CALIFORNIA STATE UNIVERSITY
MONTEREY BAY

The Monterey Bay Aquarium Innovation Lab's
Vinyl Cutter "Level 1 Badge" Course

CAPSTONE PROPOSAL

Submitted in partial satisfaction of requirements of the degree of

MASTER OF SCIENCE in

Instructional Science and Technology

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Capstone Approvals: (At least one advisor and capstone instructor should approve)

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Abstract

The efforts of this capstone project culminated in creation of the "Level 1 Badge" vinyl cutter course for the Monterey Bay Aquarium's (MBA) Innovation Lab. Acquisition of the vinyl cutter "Level 1 Badge" prepares the learner to engage with the vinyl cutter and associated software safely and effectively, and certifies the learner for vinyl cutter use in the Lab under supervision. The Aquarium education team's goal to create eLearning products for all Innovation Lab tools is supported by this project.

Learning objectives for this course aimed at 11- to 65-year-old Innovation Lab participants are both declarative and procedural. The course is designed to meet the needs of learners from a variety of backgrounds with varying experience levels.

Behaviorist and cognitivist learning theory tenets provided the foundation for much of this safety course's structure, which is framed around the cognitivist instructional theory, Gagne's Nine Events of Instruction. Stolovitch and Keeps' (2011) "5-Step Model for Structuring Training" informed the agenda, and social learning theory tenets served to maximize safe and effective learning outcomes.

The course aims to prepare Innovation Lab participants to engage with the vinyl cutter tool in a constructivist fashion, aligning with the Innovation Lab's guiding philosophy of Liberatory Design. Tenets of constructivism were consciously integrated. Reasonable incorporation of Liberatory Design into the course to facilitate its implementation by learners was an area of interest for this capstone project.

Visual and auditory online course design choices were guided by the multimedia principles of eLearning. The goals of facilitating generative and essential processing, while minimizing extraneous attention-diversion, informed design decisions (Clark & Mayer, 2016).

Course evaluation and capstone support were provided by the subject matter experts (SMEs) – Education Programs Director Katy Scott and Senior Education Specialist Luis David Calderon, and by my Master's in Instructional Science and Technology (MIST) capstone advisor, Dr. Sarah Evanick. Course pilot testing conducted with Innovation Lab program assistants and volunteer distance learners in the Summer 2023 term guided optimization of a three-module prototype and informed further course development. Summative evaluation of the entire 11-module course, completed by Monterey Bay Aquarium employees and a distance learner in the Fall 2023 semester, supported course finalization.

Introduction

Background and Problem Statement

The Innovation Lab is a maker space within the Monterey Bay Aquarium's (MBA) Bechtel Family Center for Ocean Education and Leadership (Monterey Bay Aquarium, 2022a). Their projects grant young people opportunities to engage in discovery learning, building a sense of their power to positively impact the world and combat climate change. The center additionally engages in outreach efforts that empower classroom teachers to confidently address climate education.

The Innovation Lab houses many tools including 3D printers, a vinyl cutter, sewing machines, a laser cutter, hand tools, and a heat press. To use them with supervision, participants must obtain a "Level 1 Badge," signifying completion of safe and effective use training. Prior to the COVID-19 pandemic, all training was completed in-person. Since the advent of the pandemic online instruction has been made for some tools, but the majority still require creation. The efforts of this capstone focused on creation of the vinyl cutter's "Level 1 Badge" course.

Target Audience and Context

The target audience is 11- to 65-year-old Innovation Lab participants. The Lab consistently hosts school field trips, summer programs, and teacher training programs. The age range is wide, and participants come from a variety of backgrounds. Prior knowledge of tools is not assumed. Training materials aim to meet the needs of novices and instruct to the lowest level of understanding.

Rationale for the Project

The Monterey Bay Aquarium's Innovation Lab officially opened its doors in 2019. In 2020, the COVID-19 pandemic necessitated a rapid shift to online learning. Rising to the challenge, the education team swiftly identified the learning management system (LMS) Thinkific to house online courses and set about creating necessary materials. As a result of those efforts some tools, such as the 3D printer, have "Level 1 Badge" eLearning training available. Others, like the vinyl cutter, had only very basic instructional materials at the outset of this project.

While all training was initially synchronous, the Innovation Lab's education team wished to capitalize on technology's capacity to deliver the initial portions of tool training either synchronously in-person or asynchronously online. As Stolovitch and Keeps (2011) assert, this allows more people in more places to access training in whatever timeframe works best for them, and however often they feel is necessary. While many learners will have the opportunity to complete training remotely, it is anticipated that most training in the immediate future will entail in-person, synchronous completion of online coursework. This will facilitate the provision of the support novice learners may require. Virtual coursework aims to maximize the efficiency of in-person training, significantly reducing time and personnel resource utilization in the Innovation Lab.

Before capstone efforts began, the skeleton of basic "vinyl cutter use" training existed in the form of two Google Docs and a Google Forms seven-question assessment quiz. One Google Doc was a simple introduction that included images, text, and a link to the GS-24 vinyl cutter user's manual (Roland DG Corporation, 2015). The other was a procedural checklist for final vinyl cutter skill demonstration. These existing materials were used as references, and relevant elements were integrated into the final deliverables.

Statement of the Learning Objectives

Identification of objectives is an essential initial step when designing instruction, providing a reference map and streamlining efforts. The goal of this training is to prepare Innovation Lab participants to use the vinyl cutter safely and effectively with supervision. Declarative objectives for this course include:

1) Given access to a visual job aid, Innovation Lab participants will be able to identify and state the purposes of the GS-24 vinyl cutter's major parts with 100% accuracy.

2) Given a job aid, Innovation Lab participants will be able to identify the main purposes for which the GS-24 vinyl cutter can be used with 100% accuracy.

3) Given access to a job aid, Innovation Lab participants will be able to identify appropriate materials to use with the vinyl cutter with 100% accuracy.

4) From memory, Innovation Lab participants will be able to accurately identify basic safety guidelines with 100% accuracy on presented test questions.

Procedural objectives for this course include:

1) Given access to a job aid, Innovation Lab participants will be able to download and import one of several pre-selected vector file designs compatible with the GS-24 vinyl cutter into Adobe Illustrator without receiving an error notification.

2) Given access to a performance guide, Innovation Lab participants will be to prepare a file for cutting in Adobe Illustrator, including resizing the image and modifying the "fill" and "stroke."

3) Given access to a job aid, Innovation Lab participants will be able to send design data to CutStudio software without receiving an "error" notification.

4) Given access to a job aid, Innovation Lab participants will be able to load and secure a piece of vinyl into the correct position in the vinyl cutter based on the material's width without error notification or injury.

5) From memory, Innovation Lab participants will be able to turn the vinyl cutter on and off.

6) Given access to a performance guide, Innovation Lab participants will be able to perform the steps that direct the GS-24 vinyl cutter to cut a design, resulting in successful sticker creation.

7) Given access to a performance guide, Innovation Lab participants will be able to perform the steps that create a transferable sticker that they can then transfer to a surface.

8) Given access to a performance guide and the GS-24 vinyl cutter user's manual, Innovation Lab participants will be able to identify where to find answers to questions that arise.

Literature Review

Liberatory Design and Design Thinking

Liberatory Design (LD) is the Innovation Lab's guiding design theory. As the Aquarium's team states, "we've integrated maker education with environmental education in an equity-centered process" (Monterey Bay Aquarium, 2022b, para. 22).

Liberatory Design was inspired by Stanford University d.school's design thinking (DT). Developed in the early 1940s and 1950s by John E. Arnold within the Stanford Joint Program in Design, DT gained popularity in the mid-2000s (Auernhammer & Roth, 2021). Flexible and human-centered, it aims to support practitioners in creatively building concrete, empathetic solutions.

The novel approach of Liberatory Design combines DT with deep empathy and complex design theory. Its first prototypes were presented in 2017 with the stated goal of flexibly tackling complex challenges with equity (Robalewski, 2021; National Equity Project, n.d.). Nonlinear, iterative stages called "modes" comprise its framework: empathize, define, inquire, imagine, prototype, try, see the system, notice, and reflect. The goal of slowing the pace of human-centered DT was the impetus for the addition of the "notice" and "reflect" modes. As LD co-founder David Clifford states, "Design thinking is good in that it is human-centered, but it favors the dominant culture. Liberatory Design has all the components of design thinking but is asking you to slow way down and really privilege relationships…and building that relational trust" (Getting Smart Podcast, 2022). LD's overarching framework asks its practitioners to see the problem, engage with stakeholders to create meaning, and take actions from which they intend to learn (National Equity Project, n.d.).

The vinyl cutter "Level 1 Badge" course supports the Innovation Lab's goals to facilitate LD thinking in its participants. While most of the safety coursework is delivered in alignment with behaviorist and cognitivist tenets by virtue of the objectivist nature of content, the coursework design aims to inspire equitable problem-solving. Attaining the vinyl cutter "Level 1 Badge" via course completion sets the groundwork for Liberatory Design problem-solving to commence.

While the primary goal of this course is to facilitate efficient and effective understanding of the foundational components that support vinyl cutter product creation, incorporation of Liberatory Design into the training was an area of interest for this capstone project. A large vinyl-cut wall decal of the Liberatory Design flower petal design is on prominent display in the Innovation Lab. This image was incorporated into stills and videos, and is directly highlighted as an example of a product the vinyl cutter can create. In the final "Additional Resources and Next Steps" module, the learner is provided with a link to the Liberatory Design website, as well as access to a course on Liberatory Design, which was created for a research project in the Spring 2023 semester (see Appendix J). Given the Aquarium education team's plan to develop a stand-alone course on Liberatory Design's application in the Innovation Lab, it was determined in coordination with SMEs that integration of these LD elements met intended goals, introducing relevant concepts and not detracting from streamlined delivery of content specific to the vinyl cutter.

Review of Relevant Literature/Design Thinking Application

As the Monterey Bay Aquarium's Education Programs Director Katy Scott asserts, the Innovation Lab supports participants in building not only physical solutions, but "their own identities as people who can make change in the world" (MBA, 2022b, para 8). The adoption of Liberatory Design as the Lab's leading framework merges "equity and STEM together in a single framework that includes a process for defining and solving complex problems – as well as mindsets" (MBA, 2022b, para. 20).

Given limited research accompanying LD's recent inception, a review of proposed and actual DT implementation was undertaken. Multiple examples provide compelling evidence for its continued use. One DT program, Ignite – a Duke undergraduate program created to address

the 2015 Sustainable Development Goals – required students to work within a community's cultural and geopolitical position to create night light access solutions (Mueller et al., 2020). Altman et al. (2018) conducted a systematic literature review that identified examples of DT implementation in medicine; evaluation of 19 successful studies, 11 with mixed results, and one that was unsuccessful, revealed that successful DT can result in both simple physical and technology-intensive interventions in healthcare. Design school students in Indonesia utilized the DT model to facilitate creation of a characteristic woven pattern for the village of Troso and called on DT tenets to support the identification of alternative uses for unused jeans materials, illustrating versatile application of this philosophy (Caroline et al., 2021; Fajarwati et al., 2021).

Proposed Applications of Design Thinking

Researchers in multiple domains recognize the potential for DT to benefit their fields. Earle et al. (2021) proposes that the iterative cycling DT process might be implemented in virtual reality scenarios to prepare business students for the challenge of addressing sustainability. As the field of classical mechanics transitions to mechatronic and cyber-physical systems, Tekaat et al. (2021), assert that the user-centered DT structure – supported by the growth of model-based systems engineering – can support empathetic, creative problem-solving. Moganakrishnann et al. (2018) also advocate for DT – within the framework of Liberatory Design – to support sustainable development engineering, arguing that an empathetic stance facilitates critical questioning of assumed power structures. Rois et al. (2020) propose that the waste management system in the city of Depok might benefit from application of the five-stage DT approach. The areas in which DT might prove effective are many and varied.

An Example of Liberatory Design in Action

Its creators encourage Liberatory Design's application in a variety of scenarios – when designing a class or unit, addressing inclusion or attendance challenges, or when seeking to spur organizational culture change (Getting Smart Podcast, 2022). While in its infancy beside its DT predecessor, one of LD's co-founders, David Clifford, relays an example of its recent application. When asked by the Stanford d.school to work with a school district in Israel, David jumped at the opportunity (TEDx Talks, 2019). With the problem-solving framework of LD identified, David and the school's principal Ben engaged in "many equity pauses to practice self-awareness and build relational trust." (TEDx Talks, 2019) Shadowing leaders and conducting classroom observations allowed David to build empathy. Eventually the "juicy question" was identified: "How might we engage unmotivated and disengaged students?" (TEDx Talks, 2019)

Acting on the identified goal, administration invited students "into the design process and kept them there" (TEDx Talks, 2019). Students shadowed teachers and teachers shadowed students. They then worked together to "design and build prototypes, approaching issues of engagement they both faced in school" (TEDx Talks, 2019). Months in, one student reported that, "Shadowing my teacher gave me a deeper understanding of the emotional price of being a teacher." Another student stated, "I felt seen and heard. And I wish all students got to experience this" (TEDx Talks, 2019). While David reports that the school's issues are not all resolved, "The door to creative possibilities has been opened and has not been shut yet. So, there's hope" (TEDx Talks, 2019). As asserted by LD co-founder Tania Anaissie, Liberatory Design allows its practitioners to "translate our equity values into action" (Jennifer Hennesy, 2021). Its implementation empowered David, Ben, and their team to cultivate a cultural shift.

Implications, Future Research, and Relevance to Capstone

Future research is required to explore the sustainability of DT and LD frameworks in the various companies, schools, and entities that strive to conscientiously implement them. To support their continued use, further randomized, controlled studies ought to quantitatively demonstrate their utility.

This capstone project's safe and effective vinyl cutter "Level 1 Badge" course aims to prepare its students to engage with this Innovation Lab tool with a mindset primed to address problems with empathy and equity. While comprehensive evaluation of the efficacy of Liberatory Design exceeds the limits of this straightforward design, reasonable LD integration into this capstone course was supported via collaboration with Education Programs Director Katy Scott and Senior Education Specialist Luis David Calderon. Broader evaluation of the effectiveness of conveying Liberatory Design principles in the Innovation Lab might be gathered in the months and years that follow the creation and implementation of training for all tools in the Innovation Lab, along with eventual implementation of a course that directly addresses LD application in the Lab, which SME Katy Scott communicated in a March 2023 meeting is intended for creation by the MBA's STEM Integration manager, Athena Barrios. The vinyl cutter "Level 1 Badge" course's inclusion of a Rise 360 course on LD (see Appendix J) and its integration of images and allusions to this design philosophy, along with a thought-provoking challenge to the learner in the final "Additional Resources and Next Steps" module, aim to introduce basic concepts to the learner within the context of this safety and effective use course.

Solution Description/Media and Delivery System Decisions

Delivery Format

Most of the vinyl cutter "Level 1 Badge" instructional content falls into the category of directive training (Stolovitch & Keeps, 2011). Clear performance objectives are matched with

test items, and learners are guided to engage in meaningful activities "as they progress along predetermined paths" (Stolovitch & Keeps, 2011, p. 122 – 125). As a major component of this training is safety assurance, learner self-direction is curtailed. Successfully obtaining a "Level 1 Badge" sets learners up to later engage in guided discovery learning, implementing the skills they gain in this course to take on self-identified challenges.

The Monterey Bay Aquarium utilizes the LMS Thinkific. This LMS's standalone course-building space integrates well with multiple software and offers 24/7 support (Raounda, 2022). Multiple media formats can be integrated, navigation is straightforward, and visual design is unobtrusive.

The bulk of this capstone course was built with Articulate's eLearning authoring tool Storyline 360. Please see Appendix I for module image examples. The use of this software was approved by SMEs prior to implementation. Most modules are built around a central educational video. All videos, with the exception of one, were shot in the Innovation Lab and were edited primarily with Adobe Premiere Pro. Camtasia and OBS Studio video editing software were utilized to capture screencast videos. A "Basic Vinyl Cutting" website job aid was created with Adobe Dreamweaver and integrated into the eighth module ("Cut Your Sticker").

Depending on student hardware availability, software access, and schedule constraints, the online modules may be completed asynchronously at home or synchronously in the Innovation Lab. Final hands-on instruction, assessment of procedural understanding, and ultimate "Level 1 Badge" sign-off must take place synchronously in the Innovation Lab under the supervision of certified personnel. This blended approach aims to maximize each student's ability to access and retain information while also providing the essential concrete experiences that culminate in learning transfer.

Media

Media includes video instruction, review slides, interactive understanding check-ins, online references and job aids, and audio instruction that prepare the user for in-person training and sign-off. Carefully scripted directions provide step-by-step guidance within the context of example projects, as most of the work is procedural. Slides and videos incorporate deliberately selected visuals that include only relevant information. As Clark and Mayer (2018) advise, "especially for novice learners, removing non-essential details from visual representations may be advisable" (p. 263). Videos, job aids, main points, and video scripts are made available throughout, and are consolidated for efficient reference in the "What to Do When You Have Questions" module.

SMEs Katy Scott and Luis David Calderon facilitated access to professional videography tools and the Innovation Lab. Existing videos for tools like the Innovation Lab's 3D printer are simple, but effective. These video templates, existing training, and feedback from the MBA team supported optimization of scripts and production of instructional videos. Initial Innovation Lab vinyl cutter course filming was completed on the 14th, 16th, 18th, and 20th of April 2023, culminating in production of three videos: "Vinyl Cutter Parts and Their Purposes," "Materials You Can Use with the Vinyl Cutter," and "Vinyl Cutter Safety." Fall 2023 semester video shoots were completed in the Innovation Lab on September 19th, 20th, and 21st, and on October 26th. The "Vector Files: The Language of the Vinyl Cutter" video was filmed in a home setting at the outset of the Fall 2023 semester. Storyboards for all videos were reviewed, modified, and approved by SMEs prior to filming. Edited videos were presented to SMEs and received final approval prior to course integration.

Completion of the online capstone course prepares the learner for authentic experiences with Adobe Illustrator and CutStudio software, and the vinyl cutter, optimizing transfer. Final training and sign-off is supported in the Innovation Lab by supervisors.

Instructional Strategies and Activities

Agenda Explanation

The agenda of this course is informed by the intention to maintain triangulated alignment among objectives, learning activities, and assessments. Iterative analyses within "an intentional learning environment" (Dempsey & Van Eck, 2018, p. 230) support alignment.

Recognizing the limits of short-term memory, information is presented in small chunks with frequent engagement check-ins (Stolovitch & Keeps, 2011). It is understood that, without preexisting knowledge, about four chunks of information can be held in short-term memory. If this data goes untreated, it disappears within 10-15 seconds (Stolovitch & Keeps, 2011). Recognizing this, the behavioral concept of programmed learning is incorporated – small steps are followed by simple testing before students move on to subsequent sections. Confirming or correcting feedback is provided after each miniature assessment. The opportunity to retry is provided directly after a question is missed. This is done to increase engagement and motivation through success (Bonaiuti, 2011). The timing of course completion is student-directed, allowing for pause and review of previous materials. Students are empowered to curate their own learning experience.

The mantra Stolovitch and Keeps (2011) recommend guides the design of this course: it aims to be *learner-centered* and *performance-based*. The learner's performance is elicited via frequent understanding check-in questions, preparing the learner for design modification with associated software, and hands-on vinyl cutter use.

Agenda

1. Introduction and Objectives (2 min): Introduce the vinyl cutter tool within the context of attention-grabbing examples of products it can make. Let the learner know what to expect from the course via provision of declarative and procedural learning objectives.

2. Vinyl Cutter Parts and Their Purposes (8 min): Educate students about each of the individual vinyl cutter parts and the purposes of those parts.

3. Materials You Can Use with the Vinyl Cutter (6 min): Educate students on what materials are appropriate and not appropriate to cut with the vinyl cutter.

4. Vinyl Cutter Safety (6 min): Educate students on important vinyl cutter safety protocols.

5. Vector Files: The Language of the Vinyl Cutter (5 min): Introduce students to the concept of a vector file. Provide education on why this type of file is needed to make vinyl cutter products.

6. Choose a Vector File (3 min): Provide students with a curated folder of Aquarium-style vector files and guide them through selection of a file.

7. Prepare Your File (10 min): Provide step-by-step instructions on how to prepare an image file for vinyl cutting with Adobe Illustrator and CutStudio software.

8. Cut Your Sticker (10 min): Educate students on how to set up for and direct a simple vinyl cutting project.

9. Transfer Your Sticker (7 min): Educate students on how to create a transferable sticker and how to transfer it to a surface.

10. What to Do When You Have Questions (3 min): Provide access to resources that support the individual student's ability to look up answers to questions, a consolidated repository of course resources for reference, and directions on who to reach out to for support.

11. Additional Resources and Next Steps (3 min): Introduce students to additional resources for next steps if they are interested.

Completion of this 11-module online course prepares Innovation Lab learners to complete an in-person, hands-on final sign-off with a supervisor in possession of a vinyl cutter "Level 4 Badge." A performance checklist created by Innovation Lab staff supports this final "Level 1 Badge" certification.

Teaching/Learning Activities

Introduction and Objectives (2 min): Introduce the vinyl cutter tool within the context of attention-grabbing examples of products it can make. Let the learner know what to expect from the course via provision of declarative and procedural learning objectives.

The introductory module addresses the first and second steps of the "5-Step Model for Structuring Training" that Stolovitch and Keeps (2011) prescribe: *rationale* and *objectives.*

Gaining learner attention is facilitated via presentation of example vinyl cutter products in video format. These examples communicate purposes for which the vinyl cutter may be used and serve as inspiration, providing a reason for course completion.

Clear provision of objectives to learners is known to be beneficial. According to Stolovitch and Keeps (2011), research "demonstrates the value of clarifying to the learners what it is they will be able to do at the end of the…course…The clearer…it is for the learners, the higher the probability they will learn it" (pp. 72 - 79). Having established the rationale for this training, the objectives of the course are provided in slide format and in an online reference sheet. The Innovation Lab participants, upon completion of this course, will be able to direct creation of a vinyl cut sticker, or similar product, with supervision and access to job aids.

The target audience's age ranges from 11-year-old to 65-year-old learners. Learners come from a variety of backgrounds. It is thus important to instruct to the lowest level of understanding. Encouragement alongside clear guidelines aim to speak to audience members from novice to expert. Regardless of experience level, successful completion of training and sign-off is required to use the vinyl cutter within the Innovation Lab.

Vinyl Cutter Parts and Their Purposes (8 min): Educate students about each of the individual vinyl cutter parts and the purposes of those parts.

An introductory slide with voiceover audio begins the module, after which a video familiarizes the learner with the parts of the vinyl cutter and the purposes of those parts. The video is followed by labeled vinyl cutter visual aid slides for the front of the vinyl cutter, the side of the vinyl cutter, and the operation panel. The module culminates in five understanding check-in questions in both drag-and-drop and multiple-choice format, eliciting active engagement and review.

Steps four and five of Stolovitch and Keeps' (2011) "5-Step Model for Structuring Training" are *evaluation* and *feedback*. All instructional modules include understanding check-in questions that serve to verify if understanding has been achieved and to identify gaps that require support. Confirming or correcting feedback immediately follows each question, followed by encouragement to attempt again if the question was answered incorrectly. Within the course, these evaluation and feedback opportunities are labeled "understanding check-ins" rather than "quizzes" or "tests" to mitigate the fear response the latter terms can elicit (Stolovitch & Keeps, 2011). All questions provide the opportunity to retry until 100% accuracy is achieved.

The slide preceding the final references section provides the learner with congratulations for module completion and notifies the learner of the subsequent module's content. The final

references slide includes directions on how to access the resources section. In this module, these online resources include PDFs of the main points and the video script, and access to the GS-24 vinyl cutter user's manual. This format of notifying the learner what to expect next and providing directions on how to access resources is maintained through all modules. Each module's online references section includes access to the GS-24 vinyl cutter user's manual.

All instructional modules include subtitled voiceover on the introductory slide, the video slide, the "Prepare to Review" slide, the "Understanding Check-In Questions Introduction" slide, and the "Completion Congratulations" slide. These verbal directions from a friendly online entity are incorporated to facilitate a sense of connection with the learner, encouraging engagement.

Materials You Can Use with the Vinyl Cutter (6 min): Educate students on what materials are appropriate and not appropriate to use with the vinyl cutter.

After an introductory slide a video presents materials that may appropriately be used with the vinyl cutter. Concise review slides present video content in static format. Three understanding check-in questions follows the review slides. Confirming or correcting feedback follows each question, along with the opportunity to retake incorrectly answered questions until 100% accuracy is achieved. The main points and video script are made available as online PDF reference sheets.

Vinyl Cutter Safety (6 min): Educate students on important vinyl cutter safety protocols.

A slide with voiceover audio introduces the module, after which a video shot in the Innovation Lab provides vinyl cutter safety protocols. Review slides reiterate safety information. The six understanding check-in questions include multiple-choice, drag-and-drop, and hot-spot clickable questions. Confirming or correcting feedback is provided after each question is answered. The questions may be reattempted an unlimited number of times until 100% accuracy

is achieved. The main points and video script are made available as PDF job aids in the "Resources" section.

Vector Files: The Language of the Vinyl Cutter (5 min): Introduce students to the concept of a vector file. Provide education on why this type of file is needed to make vinyl cutter products.

The "Vector Files" module is built around an educational video, which presents vector files as "the language" with which the learner can communicate with the vinyl cutter. The defining qualities and utility of vector file images are presented in contrast to raster file images, with which the learner may be more familiar. Review slides follow the central video, after which learners are presented with three interactive understanding check-in questions that provide tailored confirming or correcting feedback. Main points and video script PDFs are made available as online references.

Choose a Vector File (3 min): Provide students with a curated folder of Aquarium style vector files and guide them through selection of a file.

The adult learning principles of *autonomy* and *action* are incorporated into this module (Stolovitch & Keeps, 2011). All learners are provided with multiple vector file images to select from, incorporating a degree of autonomy. These sample vector files were obtained primarily from Pixabay.com, a site with royalty-free stock media. One of the included vector file images was drawn and vectorized for vinyl cutting as a demonstration of this skill for a final project in the IST 531: "Video and Audio Production" course in the Spring 2023 semester (see Appendix L).

The opportunity to self-select from near unlimited options is curtailed in this "Level 1 Badge" course. Per discussion with SMEs, it was deemed appropriate to await a higher badge

level training to introduce instruction on how to search for and identify vector files online and how to vectorize a self-drawn image for vinyl cutting.

Beyond interactive understanding check-in questions, this module integrates the adult learning principle of *action* in novel fashion by eliciting user self-selection. The admonition of Stolovitch and Keeps (2011) to "Above all, keep…training active" (p. 126) is honored.

Prepare Your File (10 min): Provide step-by-step instructions on how to prepare an image file for vinyl cutting with Adobe Illustrator and CutStudio software.

The third step of Stolovitch and Keeps' (2011) "5-Step Model for Structuring Training" is *activities*. Preparation for hands-on procedural engagement with software is provided via simple step-by-step guidance on how to upload a chosen file to Adobe Illustrator, make necessary image adjustments in Adobe Illustrator, send the prepared file to CutStudio, and set up for cutting in CutStudio. Four short screencast videos on each of these steps provide instruction within the context of an example project. This chunking of information is done to facilitate generative processing while preventing cognitive overload. Concise review slides follow the videos. Eight interactive understanding check-in questions in multiple choice and hot-spot-clickable format follow the review slides. Instructions are consolidated into a simplified online job aid, accessible through one of the slides. This job aid is also made available, along with video scripts, in the "Resources" section.

Directions on how to resize an image are included in the "Adobe Illustrator Adjustments" steps. In a March 2023 meeting, SME and Senior Education Specialist Luis David Calderon communicated the importance of this instruction's inclusion to facilitate conscientious preservation of materials. Encouragement to use resources wisely and prevent waste is

incorporated throughout the course. The guidance to resize designs supports making use of materials that might otherwise be discarded.

Cut Your Sticker (10 min): Educate students on how to set up for and direct a simple vinyl cutting project.

The introductory voiceover slide welcomes the learner to the module, after which the central scripted video demonstrates the steps to follow when setting up and cutting a simple sticker with the vinyl cutter within the context of an example project. Review slides follow the video, breaking the task down into nine steps. Eight interactive understanding check-in questions in multiple choice and hot-spot clickable format elicit active learner engagement. Access to an online PDF job aid is provided on a slide that follows interactive questions. An additional Dreamweaver-created, interactive online job aid is linked to the course and made accessible through one of the slides. This "Basic Vinyl Cutting" website breaks the task down into five steps. Interactive questions are integrated into two of the webpages. All job aid resources, as well as the video script and GS-24 vinyl cutter user's manual, are made available in the "Resources" section.

Transfer Your Sticker (7 min): Educate students on how to create a transferable sticker and how to transfer it to a surface.

The module's central video provides step-by-step instruction on how to transfer a sticker to a surface within the context of an example. Review slides break the process down into 11 simple steps. Four interactive understanding check-in questions elicit learner engagement and promote learning transfer. Steps are consolidated into an online job aid, made directly available on one of the slides, and in the "Resources" section along with the video script and GS-24 vinyl cutter user's manual.

What to Do When You Have Questions (3 min): Provide access to resources that support the individual student's ability to look up answers to questions, a consolidated repository of course resources for reference, and directions on who to reach out to for support.

Three of the module's slides link the learner to sections of the Roland GS-24 vinyl cutter user's manual, including the home page, the "What to Do If…" page, and the "Error Message List" page. The learner is encouraged to reach out to Innovation Lab staff members for support while they are in the Lab. It is reviewed with the learner that each individual module provides access to main points, video scripts, and job aids that pertain to each module. The learner is notified that all these resources – videos, video scripts, job aids, and main points – are consolidated for efficient reference in this module. The learner is encouraged to access these supports in the "Resources" section.

Additional Resources and Next Steps (3 min): Introduce students to additional resources for next steps if they are interested.

Continued learning opportunities are reviewed with the learner. These include subsequent badge levels for the vinyl cutter and introductory badge levels for other Innovation Lab tools.

The intention of the Innovation Lab's education team to create a full course on Adobe Illustrator use is shared with the learner. A link to the video on "How to Vectorize an Image for Vinyl Cutting," created with Adobe Premiere Pro and Camtasia video editing software as a final project for IST 531: "Video and Audio Production" in the Spring 2023 semester, is provided as a course teaser (see Appendix L).

Access to resources on the Innovation Lab's leading design philosophy, Liberatory Design – including a link to the official Liberatory Design website and a link to a course created with Rise 360 on this design philosophy (see Appendix J) – are provided.

Congratulations for successful completion of the online portion of the vinyl cutter "Level 1 Badge" training is provided.

Final Sign-Off: The third step of Stolovitch and Keeps' (2011) "5-Step Model for Structuring Training" is *activities*. They assert that learning in authentic environments maximizes transfer.

In the final procedural sign-off participants will complete hands-on activities with certified supervisory personnel. These supervisory personnel will meet learners where they are, review hands-on use instructions, and provide scaffolded support. As Hoadley and Van Haneghan (2018) state, scaffolding can take many forms, including "activity structures [and] larger social structures that support learning" (p. 73). Guidance on vinyl cutter use will be provided by supervisors with the support of a structured performance checklist to assess if the learner has met objectives. Existing instructional materials created by Innovation Lab staff include a performance checklist for the final sign-off.

Learning Theories

As Harasim (2017) asserts, the learning theories of behaviorism, cognitivism, and constructivism work in conjunction, and "ought not to be considered as distinct silos" (p. 10). If applied appropriately, their tenets complement one another in practice. The work of this capstone project is informed, in part, by all three of these theories.

The objectivist theories of behaviorism and cognitivism provide the foundation for the safety and effective use elements of this capstone project. The tenets of constructivism are integrated as relevant into the course design, retaining in mind that the end goal of the course is to prepare students to engage with the vinyl cutter in a constructivist fashion that aligns with the design philosophy of Liberatory Design.

Behaviorism

From a behaviorist perspective, optimal presentation of a stimulus results in a predictable response. Performance standards are explicit and learners are notified of success or failure (Deubel, 2003). To comply with safety standards much of this course is built around this learning theory. Learners are expected to act in accordance with stimulus results, repeating the behaviors that bring success and avoiding those that do not produce desired outcomes.

When high cognitive processing and creativity are demanded, behaviorism's failings are evident, but as Keramida (2015) asserts, this theory's application is pertinent when course objectives are precise and measurable. As this capstone project is concerned with maintaining learner safety when handling a tool, behaviorist learning theory tenets are foundational. Knowledge acquisition is facilitated in the forms of discrimination of machine components and the association of linking desired actions with the positive outcome of effective sticker creation (Keramida, 2015). Applicable understanding and appropriate actions are reinforced, while unsafe choices are explicitly discouraged. Behaviorism on its own is insufficient. The relevance of learners' mental operations and personal backgrounds is unassailable, but this learning theory provides a solid foundation for much of the work of this capstone project.

Cognitivism

The learning theory of cognitivism recognizes the complex processing that takes place between the presentation of a stimulus and the resulting response. Schemata – organized, dynamic memory structures – facilitate efficient navigation of the world. As new information is presented these schemata accommodate modification (Harasim, 2017). Active engagement with authentic tasks encourages the mental process of merging novel information with prior understanding (Deubel, 2003). Learners are encouraged to discover concepts via questioning and evaluation as a coach skillfully scaffolds new information and encourages cooperative learning

(Deubel, 2003). This capstone's work is informed by acknowledgement of the complex mental processes that learners experience between stimulus and response and incorporates tenets that a cognitivist framework espouses, facilitating schema modification via scaffolded support.

As a safety course, the framework is necessarily structured around knowledge transmission from teacher to student in an objectivist, didactic model. Both behaviorist and cognitivist tenets call for the instructor to direct attention, elicit active engagement from the learner, and facilitate feedback within authentic and meaningful experiences (Deubel, 2003). Leaning heavily on these objectivist learning tools, the design of this capstone embraces the mental processing cognitivism recognizes.

Social Learning Theory

Albert Bandura's social learning theory holds that people can learn through observation. Correct modeling of tool operation in the Innovation Lab via video demonstration and still images aims to facilitate learning in this capstone project. As stated by Bandura – who categorized his social learning theory as cognitivist – learning would be not merely arduous, but also dangerous, if physical action were always necessary for acquisition of new knowledge (Cherry, 2022). Visual models of how to safely conduct oneself around the potentially dangerous cutting tool are provided to learners. Physical supervisory models (teachers) will also be present in the Innovation Lab to demonstrate safe behavior.

The vicarious experience of witnessing correct behavior, which can alone instill belief in the learner that they too are capable, is followed by "mastery experiences." Students will assume authentic physical challenges with software and the vinyl cutter, through which they will confirm their competence (Lopez-Garrido, 2023). Social persuasion via positive verbal feedback and encouragement from trainers will further support development of student self-efficacy.

Gagne's Nine Events of Instruction

Influential American psychologist Robert Gagne introduced the Nine Events of Instruction, an instructional theory based on cognitivist learning theory tenets. These nine events inform the framework of this capstone's instructional design.

1) **Gain attention:** For eLearning, LaMotte (n.d.) suggests utilizing an attention-grabbing short video as an effective tool to draw the learner's attention. The introductory module for this course begins with a 37-second video in which multiple visual examples of products the participant can learn to make with the vinyl cutter are highlighted.

2) **Inform students of the objectives:** The introductory module provides students with clearly stated declarative and procedural objectives, framed as "What You Will Know" and "What You Will Know How to Do." These objectives are made available in both slide and online PDF formats.

3) **Stimulate recall of prior learning:** This event guides the learner to create connections, integrating new information with what is already known. To accomplish this, the initial module challenges the learner to think of other creation projects they have undertaken in the past (e.g., drawing a picture, writing a letter, building a sandcastle, etc.), introducing creation of a vinyl cut sticker as another project they are capable of accomplishing. In the vector file module, communicating with the vinyl cutter via vector files is compared to speaking to someone from a foreign country in the language they understand, creating a connection with this already familiar phenomenon. Known tasks (e.g., selecting "File" from a software's menu, raising a lever, selecting a desired image, etc.) are presented within the context of the unfamiliar task of creating a sticker with the vinyl cutter.

4) **Present the stimulus:** The "stimulus" makes up the bulk of the course. In this case, modules 2 – 11 provide information and directions, frequently within the context of example demonstrations. These are presented in video, slide, and interactive question formats. The learner is provided access to job aids, main points, and video scripts for review and reference. As LaMotte (n.d.) advises, multiple formats are utilized to optimize content provision and learner engagement.

5) **Provide learning guidance:** Much of the content is presented within the context of examples. As Clark and Mayer (2016) relate, studies across disciplines demonstrate the effectiveness of worked examples, or step-by-step guidance, especially when the material is novel and when explanations are provided. Review slides and job aids guide learner attention and provide a path for review and reference when needed. In-person Innovation Lab supervisors will support hands-on learning, and eLearning module navigation if needed. As learners communicate their current knowledge level, education personnel in the Lab will be able to tailor their scaffolded approach, introducing an element of constructivism (discussed in the following section) into the course. A key concept of Vygotsky's social constructivism is the zone of proximal development: the space in which scaffolded support for skills just outside of the learner's reach is provided (Harasim, 2017).

6) **Elicit performance:** All instructional modules include multiple interactive understanding check-in questions that require active engagement from the learner. After the training modules are complete, learner performance is elicited via active engagement with the software programs Adobe Illustrator and CutStudio, and with the vinyl cutter. The final

hands-on sign-off requires active performance, overseen by supervisory personnel with the aid of a performance checklist.

7) **Provide feedback:** Knowledge checks integrated throughout the course are followed by either confirming or correcting feedback. If a question is answered incorrectly, the participant is provided unlimited opportunities to retry. During the final hands-on software and vinyl cutter use portion of the course, learners will be provided with immediate feedback from supervisory personnel in a supportive and encouraging fashion.

8) **Assess performance:** Upon course completion learners will receive notification of passing status if all steps were completed to the standard. Successful completion, determined by a supervisor holding a vinyl cutter "Level 4 Badge," results in provision of a "Level 1 Badge," certifying the learner to use the vinyl cutter with supervision.

9) **Enhance retention and transfer:** Online job aids are made easily accessible to students. The "What to Do When You Have Questions" module provides a consolidated repository of course resources including videos, video scripts, main points, and job aids. The final "Additional Resources and Next Steps" module provides information about further learning opportunities (e.g., higher badge level certification courses, badges to use other tools in the Innovation Lab, etc.). Encouragement to request support from Innovation Lab staff is provided.

Constructivism

A constructivist curriculum is not necessarily designed to build towards a planned outcome. Teachers support learners in building their own mental models. From a Vygotskian social constructivism standpoint, this world view formation is inextricably connected to social interaction. Knowledge is a function of culture, "constructed and negotiated socially" (Harasim,

2017, p. 61). While Vygotsky emphasized the role of socialization, Piaget's cognitive constructivism championed the essential role of active participation, which allows students to organize and adapt new information into existing mental concepts (Harasim, 2017).

As the goal of this "Level 1 Badge" safety training is to prepare learners to use the Innovation Lab's vinyl cutter safely and effectively according to standards that do not permit deviation, the subjectivist tenets of constructivism (in which learners are supported in coming to their own conclusions) do not support the general objectivist framework. However, the larger goal of the course is to prepare learners to apply this tool safely and effectively within creative problem-solving scenarios, a distinctly constructivist task. The guiding philosophy of the Innovation Lab, Liberatory Design, challenges practitioners to see problems, engage with key stakeholders, and take creative actions from which they will learn (National Equity Project, n.d.).

Bearing these Liberatory Design tenets in mind, a thought challenge to the learner is included in the final module, provoking individual assessment of how the vinyl cutter tool might be used to solve problems, aligning with Vygotsky's social constructivism. Vygotsky's emphasis on tools within the context of culture is of particular interest to this capstone's work. As Harasim (2017) states, Vygotsky defined social development as "internalization of the tools of the culture" (p. 68). Tools are seen as humanity's way of engaging with the group.

In addressing the critical aspect of relevance, constructivist learning theory elements are integrated. Presenting examples of how the vinyl cutter has allowed previous learners to create products integrates a cultural element in alignment with social constructivism, prompting learners to consider how they might use this tool as well. Learners are challenged to reflect on their own previous experiences with creation to facilitate the building of connections. A defining

characteristic of a constructivist learning environment is the facilitation of reflection (Harasim, 2017).

An essential element of Piaget's cognitive constructivism is the development of symbolic thought (Mcleod, 2023). Vinyl cutter production provides a novel way to represent and communicate ideas symbolically. In this course, learners are guided to select an image that represents a concept (e.g., waves, an octopus, a seagull, etc.) to cut into the form of a sticker with the vinyl cutter.

While this "Level 1 Badge" safety course does not require presentation of products, the goal is to prepare learners to produce vinyl cutter products that they can share. This presentation to peers, an inherently social activity, informs learning (Mcleod, 2023). While not integrated at this time, the MBA team may decide to incorporate encouragement to share created projects on social media, possibly on the MBA's Instagram profile, or on a social messaging page within the MBA's LMS Thinkific. Online learning is seen as highly compatible with constructivist tenets, providing students with the opportunity to readily access data, communicate and collaborate across space, encounter challenges, and reflect on learning experiences via discussion boards or online portfolios (Harasim, 2017). This course's capitalization on eLearning offers the opportunity to implement constructivist principles further if desired. It is possible that an online discussion and sharing forum might be integrated into the course eventually based on MBA SME interest.

Community interactivity is integral to course design. Completion of the online course prepares the learner for one-on-one skill sign-off with an expert in the Innovation Lab. This final interaction facilitates teacher feedback, promoting communication and wisdom sharing. Within the Innovation Lab, students will be able to work either individually or collaboratively. The

physical layout of the Innovation Lab is an open floorplan, allowing for group interaction. Depending upon class structure, collaboration might be consciously facilitated by instructors, or it may grow naturally out of individual self-direction and communication among peers. Given the variety of learners, the degree to which collaboration takes place will vary. Learning accomplished via the group hopes to lead to individual and community development (Harasim, 2017).

<div style="text-align:center;">**Multimedia Principles**</div>

Multimedia eLearning principles guided selection of visual and auditory elements in this course with the goal of optimizing essential and deep generative processing while minimizing extraneous processing (Clark & Mayer, 2016). Choices were influenced by an understanding of three guiding cognitive science principles: (1) the dual channel principle (people have separate channels for visual and auditory processing), (2) the limited capacity principle (people can process only a limited amount of information in each channel), and (3) the active processing principle (learning occurs via meaningful engagement) (Clark & Mayer, 2016).

The Multimedia Principle

Recognized and accepted across disciplines, the multimedia principle states that people learn better from words and pictures than from either words or pictures alone (Clark & Mayer, 2016). Intentional integration of graphics and text in this course aims to facilitate learning. Representational vinyl cutter and software graphics are presented, while distracting decorative graphics are minimized. Deubel's (2003) advice to use soft background colors to limit cognitive drain is followed. Color is used as an organizational tool and to create contrast between on-screen items in accordance with study recommendations (Deubel, 2003).

The multimedia principle recommends teaching motor skills with the support of animation if tasks demand "complicated manual skills" (Clark & Mayer, 2016, p. 98). Concise software navigation screencasts and vinyl cutter manual operation videos serve to educate learners. Visual cueing, or signaling, within these animations support learner attention-direction. For example, the menu items that audio narration describe are highlighted and portions of the vinyl cutter that are being discussed are circled.

The Contiguity Principle

The contiguity principle recommends the placement of text near the graphic to which it corresponds, reducing extraneous processing (Clark & Mayer, 2016). While this principle may seem obvious, it is easy to violate. Minimizing the need to split attention by looking back and forth between images, avoiding transient text, and designing coursework to avoid distracting navigation is done to facilitate efficient learning. Feedback is displayed on the same screen as the understanding check-in question, practice question content is included in feedback as relevant, directions for interactive exercises are made available on the same screen where those directions are to be applied, and text related to graphics are placed next to those graphics (Clark & Mayer, 2016). In alignment with the contiguity principle, spoken word and corresponding visuals are synchronized.

The Modality Principle

The modality principle recommends the use of audio instead of on-screen text, when possible, to facilitate essential processing (Clark & Mayer, 2016). Considerable evidence demonstrates that audio, in place of written words, results in "significant learning gains" (Clark & Mayer, 2016, p. 130).

Capitalizing on this known learning principle, the course incorporates audio instruction frequently. Multiple slides in all modules include audio voiceover instructions. Video narration was scripted and approved by SMEs prior to implementation, ensuring the most important information was relayed. It is relevant to note that limited cognitive processing and audio's transient nature necessitated the incorporation of printed text at appropriate times. Technical terms in audio narration are accompanied by on-screen clarifying text. For example, when novel terms such as "pinch roller" and "cutting carriage" are introduced in the "Vinyl Cutter Parts and Their Purposes" video, these terms also appear in text on-screen.

The Redundancy Principle

The redundancy principle states that learning is enhanced when graphics and audio presentations do not include redundant on-screen text (Clark & Mayer, 2016). It is generally recommended to avoid integrating the full printed script alongside narrated visuals. When both graphics and printed words are present, the visual processing channel can be overwhelmed.

Redundancy principle violations are most glaring when the content "is system-controlled, includes words familiar to the target audience, and incorporates a lot of on-screen text" (Clark & Mayer, 2016, p. 157). This capstone course is self-paced, allowing participant review of previous sections and for pausing and returning as needed. Generally familiar terms are not included on-screen, while novel terms are. Judicious selection of text aims to minimize visual channel cognitive overload.

Coherence Principle

The coherence principle calls for discretion in design. It recommends avoiding the use of words, sounds, or graphics that do not explicitly support learning objectives (Clark & Mayer, 2016). While it can be "[tempting] to embellish lessons in an effort to motivate learners" (Clark

& Mayer, 2016, p. 168), any visual or auditory element's inclusion ought to be predicated upon identified learning objectives.

Elucidating learning objectives prior to embarking on design was essential. Congruous elements could then selected, minimizing extraneous processing (Clark & Mayer, 2016). While students may report greater attraction to exciting materials, studies show that "decorative and seductive visuals [do] not increase learning," (Clark & Mayer, 2016, p. 95) and that extraneous audio diminishes learner performance. Auditory and visual selection choices can either support or detract from learning. Any "words, graphics, or sounds not central to the instructional goal" (Clark & Mayer, 2016, p. 168) were excluded.

Segmenting Principle

According to Clark and Mayer (2016), especially for novice learners, segmentation of materials supports learning. Related concepts should be presented in context, but simply and appropriately. SME feedback on proposed agendas facilitated the breakdown of content into modular chunks to avoid overwhelming learners.

Clark and Mayer (2016) recommend that instruction be designed to pause at fitting junctures. It is not only the responsibility of the instructor "to present information, but also [to] prime the appropriate cognitive processing in the learner" (Clark & Mayer, 2016, p. 201). The results of a study in which an animation included a pause button versus excluded a pause button are pertinent. No difference was found between learning outcomes, "primarily because most learners did not use the pause button" (p. 224). Novice learners often do not know when it is appropriate to stop and reflect. Priming the learner to break for concept processing is the responsibility of the designer. The presentation of this course in modular sections aims to facilitate essential and generative processing.

The Personalization and Embodiment Principles

The personalization principle states that eLearning is improved when conversational style, polite wording, and audio narration with human – as opposed to robotic – voices are employed (Clark & Mayer, 2016). The goal is to "induce the learner to engage with the computer as a social conversational partner" (Clark & Mayer, 2016, p. 195). The feeling of a "social presence" (Clark & Mayer, 2016, p. 201) produces higher engagement. Scripts for this capstone employ conversational first- and second-person pronouns, the tone of narration is encouraging and polite, and spoken words come from real human voices.

The embodiment principle calls for instructional online entities to "act like humans – using human-like gestures, movements, facial expressions, and eye gaze" (Clark & Mayer, 2016, p. 210) – to optimize engagement and learning. Filmed demonstration videos adhere to the embodiment principle.

<center>**Development Plan**</center>

In the Fall 2022 semester the client was established (the Monterey Bay Aquarium's Innovation Lab), the primary SME (Education Programs Director Katy Scott) was identified, initial assessments were completed, and concepts for the projected deliverables were built out. Regular communications with SMEs guided content design and development throughout subsequent semesters.

The capstone proposal's first draft was finalized in the Spring 2023 semester in the IST 520: "Theories of Learning and Instruction" course. The Spring 2023 semester also saw the creation of three prototype modules, including both content and assessments. These modules were constructed in coordination with SMEs who provided formative feedback.

In the Summer 2023 term testing measurements and assessments were created and implemented. Feedback gathered from course pilot testing with Innovation Lab program assistants and distance learner volunteers guided module optimization and informed continued course creation efforts.

The final capstone deliverable was completed in November 2023, facilitating summative evaluation in the latter half of that same month and the beginning of December 2023. Informal formative evaluation of the entire 11-module course by a volunteer user prior to summative evaluation led to course additions, including audio directions on video slides and instruction to make screencast videos full screen for ease of processing. Analysis and implementation of gathered data and final reporting followed summative evaluation prior to graduation from the MIST program in December 2023.

Project Deliverables & Schedule/Timeline

1. **Learning Objectives**

   a. *Status:* Completed

      Learning objectives were formulated based on initial meetings, email communications with MBA stakeholders, and review of existing materials. A March 2023 SME meeting with Education Programs Director Katy Scott and Senior Education Specialist Luis David Calderon confirmed the appropriateness of proposed learning objectives.

   b. *Completion dates:* Initial approval obtained March 2023. Final confirmation, incorporating course adjustments, obtained September 2023.

c. Ongoing communications as portions of the course were built out facilitated optimization, but general approval for proposed learning objectives was obtained from SMEs at the outset.

2. **Storyboarding the 11 Course Modules**

    a. *Status:* Completed

    b. *Completion dates:* April – September 2023

    c. The "Level 1 Badge" vinyl cutter course includes 11 eLearning modules with integrated assessments and learning activities. Storyboards for each of these modules detail the scripts, visual video content, quiz questions, activity instructions, and resources to be linked. These storyboards were drafted and presented to SMEs for approval, facilitating early optimization. Storyboards for three modules ("Vinyl Cutter Parts and Their Purposes," "Materials You Can Use with the Vinyl Cutter," and "Vinyl Cutter Safety") were completed and approved by SMEs in April 2023. The storyboard for the seventh module ("Introduction to Vector Files") received SME approval in August 2023. The storyboards for all modules were completed in September 2023 (see Appendix K).

3. **Module Draft and Pilot Test**

a. *Status:* Completed

b. *Completion dates:* June – July 2023

c. The creation of three prototype modules, following the approval of storyboarded strategies developed in the proposal, was completed in the Spring 2023 semester (see Appendix A). Formative evaluation of the prototype was conducted in July 2023,

ensuring instructional methods aligned with learning objectives and assessing the ease of module navigation. Innovation Lab program assistants and volunteer distance learners supported this formative evaluation process. Elicited feedback guided revisions to modules and directed further course development decisions.

4. **Finalized Course**

   a. *Status:* Completed

   b. *Completion date:* December 2023

   c. The final course reflects the feedback obtained from prototype test pilot participants, a volunteer distance learner who supported formative testing of the full course, Innovation Lab staff member and distance learner summative testing participants, and SMEs. The course is currently integrated into the Monterey Bay Aquarium's LMS Thinkific and multiple staff members have already completed the course. More users are scheduled to complete the course in January, and it is anticipated that course implementation will continue in the Innovation Lab for those learners who desire to obtain vinyl cutter "Level 1 Badge" certification.

Challenges & Contingency Planning

While the Monterey Bay Aquarium's education team faced many demands over the course of this capstone's creation, SMEs Katy Scott and Luis David Calderon were generous with their time and support. Multiple face-to-face meetings, a tour of the Innovation Lab, introduction to Innovation Lab team members, online Zoom meetings, and in-person video shoots were facilitated. While it is reported that consistent SME communication can be one of the greatest challenges students in the MIST program face, their support was reliable. Furthermore, the MBA team member who facilitated contact with the primary SME – the MBA

Director of Learning and Engagement, Brianne Fitzgerald – is a former MIST student who offered advisement as needed.

Despite these advantages, I anticipated that time management could become a challenge. In collaboration with my MIST program capstone advisor, Dr. Sarah Evanick, I made plans to communicate with the Innovation Lab's education team well ahead of deadlines. This ensured that timelines for preliminary modules' creation, usability testing, and final deliverables were known by the team. Providing ample time for coordination allowed for contingency arrangements to be made when unforeseeable circumstances necessitated rescheduling. For example, early in the final Fall 2023 semester, my family and I moved from Monterey County, California, to Hawaii. Anticipating coordination challenges, I communicated with SMEs to schedule video shoots and meetings well in advance of the move. When I got sick after a flight back to Monterey, CA, to complete video shoots, I was able to reschedule those appointments to following weeks. Early planning allowed for easy pivoting in the wake of unforeseen events.

A chief impetus for my pursuit of a position in the MIST program was a desire to build technical competence. With limited experience before beginning the graduate program, one of my greatest anticipated hurdles was attaining proficiency with the technologies utilized to create eLearning modules. The introduction to multiple relevant tools in the IST 501: "Technology Workshop" and the IST 531: "Video and Audio Production" courses under Professor Beem's tutelage were instrumental in the development of my technical knowledge and skills. The orientation to multiple eLearning authoring tools and the basics of web design provided by Dr. Miguel Lara in the IST 526: "Interactive Multimedia" and the IST 541: "Multimedia Tools II" courses were invaluable. Not only did I gain a baseline understanding of available software and

their functions, but completing hands-on assignments in these courses imparted an understanding that answers to questions that arise are available via software guides and the internet community.

Implementation Plan

The capstone eLearning course is now available through the Monterey Bay Aquarium's learning management system Thinkific. This online portion of the "Level 1 Badge" vinyl cutter course allows for asynchronous completion in any place at any time by Innovation Lab participants. As Stolovitch and Keeps (2011) point out, this augments the ability of people in diverse locations to access the training in time frames that are ideal for them, however often they feel is necessary. Additionally, virtual accessibility cuts down on time and personnel resource utilization in the Innovation Lab, maximizing efficiency.

Course completion culminates in a hands-on vinyl cutter skill sign-off in the Innovation Lab, overseen by certified supervisory personnel. This learning experience in an authentic environment is designed to maximize transfer (Stolovitch & Keeps, 2011). Guidance in the Lab is provided to students by a supervisor with the support of an authorized performance checklist that supports assessment of whether the learner has met objectives, facilitating confirming or correcting feedback (Stolovitch & Keeps, 2011).

Instructors and/or Administrators

The primary subject matter expert for this project was the Monterey Bay Aquarium Education Programs Director, Katy Scott. She was the main point of contact and was responsible for coordination throughout and provision of final sign-off. Senior Education Specialist Luis David Calderon provided feedback and guidance, facilitated Innovation Lab access, and served as a major point of contact throughout the process.

The course's design plan included the creation of multiple instructional videos. Katy Scott and Luis David Calderon made professional videography tools and support available through the MBA. Katy Scott supported the scheduling of in-person formative testing in the Summer 2023 term, facilitating direct feedback on prototype course modules. Katy also supported final summative testing by gathering MBA staff volunteers to complete the entire course and associated activities in November and December 2023.

The final portion of the course requires hands-on vinyl cutter sign-off with certified instructors. Certification of trainers to supervise "Level 1 Badge" sign-offs is integrated into higher badge levels and did not require this capstone work's support. The Aquarium has arrangements in place to coordinate supervisor availability.

Other Implementation Requirements

All eLearning course modules are to be completed online and have been made available in the LMS Thinkific's Innovation Lab training section. The final sign-off is completed in the Innovation Lab via established field trip programs for students and teachers.

This capstone project was provided by the Innovation Lab team and was approved by Monterey Bay Aquarium staff for creation. The Innovation Lab field trip schedule is well-established; marketing of the course is unnecessary.

Evaluation

The "Level 1 Badge" vinyl cutter course underwent multiple formative evaluations. Summative evaluation conducted in the last semester guided finalization.

SME feedback provided formative evaluation data throughout design and development. Innovation Lab program assistants and distance learner volunteers supplied user feedback in the Summer 2023 term pilot test. A volunteer distance learner completed the full course and

provided recommendations that were integrated prior to formal summative evaluation. Summative evaluation facilitated final modifications in December 2023 before delivery. The first two levels of the Kirkpatrick Model for course evaluation were applied to the course.

Formative Evaluation

Formative assessments were conducted throughout the design and development process. Rothwell et al. (2016) describes four major formative evaluation methods. The formative evaluation strategies they describe of (1) expert reviews by SMEs, (2) expert reviews by individuals, and (3) group pilot testing, were implemented.

Storyboards, scripts, and drafted proposals were presented to SMEs for feedback. Regular meetings with SMEs facilitated communications that guided early corrective action. As Rothwell et al. (2016) advise, SME feedback was elicited on course materials, audiovisuals, case examples, and content. Catching mistakes and areas that required modification early in the process minimized the need for massive revisions late in development.

Gathering ample user feedback further supported the identification of modification needs – of delivery style, formatting, questions, pause points, audio cues, general clarity, etc. As the final course is housed in the LMS Thinkific, there was limited ability to elicit Thinkific-specific usability feedback from users not enrolled in the MBA's education program. However, many Thinkific account holders were able to provide feedback, and modules hosted outside the LMS allowed distance learner volunteers to participate and provide critiques. As Stolovitch and Keeps (2011) assert, it is critical to gather detailed feedback on the front-end when creating eLearning content; when online courses are launched, many users may not have access to instructor support.

The research hypothesis that completion of the three-module "Level 1 Badge" vinyl cutter training improves post-course test scores as compared to pre-course test scores was supported by the results of the Summer 2023 term formative evaluation's paired t-test statistical analysis (see Appendix B). The absolute one-tail t-test statistic value of 8.08 exceeded the one-tail t-critical value of 1.89, and the one-tail p-value of 0.00043 was less than the conventional alpha level of 0.05. The Cohen's d effect size analysis result of 3.79 demonstrated that training completion has great practical significance, indicating that completion of the three-module prototype was a significant factor in improving post-course test scores. These statistical analyses support the implementation of these training modules in the Innovation Lab to significantly increase learning gains for participants who would like to use the vinyl cutter with supervision.

The usability survey and interview question responses collected during this evaluation demonstrated positive reactions to ease of use, navigation, and understanding, as well as learner appreciation for multimedia use, clear audio, informational graphics, and clear course design (see Appendix C).

As work on the final 11-module "Level 1 Badge" vinyl cutter course continued, feedback drawn from the protype assessment was integrated. Module improvement recommendations – including the addition of signaling cues, and course look and notification improvements – were made to prototype modules. Modules that were already planned for creation – including a start-to-finish vinyl cutter project demonstration and a "What to Do When You Have Questions" module – were created, supporting learner requests made in the usability survey. Please see Appendix D for a link to the full document that details the process, results, and implemented recommendations from the Summer 2023 term prototype evaluation.

A volunteer distance learner who completed the full 11-module course prior to formal summative evaluation provided formative feedback. Recommendations – including incorporation of automatic audio directions on all video slides to ensure user selection of "Next" when the video completes, the addition of directions to make screencast videos full-screen, and minor grammatical corrections – were implemented.

Summative Evaluation

Process

The summative evaluation was comprised of two parts: 1) Pre-course and post-course tests to measure learning gains and 2) a usability survey to measure reaction and gather recommendations. The tests and survey were created in Google Forms and shared with Monterey Bay Aquarium employees via linear integration into the MBA's LMS Thinkific, One volunteer distance learner completed the course outside of Thinkific. All sections integrated into the LMS, including an introductory message with instructions (see Appendix H), a pre-course test, links to the 11 modules, a post-course test, and a usability survey, were emailed to the volunteer distance learner. Pre- and post-course tests were linked to learners' emails, allowing completion of a paired t-test statistical analysis. Usability survey responses remained anonymous. All five learners completed the pre-course test, post-course test, and usability survey in the prescribed linear fashion.

Pre-Course and Post-Course Tests

Paired pre-course and post-course tests provided a measurable way to evaluate learning gains (see Appendix G). Pre-course and post-course questions were identical. To minimize test anxiety, the tests were labeled "Understanding Check-Ins" and pre-course test learners were greeted with an introductory message informing them of the expectation that they will not know

the answers to presented questions. All test questions were multiple choice with one correct answer. As all questions were comparably difficult, they were each assigned a one-point value. Care was taken to ensure incorrect answers were plausible distractors. Multiple questions were framed within probable scenarios. Images with basic vinyl cutter parts labeled were provided as a reference.

Training

The 11 Storyline 360 modules were linearly integrated into the LMS Thinkific for completion. The volunteer distance learner was provided links to the modules in order by email. All modules were made available via a personal GitHub account. Please see Appendix A for course module links.

Usability Survey

Before initiating the process, all learners were notified to anticipate a final usability survey, facilitating provision of their thoughts on design, organization, ease of use, ease of understanding, and the degree to which multimedia did or did not support their learning. The usability survey, created in Google Forms, was integrated into the Thinkific course for MBA employees' completion and was emailed to the volunteer distance learner. The first seven questions requested that learners rate their agreement with statements on a scale of one to five from "strongly disagree" to "strongly agree." Statements included, "The graphics in this course supported my understanding," "The content of instructional videos supported my learning," and "The organization of information in this course was clear." The final four questions were free-response. Learners were required to complete all but the last of the usability survey questions. Examples of free-response questions included, "What elements in this course did you like? What supported your learning?" and "What suggestions do you have for course improvement? How

might your learning be enhanced?" Please see Appendix F for usability survey questions and responses.

Tryout Conditions

The purpose of this eLearning capstone is to facilitate efficient asynchronous course completion, which may take place in the Innovation Lab or remotely. While coursework culminates in hands-on vinyl cutter use in the Lab, the intention of this training is to facilitate completion at any time and in any place that accommodates the learner. As all five learners completed the course either remotely or in the Innovation Lab, the tryout conditions were compliant with intended course completion conditions.

Outcomes

Learning Gains

Individual pre- and post-course paired test scores were gathered from Google Forms and transferred to an Excel spreadsheet. Table 1 below provides the scores of the five learners. Table 2 below provides a visual histogram comparing pre- and post-course test results for each of the learners.

Table 1

Title: Summary of Collected Data

	Pre-Test Score	Post-Test Score
Learner 1	7	10
Learner 2	6	10
Learner 3	8	9
Learner 4	7	10
Learner 5	3	10

Table 2

Title: Histogram of Pre- and Post-Test Scores
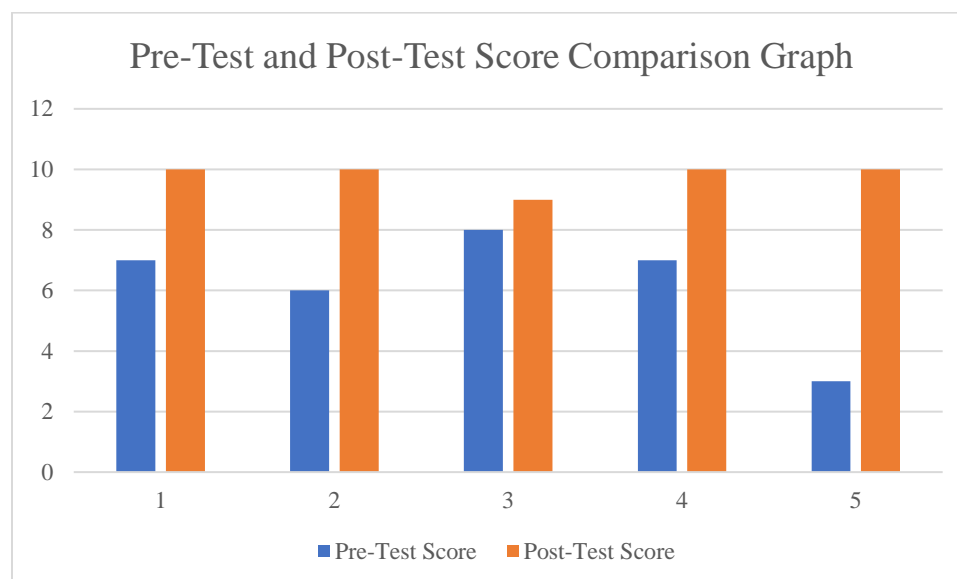
The ten questions in the pre-course test were repeated in the post-course test. As illustrated in the preceding tables, all learners scored higher on the post-test, with a mean pre-course test score of 62% and a mean post-course test score of 98%. Please see Appendix E, Tables 2 and 3, for pre- and post-course test descriptive statistics. A paired t-test data analysis with a degree of freedom of four was conducted in Excel to evaluate the research hypothesis that completion of the 11 modules would result in a statistically significant increase in test scores. The null hypothesis was that the training would have no effect, resulting in no statistical difference between the pre-course and post-course test scores. Because the research hypothesis was directional, the one-tail results of the paired t-test analysis were utilized (see Appendix E, Table 1). Statistical significance was demonstrated between the mean pre-course and mean post-course test scores because the absolute value of the one-tail t-test statistic – 3.67 – was greater than the one-tail t-critical value of 2.13. Statistical significance was additionally demonstrated by a one-tail p-value of 0.021, which is less than the conventional alpha level of 0.05. These

statistically significant results are indicative of an increase in learning due to completion of the 11 training modules. The null hypothesis was rejected, and the research hypothesis was accepted.

Given the statistical significance of results, further analysis was conducted to determine the magnitude of practical significance. With a pre-course test standard deviation (SD) of 1.92 and a post-course test SD of 0.45, the pooled SD was calculated to be 1.19. The pooled SD of 1.19, the mean pre-course test score of 6.2, and the mean post-course test score of 9.8 were utilized to calculate the effect size with Cohen's d formula. As the Cohen's d result of 3.03 is greater than 0.8, the magnitude of practical significance was determined to be great. Paired t-test and effect size analyses demonstrate statistical significance and great practical significance, respectively, indicating that completion of the 11-module course is a significant factor in improving post-course test scores.

Learner Reactions

Seven linear scale usability survey questions requested that learners indicate the degree to which they agreed, disagreed, or were neutral on presented statements. The final four questions were free-response. Please see Appendix F for usability survey questions and responses. The statements that received the most enthusiastic support were, "This course was easy to navigate" and "The content of instructional videos supported my learning," with 100% of users selecting "strongly agree." Eighty percent of users "strongly agreed" with the statements, "The graphics in this course supported my understanding," "The organization of information in this course was clear," "Audio in this course was easy to understand," and "After completing these modules, I feel better prepared to use the vinyl cutter in the Innovation Lab;" the remaining 20% selected that they "agreed" with these statements. Sixty percent of users "strongly agreed" with the statement that "The amount of information in each of the modules felt appropriate," while 20%

selected "agree," and 20% selected "neutral." Linear scale question responses demonstrated the most positive learner responses towards the effectiveness of video instruction and the ease of navigation.

On the free response usability survey questions, 80% of learners independently expressed that their learning was supported by the educational videos, 40% communicated appreciation for the active learning facilitated by interactive questions, and 20% noted that course organization was clear. One individual expressed that video, written, and quiz delivery of content drove home points, but that it felt repetitive. One user expressed that some images in the "Prepare Your File" interactive clickable questions were challenging to see, confirming feedback received from the volunteer user who completed the 11-module course prior to the summative evaluation. One user requested that an explanation be integrated into the course for why users are directed to select "ROLL" instead of "PIECE" when setting up the vinyl cutter in the Innovation Lab. Another user expressed interest in learning more, communicating particular interest in receiving instruction on how to vectorize an image for vinyl cutting. When asked if they experienced any difficulty with understanding or navigation in the course, one user reported a software error in navigation when they went back in the course. In order to proceed, they had to manually select items from the drop-down menu. The remaining users reported no issues with navigation.

Final notes provided at the end of the survey included, "this is awesome!," "Excellent job!," and, "Great course! This was very informative and I learned a lot!" One user sent an independent email with the feedback, "Nice job on your capstone! You really put your heart and soul into this."

Recommendations

Enlargement of "Prepare Your File" Images

While full-screen software and vinyl cutter images were initially selected with the goal of providing authentic context, both a formative evaluation user and a summative evaluation user reported difficulty seeing small sections in Adobe Illustrator and vinyl cutter operation panel images. In response to this feedback, images were cropped to allow enlargement of the noted sections. Additionally, enlarged images of relevant sections that aim to support the learner's ability to place the primary images in context were integrated. For example, see Appendix I, Image 7.

Explanation for "ROLL" vs. "PIECE" Selection

Learners are directed in both video and slide format to select "ROLL" instead of "PIECE" when setting up the vinyl cutter to cut a piece of vinyl. In response to the request for clarification, a short explanation was integrated, communicating to the learner that, due to an inoperable sensor at the time of course creation, "we currently have you select 'ROLL'." Users are then directed to confirm current practice recommendations with Innovation Lab staff.

Intended Integration of Future Developed Courses

The final module in the course alludes to future availability of courses under development, including higher badge levels for the vinyl cutter, certification to use other tools in the Lab, and a course on Adobe Illustrator use. User feedback included expressed interest in these continuing education opportunities. As courses are built out, and as directed by SMEs, links to these courses may be integrated into the "Additional Resources and Next Steps" module.

Summative Evaluation Summary

The research hypothesis that completion of the 11-module "Level 1 Badge" vinyl cutter course improves post-course test scores as compared to pre-course test scores was supported by the results of the paired t-test statistical analysis. Effect size analysis with Cohen's d formula

demonstrated great practical significance. These statistical analyses support the implementation

of these training modules in the Innovation Lab to significantly increase learning gains for

participants who would like to use the vinyl cutter with supervision. The usability survey

responses provided positive reactions to ease of use and understanding, as well as learner

appreciation for interactive questions, informative videos, and clear course design.

Select recommendations from the summative evaluation were integrated into the course,

and access to courses intended for development may be integrated into the vinyl cutter "Level 1

Badge" course in the future as they become available.

The Kirkpatrick Model

The Kirkpatrick Four-Level Evaluation framework is utilized to assess the effectiveness

of training programs and is comprised of (1) learner satisfaction ("Reaction"), (2) new

knowledge or skill acquisition ("Learning"), (3) implementation or transfer of knowledge or skill

to the workplace ("Application"), and (4) actual impact on the organization's desired outcomes

(Rothwell et al., 2016). Beyond this four-level evaluation framework, the Phillips ROI model

adds an additional fifth level: return-on-investment (ROI) (Mindflash, n.d.).

- **Reaction (Level 1)** was evaluated via usability surveys administered upon

  completion of the prototype and the full course. It is important to remember that,

  while this type of assessment provides valuable data, it is highly subjective and

  studies have demonstrated little correlation between learner reaction and actual

  learning transfer (Rothwell et al., 2016).

  Formative Summer 2023 term usability feedback was positive, with all learners

  either "strongly agreeing" or "agreeing" with statements including, "The graphics

  in this course supported my understanding," "Audio in this course was easy to

understand," "This course was easy to navigate," "The organization of information in this course was clear," and "After completing these modules, I feel better prepared to use the vinyl cutter in the Innovation Lab." On the free response usability survey questions, 37.5% of learners independently expressed that their learning was supported by the clarity of content delivery, 25% expressed appreciation for the active learning facilitated via integrated questions, and 25% noted that the repetition of concepts via multiple media formats (audio, graphics, video, and text) supported their learning (see Appendix C).

Final summative course testing completed in November and December 2023, supplied further feedback, including positive learner reactions to the clarity of instructional videos, the effectiveness of interactive questions, and clear course organization.

- **Learning (Level 2)** was evaluated via pre- and post-course testing in both the formative three-module prototype evaluation and the final 11-module summative evaluation.

The research hypothesis that completion of the three-module "Level 1 Badge" vinyl cutter prototype training improves post-course test scores as compared to pre-course test scores was supported by the results of paired t-test statistical analysis in the Summer 2023 term. Effect size analysis with Cohen's d formula demonstrated great practical significance (see Appendix B). These statistical results support the implementation of the prototype training modules in the Innovation Lab to significantly increase learning gains for participants who would like to use the vinyl cutter with supervision.

Similar pre- and post-testing, carried out in November and December of 2023 for the entire "Level 1 Badge" vinyl cutter course, supported the research hypothesis that completion of the 11-module "Level 1 Badge" vinyl cutter course improves post-course test scores as compared to pre-course test scores. The results of the paired t-test and effect size statistical analyses support the implementation of the 11-module course in the Innovation Lab to significantly increase learning gains for participants who would like to use the vinyl cutter with supervision. Within the course, learning is evaluated throughout via understanding check-in questions. Learning is ultimately evaluated through the procedural skill sign-off, supported by Innovation Lab supervisors. It is possible that data collected from these integrated quizzes and the skill sign-off checklist may be utilized for statistical analyses if deemed desirable by Innovation Lab stakeholders.

- **Application (Level 3)** systematic evaluation is not planned. Learners may be encouraged to provide feedback on their future projects within the Innovation Lab if facilitated by stakeholders. Documentation of created works after training completion could provide data on the degree to which learning is implemented if desired.

- **Impact (Level 4)** could be measured by determining the degree to which asynchronous completion of online portions of the course reduces the number of personnel and degree of labor required to sign off participants. If the dissemination of this course demonstrates an impact that reduces resource utilization in the Innovation Lab, it may support the creation of further

instructional modules that address the rest of the tools the Lab houses. The plan to

create online training for all tools is, however, already in place.

- If completed, data collected to assess the 'Impact' could support evaluation of

  ROI (Level 5). Quantitative ROI evaluation would likely prove challenging, but

  as this capstone course was created by a graduate student service learner, it is

  hoped that it is evident that the ROI benefits the organization.

As Rothwell et al. (2016) assert, the resources and effort that evaluation require increase

as the levels rise. Communication with SMEs determined the degree to which evaluation of

reaction, learning, behavior, impact, and ROI was desired during capstone efforts.

Evaluation Summary

This capstone course on safe and effective vinyl cutter use for MBA Innovation Lab

participants is finalized. The 11 interactive eLearning modules are integrated into the MBA's

LMS Thinkific. The course includes multiple edited videos, interactive understanding check-ins,

job aids, and support documents. This capstone proposal document provided a framework around

which goals and timelines were organized, allowing course completion to proceed smoothly.

Storyboards, initial modules, and preliminary mock-ups facilitated formative evaluations

that dictated modifications. Feedback from SMEs was critical, as were the results of the final

summative evaluation conducted in November and December of 2023.

The design, development, implementation, and evaluation of this course were completed

in a collaborative fashion. The support of generous MBA SMEs, my MIST program advisor, and

my MIST professors made this capstone project possible. It is hoped that the creation of this

course will benefit the Monterey Bay Aquarium's Innovation Lab team and many Innovation

Lab learners in years to come.

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Appendix A

Links to the "Vinyl Cutter 'Level 1 Badge' Course" Modules

Module 1: Introduction and Objectives

Module 2: Vinyl Cutter Parts and Their Purposes

Module 3: Materials You Can Use with the Vinyl Cutter

Module 4: Vinyl Cutter Safety

Module 5: Vector Files: The Language of the Vinyl Cutter

Module 6: Choose a Vector File

Module 7: Prepare Your File

Module 8: Cut Your Sticker

Module 9: Transfer Your Sticker

Module 10: What to Do When You Have Questions

Module 11: Additional Resources and Next Steps

Note. The three-module prototype utilized for the Summer 2023 term formative evaluation

consisted of Modules 2, 3, and 4 above. Updates have been applied to these modules since

testing.

Appendix B

Statistical Analyses from the Summer 2023 Formative Evaluation of Three-Module Prototype

Table 1

Title: t-Test: Paired Two Sample for Means

	Pre-Test Score	Post-Test Score
Mean	5.5	9.75
Variance	3.142857143	0.214285714
Observations	8	8
Pearson Correlation	0.696310624	
Hypothesized Mean Difference	0	
df	7	
t Stat	-8.078246376	
P(T<=t) one-tail	4.28262E-05	
t Critical one-tail	1.894578605	
P(T<=t) two-tail	8.56523E-05	
t Critical two-tail	2.364624252	

Table 2

Title: Pre-Test Score Descriptive Statistics

Mean	5.5
Standard Error	0.626783171
Median	5.5
Mode	5
Standard Deviation	1.772810521
Sample Variance	3.142857143
Kurtosis	1.851239669
Skewness	-0.820474291
Range	6
Minimum	2
Maximum	8
Sum	44
Count	8

Table 3

Title: Post-Test Score Descriptive Statistics

Mean	9.75
Standard Error	0.163663418
Median	10
Mode	10
Standard Deviation	0.46291005
Sample Variance	0.214285714
Kurtosis	0
Skewness	-1.4401646
Range	1
Minimum	9
Maximum	10
Sum	78
Count	8

Appendix C

Usability Survey Results from Summer 2023 Formative Evaluation of Three-Module Prototype

Question 1 Responses

This course was easy to navigate.   Please select one. 1 = Strongly Disagree 2 = Disagree 3 = Neutral 4 = Agree 5 = Strongly Agree
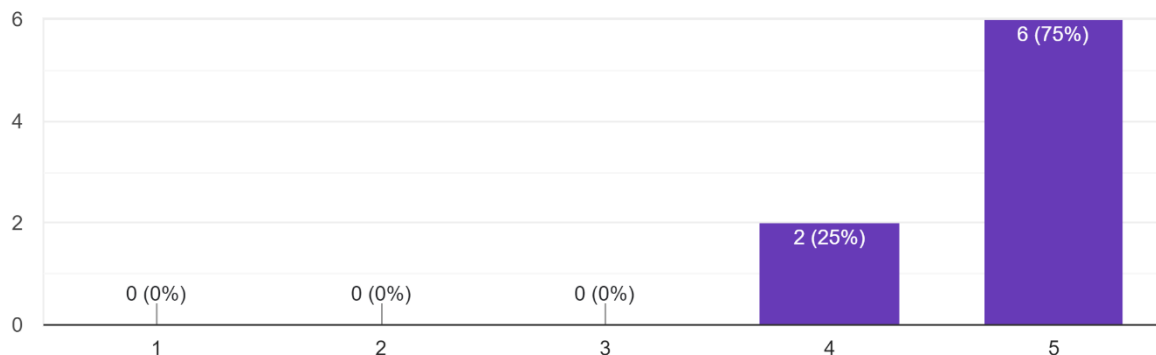
8 responses

Question 2 Responses

The graphics used in this course supported my understanding.   Please select one. 1 = Strongly Disagree 2 = Disagree 3 = Neutral 4 = Agree 5 = Strongly Agree
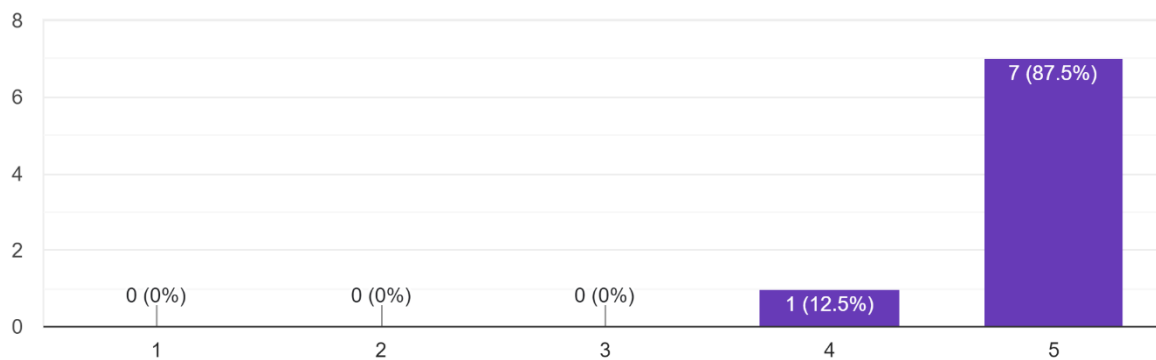
8 responses

Question 3 Responses

The amount of information in each of the modules felt appropriate. Please select one. 1 = Strongly Disagree 2 = Disagree 3 = Neutral 4 = Agree 5 = Strongly Agree
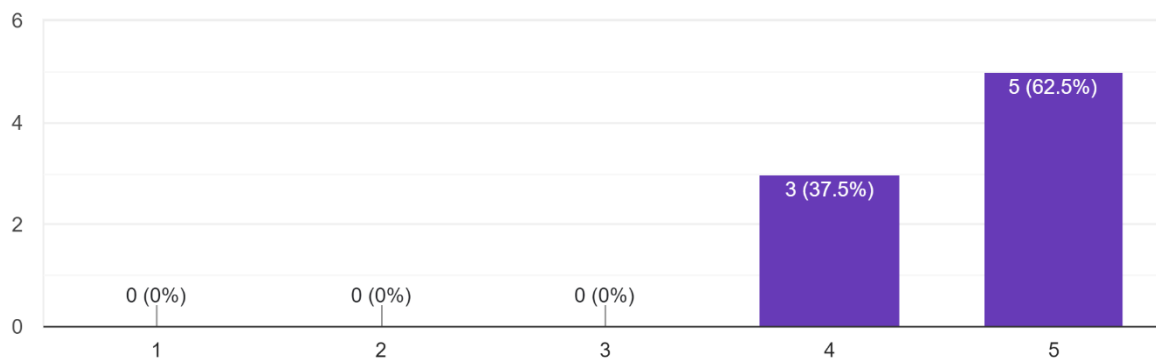
8 responses

Question 4 Responses

The organization of information in this course was clear. Please select one. 1 = Strongly Disagree 2 = Disagree 3 = Neutral 4 = Agree 5 = Strongly Agree
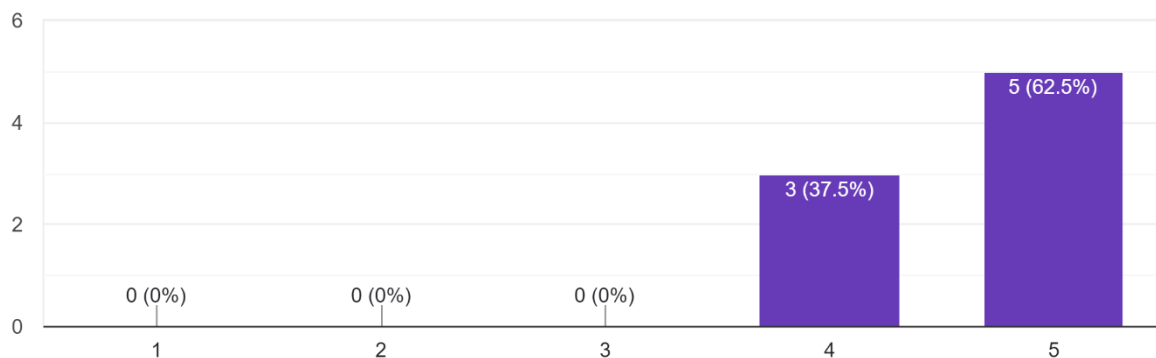
8 responses

Question 5 Responses

The pace of instructional videos supported my learning. Please select one. 1 = Strongly Disagree 2 = Disagree 3 = Neutral 4 = Agree 5 = Strongly Agree
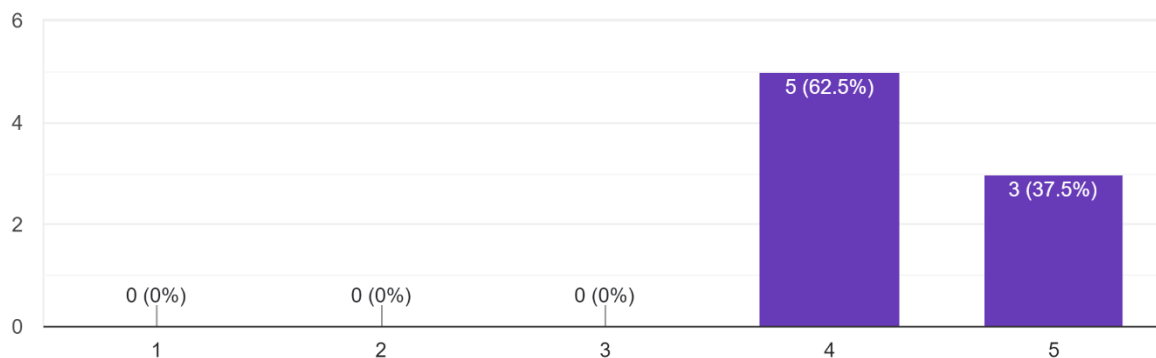
8 responses

Question 6 Responses

Audio in this course was easy to understand. Please select one. 1 = Strongly Disagree 2 = Disagree 3 = Neutral 4 = Agree 5 = Strongly Agree
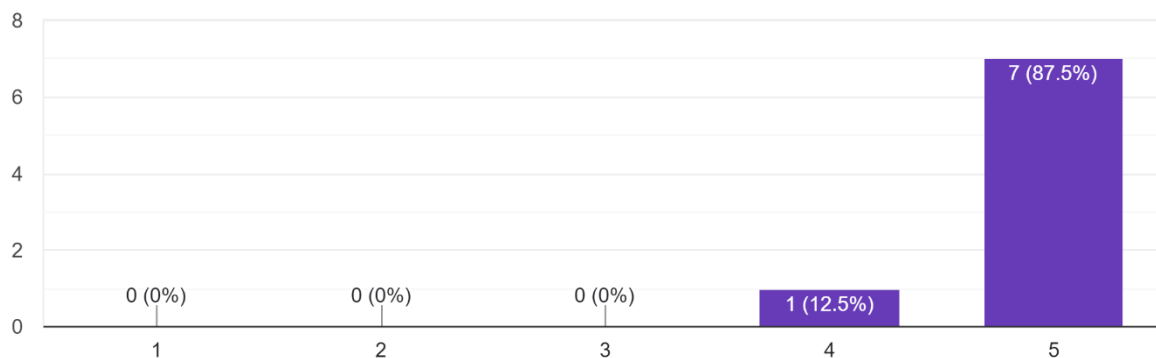
8 responses

Question 7 Responses

After completing these modules, I feel better prepared to use the vinyl cutter in the Innovation
Lab. Please select one. 1 = Strongly Disagree 2 = ...sagree 3 = Neutral 4 = Agree 5 = Strongly Agree
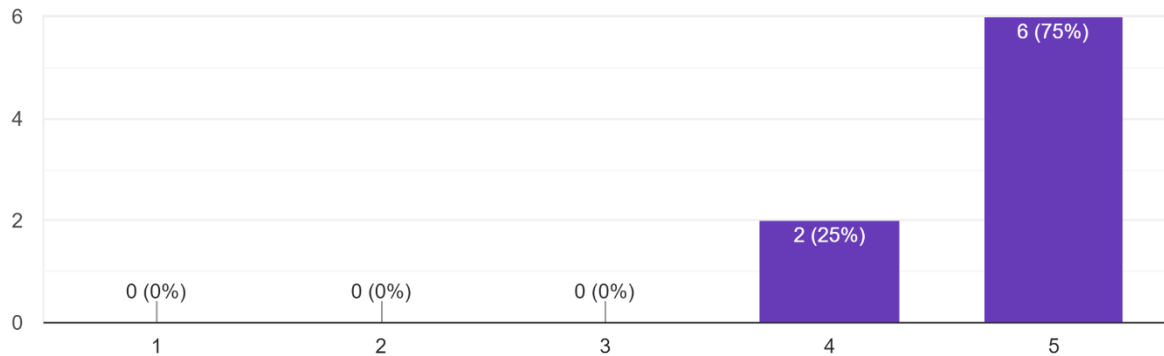
8 responses

Question 8 Responses

What elements in this course did you like? What supported your learning?

I liked how clear everything was

I feel as though the follow up questions to the video was a good way to cement my understanding. It gave me a chance to think about what I was doing versus just listening to what I am supposed to do.

I liked the diagrams and videos, as I was able to have a visual understanding of the vinyl cutter and how it is supposed to be used.
I enjoyed your simple and clear explanation of the parts and what each's function was to do. The review slides were also enjoyable.

I enjoyed the quiz questions and how interactive they were. The name game and actually clicking on the vinyl cutter helped my understanding.

The format was very clear and easy to follow and understand. It was easy to rememer the information after watching the video. I appreciated the graphics, pictures, and seeing the vinyl cutter in the room where I would be using it. I appreciated that there were multiple ways the material was presented to me, I was able to hear it explained to me and also read it/see pictures of the vinyl cutter.

Seeing products from machine

the repetition of concepts through hearing, seeing, and reading

Question 9 Responses

What suggestions do you have for course improvement? How might your learning be enhanced?

Some things were over-stated, they sort of made me feel like I was dumb by reemphasizing very straightforward information. I would benefit from having examples of the cutting process, to include finished products and errors or difficulties that I might avoid from spending time with this learning module

I think it was a solid course but maybe you can include a list of materials unfit for the vinyl cutter.

My learning would be enhanced if I was able to review my incorrect answers so that I know what I need to remember or go over again.

Seeing a video of actual footage of the machine cutting might be helpful to understand the process.

Possibly by showing an example of someone cutting something and the procedure.

Showing examples of what you can make, watching someone make something, watching someone deal with some possible mistakes

Seeing how to make something start to finish.

None, it was excellent.

Question 10 Responses

Did you experience difficulty with understanding or navigation at any point in this course? If so, please let us know where difficulty was encountered.

I don't think I did. It was super clear!

I think it was very accessible and easy to understand.

No (4x)

Not really

I forgot I had to go to Next after one of the videos

Question 11 Responses

Do you have any additional notes you would like to share?

I think it was really wonderfully done, the acting and especially the voice-overs were very clear and beautiful. I enjoyed it very much, thank you

Great job on your capstone!

I genuinely enjoyed doing this course. I was attentive the whole time.

Great job!!

Appendix D

Summer 2023 Formative Three-Module Prototype Testing Document

Link to document: Evaluation of Vinyl Cutter Training Modules

Appendix E

Statistical Analyses from the Fall 2023 Summative Evaluation of 11-Module Course

Table 1

Title: t-Test: Paired Two Sample for Means

	Pre-Test Score	Post-Test Score
Mean	6.2	9.8
Variance	3.7	0.2
Observations	5	5
Pearson Correlation	-0.523114374	
Hypothesized Mean Difference	0	
df	4	
t Stat	-3.674234614	
P(T<=t) one-tail	0.010655821	
t Critical one-tail	2.131846786	
P(T<=t) two-tail	0.021311641	
t Critical two-tail	2.776445105	

Table 2

Title: Pre-Test Score Descriptive Statistics

Mean	6.2
Standard Error	0.860233
Median	7
Mode	7
Standard Deviation	1.923538
Sample Variance	3.7
Kurtosis	2.607743
Skewness	-1.51747
Range	5
Minimum	3
Maximum	8
Sum	31
Count	5

Table 3

Title: Post-Test Score Descriptive Statistics

Mean	9.8
Standard Error	0.2
Median	10
Mode	10
Standard Deviation	0.447214
Sample Variance	0.2
Kurtosis	5
Skewness	-2.23607
Range	1
Minimum	9
Maximum	10
Sum	49
Count	5

Appendix F

Usability Survey Results from the Fall 2023 Summative Evaluation of 11-Module Course

Question 1 Results

This course was easy to navigate.   Please select one. 1 = Strongly Disagree 2 = Disagree 3 = Neutral 4 = Agree 5 = Strongly Agree
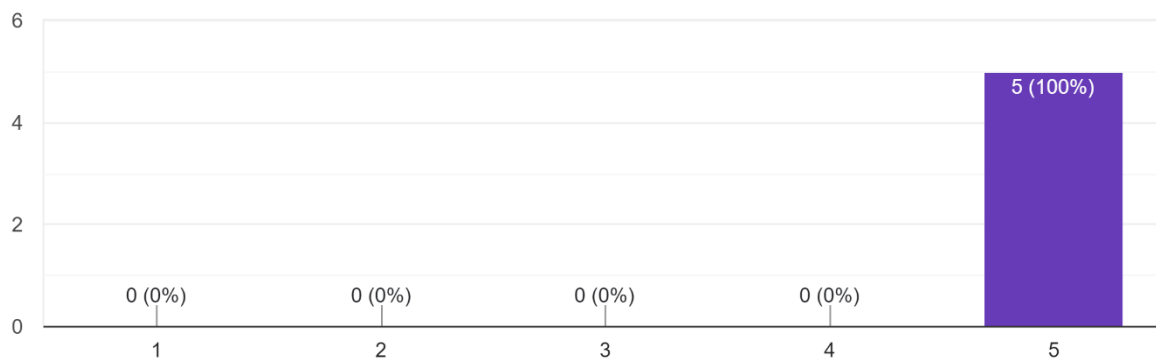
5 responses

Question 2 Results

The graphics used in this course supported my understanding.   Please select one. 1 = Strongly Disagree 2 = Disagree 3 = Neutral 4 = Agree 5 = Strongly Agree
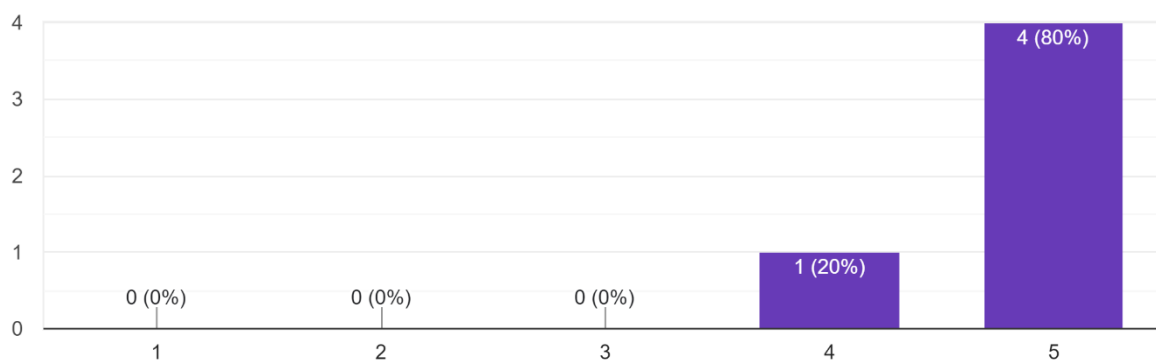
5 responses

Question 3 Results

The amount of information in each of the modules felt appropriate. Please select one. 1 = Strongly Disagree 2 = Disagree 3 = Neutral 4 = Agree 5 = Strongly Agree
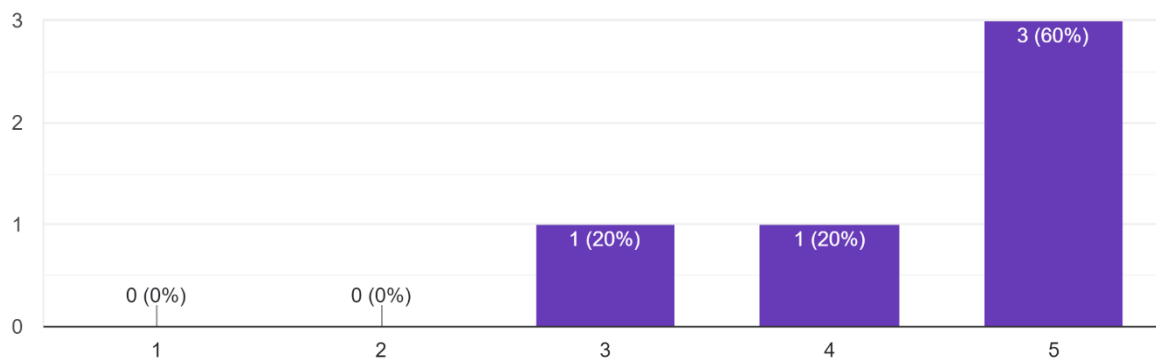
5 responses

Question 4 Results

The organization of information in this course was clear. Please select one. 1 = Strongly Disagree 2 = Disagree 3 = Neutral 4 = Agree 5 = Strongly Agree
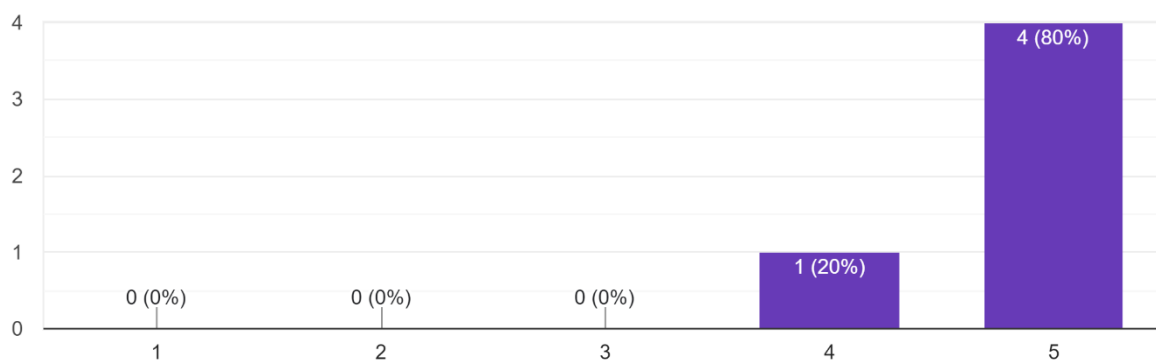
5 responses

Question 5 Results

The content of instructional videos supported my learning. Please select one. 1 = Strongly Disagree 2 = Disagree 3 = Neutral 4 = Agree 5 = Strongly Agree
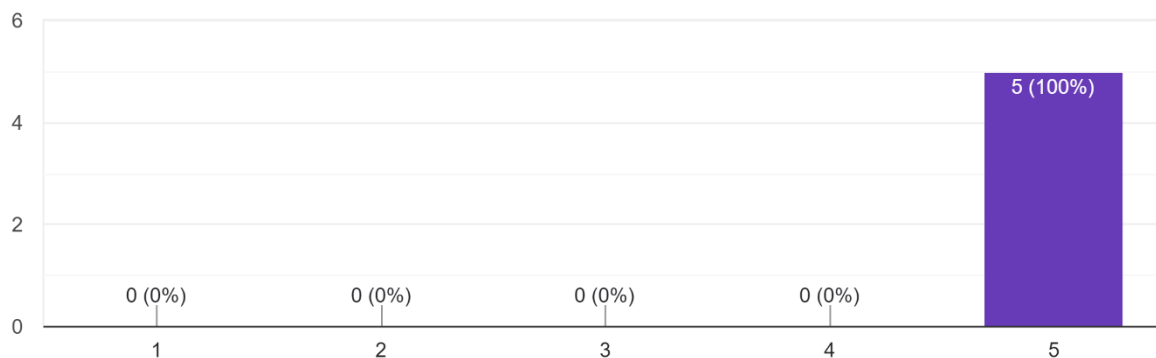
5 responses

Question 6 Results

Audio in this course was easy to understand. Please select one. 1 = Strongly Disagree 2 = Disagree 3 = Neutral 4 = Agree 5 = Strongly Agree
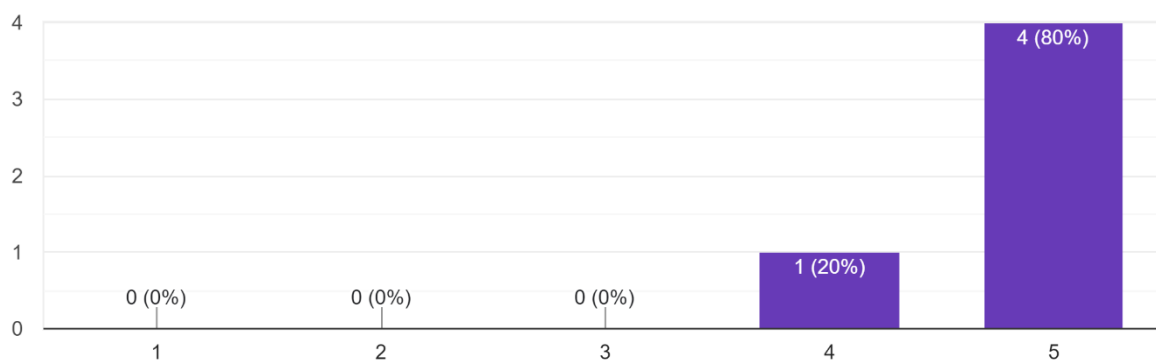
5 responses

Question 7 Results

After completing these modules, I feel better prepared to use the vinyl cutter in the Innovation Lab. Please select one. 1 = Strongly Disagree 2 = ...sagree 3 = Neutral 4 = Agree 5 = Strongly Agree
5 responses
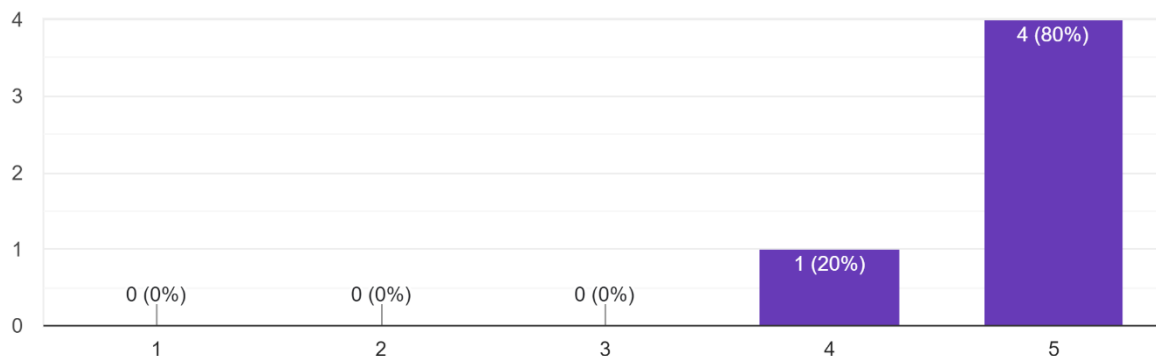
Question 8 Results

What elements in this course did you like? What supported your learning?

The quiz questions that allowed us to press the actual buttons on the machine

It all was very easy and clear to follow. It was nice to see the same survey again at the end and feel confident in my answers.

The videos and the interactive quizzes

The videos showing how to use the vinyl cutter were very informative and allowed me to see where everything was.

The demonstration videos before the written directions facilitated my understanding quickly

Question 9 Results

What suggestions do you have for course improvement? How might your learning be enhanced?

The left pinch roller and Loading lever in the main diagram are somewhat hard to distinguish. Any way to enlarge the words in the saftey training section?

None

Feels like its very repetitive between the video, written and quizzes. drove the point home but made it feel like you get bogged down in the middle of each section.

I would like to learn how to take my own images and convert them to vector files. Maybe this is in the Adobe Illustrator course you mentioned was in the works?

I needed just a little more time to read some of the instructions that faded in and out.

Question 10 Results

Did you experience difficulty with understanding or navigation at any point in this course? If so, please let us know where difficulty was encountered.

I tried to go back one time and it froze the whole thing on me. I had to manually select the remaining pieces of that module

No

no, very thorough

I found some of the questions where you had to click a specific part on the operational panel to be challenging since the buttons and writing small. Some of the questions asking a similar concept had orange boxes around specific parts. It might help to add orange boxes for some of the other questions.

NA

Question 11 Results

Do you have any additional notes you would like to share?

Why are we selecting "roll" in stead of "piece" there were several mentions of this but it never explained why

this is awesome!

Great course! This was very informative and I learned a lot!

Excellent job!

Appendix G

Pre-Course and Post-Course Vinyl Cutter Test

Correct answers are underlined for the purposes of this report.

Pre-Course Test Introduction: It is expected that you will NOT know the answers to these questions yet. Think of this "understanding check-in" as a preview of what you will be learning. Thank you for your participation!

(Please note: Correct answers will not be provided after completion of this form, but "understanding check-in" questions throughout the course will provide individualized feedback after you answer questions).

Post-Course Test Introduction: Thank you for taking the time to complete the course! Let's revisit the questions you were presented with before you took the course.

Vinyl Cutter Parts: Please use as a reference if needed.
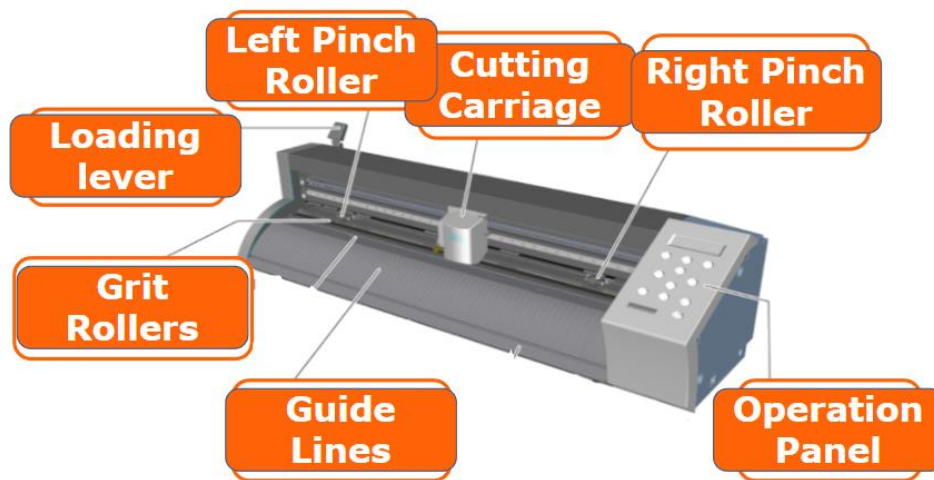
Vinyl Cutter Parts (continued): Please use as a reference if needed.
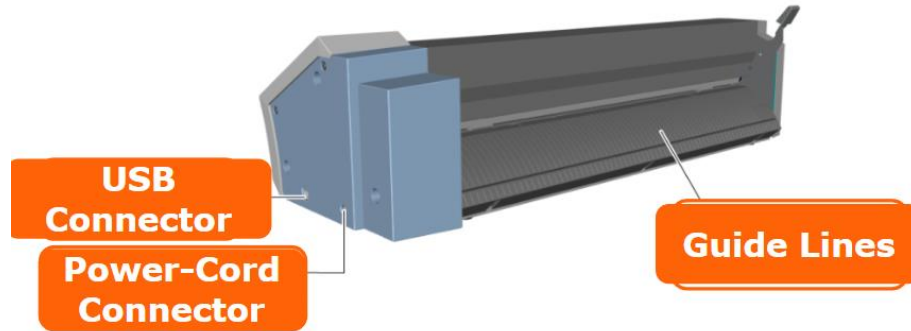
1) Which one of these non-vinyl materials CANNOT be cut by the vinyl cutter?

a) Paper
b) Thin cardboard
c) <u>Hard plastic</u>
d) Fabric

2) You are preparing to cut an octopus wall decal. You know the vinyl cutter will be able to read the octopus image design data when you see the file format is saved as:

a) .png
b) .gif
c) .jpeg
d) <u>.svg</u>

3) You found an otter image file you're excited to vinyl cut! What adjustments to the fill and stroke of your otter file need to be made in Adobe Illustrator to prepare it for vinyl cutting?

a) <u>Make the fill transparent and the stroke thin</u>
b) Make the fill opaque and the stroke visible
c) Ensure the fill and stroke colors match those you would like for your sticker
d) Set the fill at 50% transparency and the stroke thickness at 0.1 inches

4) You told the vinyl cutter to cut a sandcastle design. The vinyl cutter is cutting, but (oh no!) you notice that the vinyl isn't in the right place. What should you do?

a) <u>Select the "Pause" button. Once you are certain the blade has stopped moving, make the needed adjustments. Ask an Innovation Lab staff member for help if needed.</u>
b) When the cutting carriage is far away from the point that needs to be fixed, carefully adjust the vinyl into the right location.
c) Select the "Force Key." This will allow you to make force adjustments that fix the vinyl's placement. Ask an Innovation Lab staff member for help if needed.

d) Select the "Origin Key." This will take the blade back to the origin, allowing adjustments to be made. Ask an Innovation Lab staff member for help if needed.

5) Raising which piece of the vinyl cutter clamps the vinyl into place?

a) The right pinch roller
b) <u>The loading lever</u>
c) The grit rollers
d) The left pinch roller

6) The USB connector is an important part of the vinyl cutter because:

a) <u>The USB connector allows you to provide design information to the vinyl cutter from your computer. It lets you tell the vinyl cutter what you want it to cut.</u>
b) The USB connector allows you to charge the vinyl cutter. It lets you power your machine.
c) The USB connector lets you update the settings on the vinyl cutter. You'll need to perform this action every time you use the vinyl cutter.

7) Which part of the vinyl cutter holds the blade?

a) The grit rollers
b) The loading lever
c) <u>The cutting carriage</u>
d) The pinch rollers

8) You'll know you've found the glossy, waterproof vinyl when you see this number on the backing:

a) 631
b) 600
c) <u>651</u>
d) 000

9) You notice that the blade isn't cutting all the way through your vinyl. What should you do?

a) <u>Notify an Innovation Lab staff member. They will be able to make force adjustments to fix this problem.</u>
b) Read the manual and then adjust the blade force as directed.
c) After pausing cutting you can use the pen force slider to adjust the force.

10) You want to cut a shark shape out of green, glossy vinyl to attach to your water bottle. Where should you look first?

a) The cupboard (below the vinyl cutter) where the rolls of glossy vinyl are stored
b) <u>The remnants box</u>

c) The location for ready-to-use vinyl changes frequently. Ask an Innovation Lab staff member to show you the current location.

Appendix H

Introductory message to the Fall 2023 Summative Evaluation of 11-Module Course

"Welcome to 'Assessment of the '**Vinyl Cutter Level 1 Badge Course**!'

You are on the ground floor of this course's creation, and we thank you for your participation! The online portion of this course is comprised of 11 interactive modules:

- Introduction and Objectives
- Vinyl Cutter Parts and Their Purposes
- Materials You Can Use with the Vinyl Cutter
- Vinyl Cutter Safety
- Vector Files: The Language of the Vinyl Cutter
- Choose a Vector File
- Prepare Your File
- Cut Your Sticker
- Transfer Your Sticker
- What to Do When You Have Questions
- Additional Resources and Next Steps

This online portion of the 'Vinyl Cutter Level 1 Badge Course' is intended to precede hands-on vinyl cutter use by Innovation Lab learners.

Before you begin the course, we'll have you complete:

- A Google Forms **10-Question Pre-Course Understanding Check-In**
    - It is expected that you won't know the answers to these questions yet. Think of it as a preview of what you'll be learning.
    - Please note: Correct answers will not be provided after completion of this form, but "understanding check-in" questions integrated throughout the course provide individualized feedback after each question.

After you complete the 11-module course, we'll have you complete:

- A Google Forms **10-Question Post-Course Understanding Check-In**
- A Google Forms **Usability Survey** (This gives us feedback on your experience to help us make the course better. Please feel free to give us your recommendations for this course under construction!)

Thank you for your participation!"

Appendix I

Vinyl Cutter "Level 1 Badge" Course Image Examples

Image 1

Title: Module 1 visual example

Image 2

Title: Module 2 visual example

Image 3

Title: Module 3 visual example

Image 4

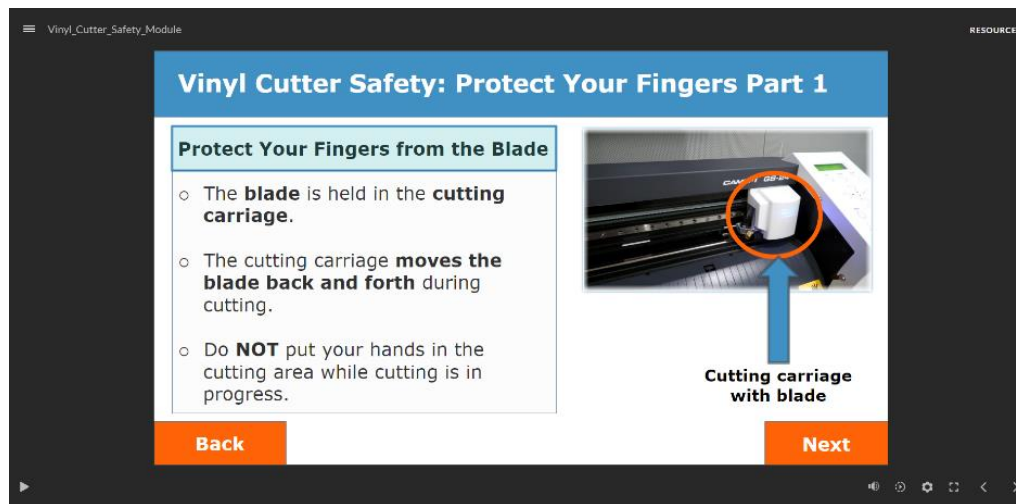*Title: Module 4 visual example*

Image 5
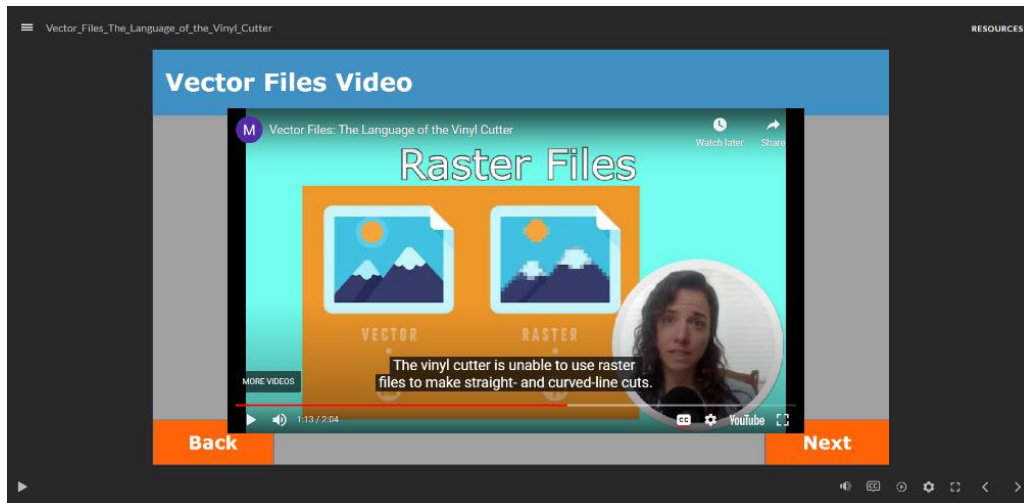
Title: Module 5 visual example
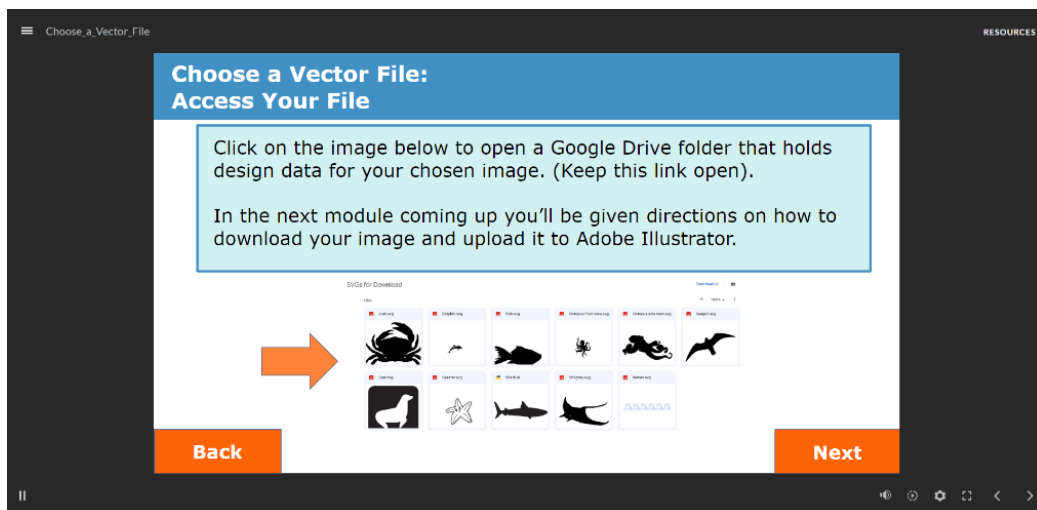
Image 6

Title: Module 6 visual example

Image 7

Title: Module 7 visual example
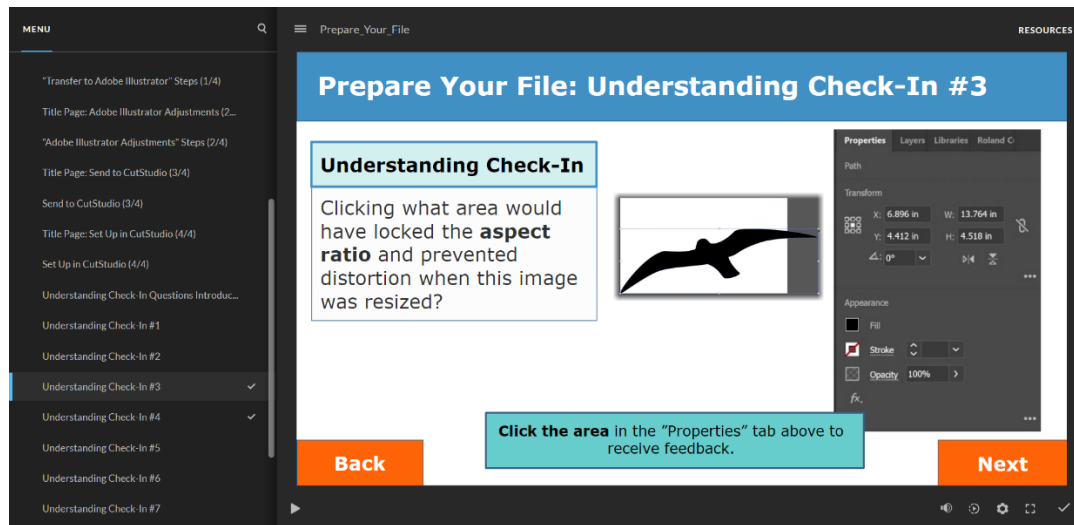
Image 8

Title: Module 8 visual example
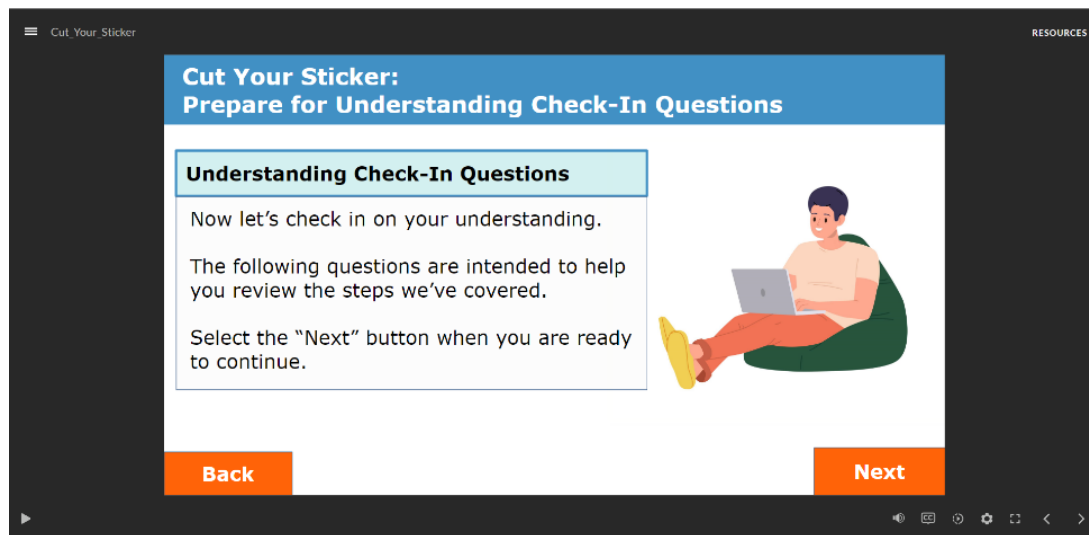
Image 9

Title: Module 9 visual example

Image 10

Title: Module 10 visual example

Image 11

Title: Module 11 visual example
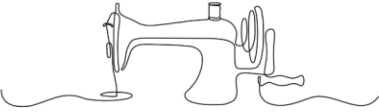
Additional Resources and Next Steps:
Other Innovation Lab tools

Other Tools

The Innovation Lab houses many tools
for which you can obtain safety
badges, including:

• 3D printers
• A heat press
• A laser cutter
• Hand tools
• Sewing machines

Ask an Innovation Lab staff member
about next steps.

Back   **Next**

Appendix J

Liberatory Design Course

Link to course: [Liberatory Design Course](#)

Appendix K

Vinyl Cutter "Level 1 Badge" Course Storyboards

Link: [Storyboards](#)

Appendix L

"How to Vectorize a Drawing for Vinyl Cutting" Video

Link to YouTube video: How to Vectorize a Drawing for Vinyl Cutting