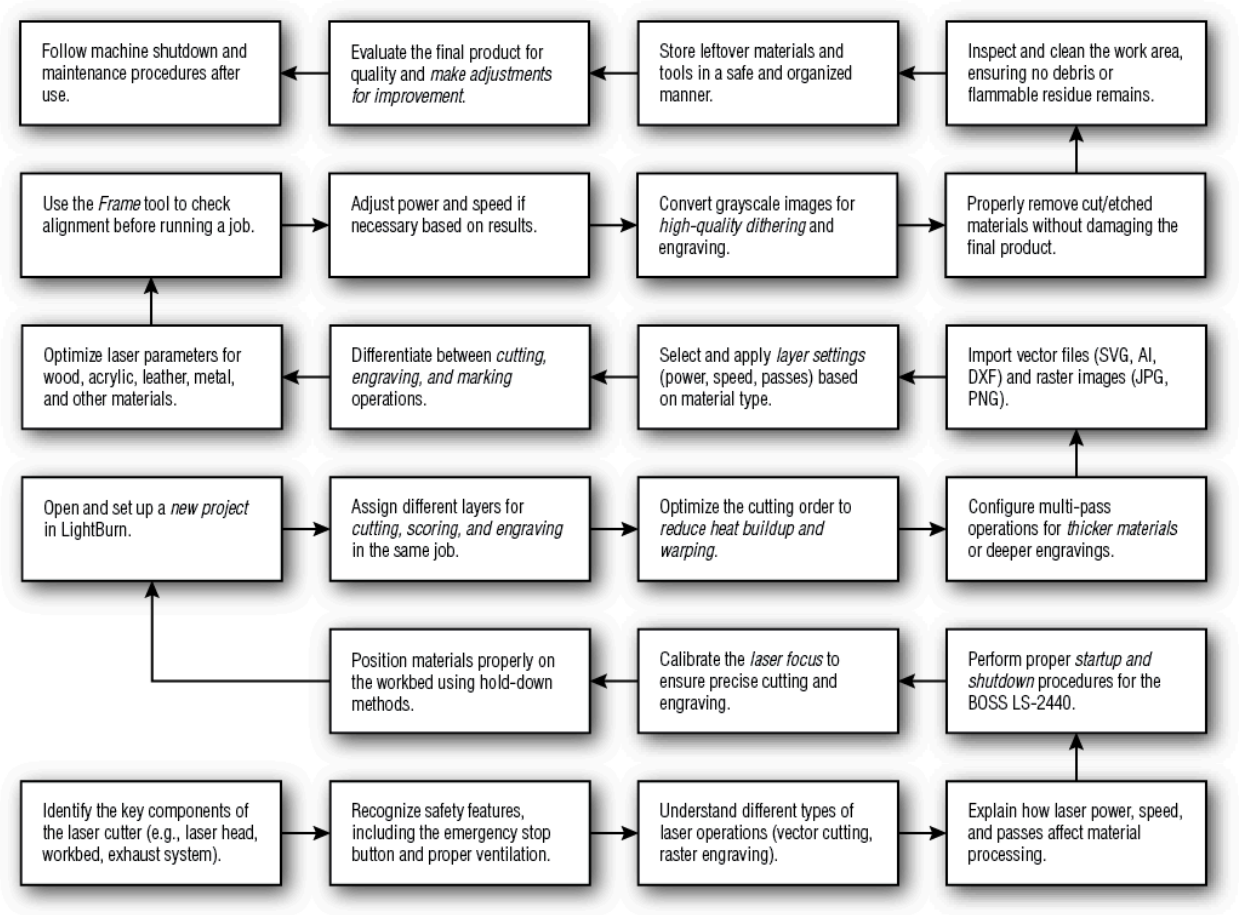
The learners will apply their new skills in Ann Peppers Hall room 222 where the laser cutter is installed.

The learners will need sheet material that is appropriate for the laser cutter, vector files for cutting the material, and raster files for etching the material. Learners will also need removable storage media formatted to FAT 32.

Step 2: Conduct Instructional Analysis

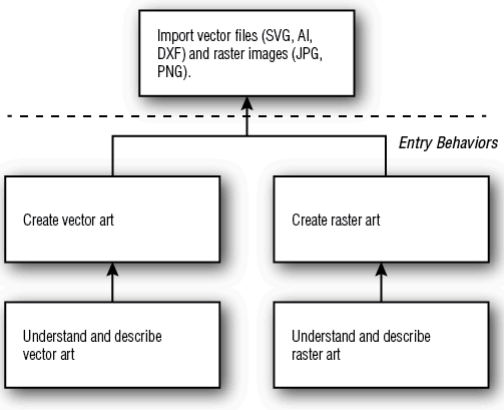
Major Steps

This instructional goal falls under the Psychomotor Domain as the students will be learning to operate machinery, follow steps, and integrate skills. Some of the sub skills also fall under the Cognitive Domain as the students will need to understand vector art, raster art, resolution, imperial-metric conversion.



Subordinate and Entry Skills

I've selected "Import vector files (SVG, AI, DXF) and raster images (JPG, PNG)" to break down into its constituent sub skills and have denoted entry behaviors with a dashed line:



Step 3: Analyze Learners and Contexts

Target Population and Performance Setting

The learners are faculty and students in the art department at the University of Redlands. There is a mix of graduate and undergraduate education. They should all be motivated to learn this new production technique, have college-level reading and comprehension skills, and possess a basic understanding of using computers including opening files and using removable storage media.

All of the technology needed to achieve the Terminal Objective is provided by the university. The laser cutter itself is in a second-floor classroom with just enough space for a few people, so somebody with mobility issues might find it uncomfortable. There is elevator accessibility to the second floor.

The learners will apply their new skills in Ann Peppers Hall room 222 where the laser cutter is installed.

The learners will interact with this course through the University's LMS, Canvas.

- **Stop here for your Analysis Report**

Step 4: Write Performance Objectives

Terminal Objective and Subordinate Objectives

Using the BOSS LS-2440, the student will demonstrate proper startup procedures, explain relevant safety precautions, utilize LightBurn software in order to etch and cut appropriate materials, and demonstrate proper shutdown and cleanup procedures.

Subordinate Objectives

- Accurately identify the main components of the laser cutter when presented with the machine in an operational state, without missing any parts.
- Correctly identify the safety features of the laser cutter when given a functional machine and a safety checklist, without missing any required features.
- Distinguish between examples of cutting and etching when shown physical or digital samples, with 100% accuracy.
- Explain how laser power and speed affect material processing when given different material samples and machine settings, demonstrating an understanding of depth, burn marks, and efficiency.
- Perform proper startup and shutdown procedures for the BOSS LS-2440 following the guidelines, without skipping any steps.
- Calibrate the laser focus to ensure precise cutting and engraving, achieving sharp and accurate results on test materials.

- Position materials properly on the workbed using hold-down methods to prevent movement during operation, ensuring proper alignment and cutting accuracy.
- Open and set up a new project in LightBurn when provided with the software and a design file, ensuring all settings are correctly configured.
- Assign different layers for cutting, scoring, and engraving in the same job using LightBurn software, with correct layer settings and differentiation.
- Optimize the cutting order in LightBurn to reduce heat buildup and prevent warping, ensuring material integrity and reducing cycle time.
- Configure multi-pass operations for thicker materials or deeper engravings using LightBurn settings, achieving the desired depth without excessive burning.
- Import vector files (SVG, AI, DXF) and raster images (JPG, PNG) into LightBurn, ensuring correct scaling and positioning.
- Select and apply appropriate layer settings (power, speed, passes) based on material type, achieving clean and efficient cuts or engravings.
- Differentiate between cutting, engraving, and marking operations when given sample materials and LightBurn settings, explaining the effects of each process.
- Optimize laser parameters for wood, acrylic, leather, metal, and other materials based on a provided materials reference chart, achieving precise and clean results.
- Use the Frame tool in LightBurn before running a job to check material alignment, ensuring the design fits within the intended work area.
- Adjust power and speed settings based on test results, achieving the desired cut depth or engraving clarity without excessive charring.
- Convert grayscale images for high-quality dithering and engraving using LightBurn's image processing tools, ensuring clarity and contrast in the final output.
- Properly remove cut and etched materials without damaging the final product, ensuring a clean and professional finish.
- Inspect and clean the work area after using the laser cutter, removing all debris and flammable residues to maintain safety.
- Store leftover materials and tools in designated storage areas, keeping the workspace organized and preventing material damage.
- Evaluate the final product for quality against a provided checklist, making necessary adjustments for improvement.
- Follow machine shutdown and maintenance procedures as outlined in the manufacturer's manual, ensuring the laser cutter remains in optimal working condition.

Step 5: Develop Assessment Instruments

Assessment Instruments

Hint: Create assessments that align with your performance objectives. Ensure test items match the behaviors described in each objective. Create rubrics to guide learners'.

Multiple Choice Entry Skills Test

Instructions: Select the best answer for each question.

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1. Which of the following file types is considered vector art?

A. JPEG
B. PNG
C. SVG *(correct answer)*
D. GIF

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2. What keyboard shortcut commonly allows you to "undo" your last action on a computer?

A. Ctrl + C
B. Ctrl + Z *(correct answer)*
C. Ctrl + Alt + Delete
D. Ctrl + P

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3. What is the proper procedure for removing a thumb drive?

A. Pull it out of the computer
B. Select “Eject” from the File Explorer then remove the drive *(correct answer)*
C. Push the eject button on the keyboard
D. Use the cloud

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4. What best describes raster art?

A. Scalable without quality loss
B. Composed of pixels *(correct answer)*
C. Primarily mathematical paths and shapes
D. Always small file size

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5. Which action is used to import a file into most software programs?

A. File > Export
B. File > Save
C. File > Import *(correct answer)*
D. Edit > Paste

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5. If you have an imperial measurement of 12 inches, what is the equivalent length in centimeters (cm)?

A. 12 cm
B. 24 cm
C. 30.48 cm *(correct answer)*
D. 48 cm

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6. Vector art is primarily composed of:

A. Pixels
B. Paths and nodes *(correct answer)*
C. Shaded pixels
D. Photos and scanned images

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6. Which of the following file formats would most likely lose quality when scaled up significantly?

A. DXF
B. SVG
C. AI
D. JPG *(correct answer)*

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7. What shortcut is typically used to copy text or objects on most computer systems?

A. Ctrl + C *(correct answer)*
B. Ctrl + V
C. Ctrl + Z

D. Ctrl + S

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7. How many millimeters (mm) are in one inch?

A. 10 mm
B. 25.4 mm *(correct answer)*
C. 30 mm
D. 2.54 mm

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8. Vector images primarily consist of:

A. Pixels
B. Color gradients
C. Mathematical paths *(correct answer)*
D. Raster grids

Answer Key: 1-C, 2-C, 3-B, 4-D, 5-C, 6-D, 7-B

Pretest: General Laser Cutting Knowledge

Instructions: Select the best answer for each question.

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1. What is the primary function of a laser cutter?

A. Melting metal for welding
B. Cutting and engraving materials using a focused laser beam *(correct answer)*
C. Printing designs onto paper
D. Mixing chemical solutions

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2. Which of the following materials is unsafe to cut with a laser cutter due to toxic fumes?

A. Acrylic
B. Plywood

C. PVC *(correct answer)*
D. Cardboard

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3. What safety precaution should always be taken before starting a laser cutting job?

A. Ensuring the ventilation system is on *(correct answer)*
B. Leaving the machine unattended to work faster
C. Using higher power settings for efficiency
D. Holding the material by hand during the cut

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4. What happens if the laser focus is not properly calibrated?

A. The laser cutter will shut down automatically
B. The cutting and engraving results may be blurry or incomplete *(correct answer)*
C. The material will always burn completely through
D. The laser will become stronger

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5. What is the emergency stop button used for?

A. Increasing laser power
B. Resetting the machine after a job
C. Immediately stopping all machine functions for safety *(correct answer)*
D. Pausing the job for adjustments

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6. Why should you avoid stacking multiple layers of material when cutting?

A. The laser will cut through all layers cleanly
B. It may cause inconsistent cuts and fire hazards *(correct answer)*
C. It helps speed up the cutting process
D. It ensures higher precision in engraving

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7. What type of file is best for vector cutting in LightBurn?

A. JPEG
B. PNG
C. SVG *(correct answer)*
D. BMP

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8. What should you do if a fire starts inside the laser cutter?

A. Open the lid to blow it out
B. Turn off the machine and use a fire extinguisher if needed *(correct answer)*
C. Increase the air assist to put it out
D. Continue the job and hope it burns out

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9. Why is it important to remove leftover debris after cutting?

A. It improves ventilation efficiency
B. Debris can catch fire if left in the machine *(correct answer)*
C. It helps future jobs run faster
D. It makes the machine look clean for the next user

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10. What is the purpose of air assist in a laser cutter?

A. To cool down the laser tube
B. To blow debris away and prevent flare-ups *(correct answer)*
C. To increase laser power
D. To enhance engraving detail

Answer Key: 1-B, 2-C, 3-A, 4-B, 5-C, 6-B, 7-C, 8-B, 9-B, 10-B

Module 3 Test: File Types and LightBurn Settings

Instructions: Select the best answer for each question.

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1. Which file type is NOT commonly used for laser cutting?

A. SVG
B. AI
C. BMP *(correct answer)*
D. DXF

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2. What is the difference between vector and raster graphics?

A. Vector graphics use pixels, raster graphics use paths
B. Raster graphics use pixels, vector graphics use paths *(correct answer)*
C. Both are the same and can be used interchangeably
D. Vector graphics are only for photographs

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3. Which of the following is a correct power and speed setting guideline?

A. Higher power and slower speed for deep cuts *(correct answer)*
B. Higher power and higher speed for deep cuts
C. Lower power and lower speed for deep cuts
D. Speed and power settings don't affect depth

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4. What is the purpose of layer colors in LightBurn?

A. To visually separate designs
B. To assign different cutting and engraving operations *(correct answer)*
C. To make the design more colorful
D. They have no function in laser cutting

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5. Which LightBurn tool helps ensure the design fits within the work area?

A. Arrange Tool
B. Framing Tool *(correct answer)*
C. Fill Tool
D. Align Tool

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6. What does increasing the number of passes in LightBurn do?

A. Reduces laser power
B. Increases cutting depth *(correct answer)*
C. Makes engraving less visible
D. Decreases speed

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7. What is the best way to avoid overheating and warping when laser cutting?

A. Cut the job in one single pass with high power
B. Use multiple light passes with moderate power *(correct answer)*
C. Cut as fast as possible
D. Reduce air assist completely

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8. What is a common issue when using JPEG images in LightBurn?

A. They are not scalable without losing quality *(correct answer)*
B. They always engrave with high detail
C. They work the same as vector images
D. They are preferred for cutting operations

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9. How does the "Fill" mode in LightBurn affect engraving?

A. It creates vector outlines
B. It fills engraved areas with a pattern *(correct answer)*
C. It increases cutting speed
D. It prevents engraving altogether

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10. When importing a DXF file into LightBurn, what is a common issue that may need correction?

A. File size reduction
B. Missing text layers
C. Double overlapping lines *(correct answer)*
D. Converting it to raster

Answer Key: 1-C, 2-B, 3-A, 4-B, 5-B, 6-B, 7-B, 8-A, 9-B, 10-C

Grading Criteria for the final project:

- Correct file preparation and setup.
- Successful execution of cutting/engraving.
- Adherence to safety and cleanup procedures.
- Quality of the final product.

Step 6: Develop Instructional Strategy

Learning Components

Hint: Use information from Steps 1-3 to define an effective instructional strategy.

What you will include here:

- Descriptions of preinstructional activities
- Descriptions of presentation of information
- Descriptions of learner participation
- Descriptions of assessment
- Descriptions of follow-through activities.

📌 Use tables to organize your instructional strategy. Tables 8.9 to 8.12 in chapter 8 provide excellent examples.

Learning Components	Considerations for Each Component	Instructional Strategy
Preinstructional Activities		
Presentation Activities		
Learner Participation		
Assessment		
Follow-Through		

Step 7: Develop & Select Instructional Materials

Instructional Materials

Hint: Develop materials based on your instructional strategy. Refer to Chapter 10 for guidance.

The types of materials I plan to create are a canvas shell, 6 modules, video walk throughs, illustrations, and a wiki to allow the users to build a knowledge base. The types of materials I create are aligned with the instructional goal and will represent the information in multiple formats for accessibility.

Storyboard

Module 1: Introduction to Laser Cutting

Learning Objective: Students will describe the purpose and capabilities of the BOSS LS-2440 laser cutter.
Content: Overview of laser cutting vs. other fabrication methods.
Applications of laser cutting (engraving, cutting, marking).
Instructional Materials:
Infographic: "How a Laser Cutter Works"
Video: Introduction to Laser Cutting Technology
Assessment:
Pretest (multiple-choice) on general laser cutting knowledge.

Module 2: Machine Components and Safety

Learning Objective: Students will accurately identify machine components and safety features.
Content: Interactive diagram of the BOSS LS-2440.
Safety procedures and emergency stop functions.
Instructional Materials:
Video tutorial: "Safety First – Operating the BOSS LS-2440"
Infographic: "Laser Cutter Safety Checklist"
Activities:
Drag-and-drop labeling activity for machine parts.
Assessment:
Quiz: Identify key machine components and safety features.

Module 3: File Preparation in LightBurn

Learning Objective: Students will set up a project in LightBurn and differentiate between raster and vector graphics.
Content: Importing and preparing vector and raster files.
Assigning layers for cutting, engraving, and marking.
Instructional Materials:
Video tutorial: "LightBurn Basics: Importing and Setting Up a File"
Infographic: "Raster vs. Vector – What's the Difference?"
Activities:
Hands-on LightBurn exercise: Import a file and set up a job.
Assessment:
Multiple-choice quiz on file types and LightBurn settings.

Module 4: Operating the BOSS LS-2440

Learning Objective: Students will perform proper startup and shutdown procedures.
Content: Step-by-step guide for powering on/off the machine.
Laser focus calibration and material alignment.
Instructional Materials:
Video demo: "Startup and Shutdown Procedures"
Infographic: "Laser Cutter Calibration Guide"
Activities:
Practice of startup/shutdown.
Assessment:
Practical test: Instructor observes startup and shutdown procedures.

Module 5: Running a Cutting & Engraving Job

Learning Objective: Students will execute a laser cutting and engraving job with correct power and speed settings.
Content: Adjusting laser power, speed, and passes for different materials.
Using framing tools to ensure proper alignment.
Instructional Materials:
Video tutorial: "Optimizing Laser Settings for Different Materials"
Infographic: "Material Reference Chart for Laser Cutting"
Activities:
Practice exercise: Test different settings on wood and acrylic.
Assessment:
Hands-on test: Cut and engrave a design following provided specifications.

Module 6: Post-Processing and Maintenance

Learning Objective: Students will safely remove materials and clean the machine after use.
Content: Proper removal techniques to avoid damaging finished products.
Cleaning and maintaining the laser cutter for longevity.
Instructional Materials:
Infographic: "How to Clean and Maintain Your Laser Cutter"
Video tutorial: "Post-Processing Tips for Laser Cutting"
Activities:
Checklist activity: Ensure all maintenance steps are completed.
Assessment:
Final Performance Evaluation:
Execute a complete job (from setup to shutdown).
Evaluate final product quality against a checklist.

Final Project: Independent Laser Cutting Project

Objective: Students apply all learned skills to create a final project.
Requirements:
Design, prepare, and execute a custom laser-cut/engraved project.
Submit a brief process summary explaining their settings and decisions.
Grading Criteria:
Correct file preparation and setup.
Successful execution of cutting/engraving.
Adherence to safety and cleanup procedures.
Quality of the final product.

- **Stop here for your Design and Storyboard**

Step 8: Formative Evaluation and Revision

Implement and evaluate materials

Hint: Follow formative evaluation phases:

1. **One-to-one evaluation** – Test with individuals from the target group.
2. **Small-group evaluation** – Conduct a trial with a small group from the target population.
3. **Field trial** – Test on the intended learning environment.
4. **Summarize and analyze data** from one-to-one trials, small-group trials, and field trials.
5. **Revise instructional materials and procedures** using learner-based data tables that indicate areas of strength and problems in the materials or procedures.

Evaluation Methods & Materials

I conducted the one-on-one evaluation with my wife and she provided some very prescient feedback on the format of my current design.

Small-group and field-trial will be conducted by email using the pre-test and post-test.

Data Collected

The first comment was to make the formatting of each module consistent. The use of emojis on many of the head levels was distracting and looked messy. It was suggested that I create module overview pages and link the landing page to those instead of the modules—if the learner wants to view the modules, they can use the Module navigation provided by Canvas.

Revisions

I deleted most of the emojis from the Heads, but I left a few in as visual cues for important warnings. I created module overview pages and restated the module objectives from the landing page for each module.

- **Stop here for your Formative Evaluation & Revision**

Step 9: Summative Evaluation

Expert Judgment Phase Only

Summative evaluation has two stages: expert judgment and impact analysis. **Hint:** Complete the **expert judgment phase**, rather than the impact phase.

The main purpose of a summative evaluation is to figure out whether the instruction actually worked—did it do what it was supposed to do, and was it worth the time and resources? It's not about tweaking things mid-course (that's formative); it's about stepping back at the end and asking big-picture questions: Did learners meet the goals? Did the instruction have a measurable impact? Would we recommend it—or change it—based on real evidence? Summative evaluation helps justify decisions (keep, revise, toss) and gives stakeholders the kind of results they actually care about—especially when there's budget, scale, or policy on the line.

I'm still waiting to get results from my Expert Judgment evaluation, but I created a fairly simple instrument to ask the main questions of my evaluator. They were all-open ended questions:

1. Please provide feedback on your experience with the course.
2. Was there anything you found confusing or difficult to follow?
3. Do you feel the information was sufficiently presented in different formats for the learners?
4. Did you catch any mistakes? Please enumerate them here.
5. Any suggestions for improving this training module?

There are some recommendations that I came up with to improve the course: I need more video walkthroughs for sub-processes. I created one for focusing the laser and for the startup procedure, but the final module needs more video walkthroughs—positioning the material and running the whole job. I can get around to that during the summer.

- **Stop here for your Summative Evaluation**

Final Project

Final Reflection & Project URL

Hint: Reflect on your experience following the Dick and Carey Model throughout your instructional design project.

Designing this Canvas course using the Dick and Carey model gave me structure—but also exposed how messy real-life instructional design can be. Breaking everything down into discrete steps made the whole process feel less overwhelming; I always had a clear "next move." That said, translating a studio-based, hands-on subject into clean modules with measurable objectives wasn't easy. One challenge I ran into early was making sure my performance objectives actually aligned with what learners would do—not just what they'd vaguely "understand." I kept catching myself writing outcomes that were too soft or too broad.

To fix that, I leaned back into the model—especially the steps on instructional analysis and performance objectives—and forced myself to articulate the exact observable skills each module needed to deliver. Another challenge: the evaluation piece. It's tempting to skip ahead and just

build the course, but forcing myself to draft pretests and formative checks made the content stronger. It revealed gaps I hadn't noticed.

I really like the explicit nature of the Dick and Carey model—while I can map the steps from ADDIE to the steps from Dick and Carey, having the explicit instructions laid out in the steps themselves is quite helpful. I think I was able to remember the Dick and Carey steps more clearly than the ADDIE steps even without the helpful mnemonic. (Sometimes I find myself thinking through the ADDIE mnemonic in order to describe Dick and Carey.)

Honestly, the biggest shift was letting go of perfection early on—using the model iteratively, revising as I went, and trusting that the structure would hold.

I still have some summative evaluation to finish this summer as I've already imported this course into the University's Canvas system and am presenting it to the ID team there to get feedback for more revisions. Because I've been a graphic designer for my entire adult life, the concept of "never being done" is not new to me. I'll continue to refine this job aid as new technology emerges and as feedback is received.

The link to my final project is a Canvas course that you must sign up for. You can visit an HTML facsimile of the course as well.