



CALIFORNIA STATE UNIVERSITY  
MONTEREY BAY

The Monterey Bay Aquarium's Innovation Lab  
“Level 1 Badge” Vinyl Cutter 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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## Table of Contents

Abstract	4
Introduction	5
Background and Problem Statement	5
Target Audience and Context	5
Rationale for the Project	6
Statement of the Learning Objectives	7
Literature Review	8
Liberatory Design and Design Thinking	8
Review of Relevant Literature/Design Thinking Application	9
Proposed Applications of Design Thinking	10
An Example of Liberatory Design in Action	11
Implications, Future Research, and Relevance to Capstone	12
Solution Description/Media and Delivery System Decisions	13
Delivery Format	13
Media	14
Instructional Strategies and Activities	15
Agenda Explanation	15
Agenda	16
Teaching/Learning Activities	18
Learning Theories and Instructional Strategies	25
Behaviorism	26
Cognitivism	27

	3
Social Learning Theory	27
Nine Events of Instruction	28
Constructivism	30
Multimedia Principles	33
The Multimedia Principle	33
The Contiguity Principle	34
The Modality Principle	34
The Redundancy Principle	35
The Coherence Principle	35
The Segmenting Principle	36
The Personalization and Embodiment Principles	37
Development Plan	37
Project Deliverables & Schedule/Timeline	38
Potential Challenges & Contingency Planning	41
Implementation Plan	42
Evaluation Plan	44
Formative Evaluation	44
Summative Evaluation	45
Evaluation Summary	48
References	49
Appendix A	54
Appendix B	55
Appendix C	57

## **Abstract**

The efforts of this capstone are directed at creation of a “Level 1 Badge” course on safe and effective vinyl cutter use for the Monterey Bay Aquarium’s (MBA) Innovation Lab. Acquisition of a “Level 1 Badge” permits the learner to use the vinyl cutter with 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. Successful course completion demonstrates the learner’s ability to use the vinyl cutter safely and effectively with supervision.

Behavioral and cognitivist learning theory tenets provide 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” informs the agenda, and social learning theory tenets serve 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 are consciously integrated. Incorporating Liberatory Design into the course to facilitate its implementation by learners is an area of interest this capstone project.

Visual and auditory online course design choices are guided by the multimedia principles of eLearning. The goals of facilitating generative and essential processing, while minimizing extraneous attention-diversion, informs course 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 and Innovation Lab manager Luis David Calderon. 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 final course development decisions.

## **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 focus on creation of the vinyl cutter “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 trainings and set about creating necessary materials. Some tools, such as the 3D printer, now 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 will allow more people in more places to access the 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 this online coursework. This will facilitate the provision of the support novice learners may require. Virtual coursework will 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 a visual job aid, Innovation Lab participants will be able to 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 send design data to CutStudio software without receiving an "error" notification.
- 2) Given a reference sheet, Innovation Lab participants will be able to load A4-size material into the correct position in the vinyl cutter based on the material's width with 100% accuracy.

- 3) Given access to vinyl cutter course instructions, Innovation Lab participants will be able to download and import one of several pre-selected vector designs that are compatible with the GS-24 vinyl cutter into Adobe Illustrator without receiving an error notification.
- 4) From memory, Innovation Lab participants will be able to turn the vinyl cutter on and off.
- 5) Given access to a performance guide, Innovation Lab participants will be able to direct the GS-24 vinyl cutter to cut a design.
- 6) Given access to a performance guide, Innovation Lab participants will be to prepare a file for cutting in Adobe Illustrator, including resizing and modification of the “fill” and “stroke.” This vector design will be compatible with the GS-24 vinyl cutter.
- 7) 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 might arise.

## **Literature Review**

### **Liberatory Design and Design Thinking**

The Innovation Lab is built upon the philosophical tenets of Liberatory Design (LD). As the Aquarium’s team states, “we’ve integrated maker education with environmental education in an equity-centered process” (Monterey Bay Aquarium, 2022b, ‘At the heart of everything we’re doing’).

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 design thinking 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 will be 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. This will be communicated within the course to students.

While the primary goal of this course is to facilitate efficient and effective understanding of all components that support GS-24 vinyl cutter design and product creation, creative

incorporation of the tenets of LD philosophy into the training is an area of research and interest for this capstone project.

### **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, excerpt 1). 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, ‘Specific challenges, underlying issues’).

Given limited data accompanying LD’s recent inception, a review of proposed and actual DT implementation was undertaken. Many 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, demonstrating 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, Teka et al. (2021), asserts that the user-centered DT structure – supported by the growth of model-based systems engineering – can support empathetic, creative problem-solving. Moganakrishnan et al. (2018) also advocates for DT – within the framework of Liberatory Design practice – to support sustainable development engineering, arguing that an empathetic stance facilitates critical questioning of assumed power structures. Rois et al. (2020) proposes 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 next to its DT predecessor, one of LD's co-founders David Clifford relays a compelling personal 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). While the school's principal Ben wished to use Design Thinking, David advocated for “something a bit stronger” because he saw a need for “designing trust across power systems – between students and teachers, teachers and administration, men and women, Arab-Israelis and Jewish-Israelis” (TEDx Talks, 2019). With the problem-solving framework of LD agreed upon, Ben and David engaged in “many equity pauses to practice self-awareness and build relational trust” (TEDx Talks, 2019). David

shadowed Ben to gain empathy for him as a leader and went into the classrooms to ascertain the energy. David reported back that “the apathy was violent...The students’ dignity and learning spirit were being violated...they reciprocated with disrespect, disruption, and disengagement. The teachers had given up and so had the students” (TEDx Talks, 2019). Eventually, Ben and his team identified their ‘juicy question’: ‘How might we engage unmotivated and disengaged students?’” (TEDx Talks, 2019)

Acting on the identified goal of student engagement, 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 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 its co-founder Tania Anaissie, Liberatory Design’s ability to “translate our equity values into action,” (Jennifer Hennesy, 2021) allowed David, Ben, and their team to make headway in cultivating cultural shifts in the school.

### **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 complex problems with empathy and equity. While comprehensive evaluation of the efficacy of Liberatory Design exceeds the limits of this straightforward design, effectiveness of LD integration into this capstone course might be evaluated via multiple avenues. Input from the Aquarium's STEM Integration Manager Athena Barrios, the Education Programs Director Katy Scott, and the MBA's Senior Education Specialist Luis David Calderon will be elicited to assess its incorporation. Participant feedback will be collected upon completion of the course. 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 completion of the vinyl cutter and other tools' courses.

In a March 2023 SME meeting, Education Programs Director Katy Scott communicated that the STEM Integration Manager Athena Barrios intends to create a course on Liberatory Design in the summer of 2023. Communication was sent to Athena, expressing an interest in her work, and requesting her input on how this "Level 1 Badge" course might best reflect and inspire Liberatory Design. A summer term personal interest project led to my creation of a [Liberatory Design course](#) in Articulate Rise 360, which has been provided to SME Katy Scott along with notification that the Innovation Lab may utilize the course as it serves the needs of their staff if desired.

### **Solution Description/Media and Delivery System Decisions**

#### **Delivery Format(s)**

Most of 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 at this stage. Successfully attaining a “Level 1 Badge” sets learners up to later engage in guided discovery learning, implementing the skills they gain in this course to tackle 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. While Thinkific remains the active LMS as of August 2023, SME Katy Scott communicated during summer prototype testing that a possible LMS transition may take place soon.

The intention is to create most of the capstone course content with the eLearning authoring tool Articulate 360 Storyline. This plan has been confirmed with the SMEs. The majority of modules are built around a central educational video. These videos were shot in the Innovation Lab and were edited primarily with Adobe Premiere Pro. Camtasia and OBS Studio video editing software were utilized to create screencast videos. Simple webpage instruction built with Adobe Dreamweaver may be integrated into Storyline 360 modules as approved by SMEs.

Based upon student hardware and software access, the first 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. The goal of

this blended approach is 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, physical and online job aids, picture references, direct software interaction accompanied by audio and textual instruction, and in-person training and sign-off. Consciously scripted audiovisual instruction provides step-by-step guidance within the context of example projects, as most of the work is procedural. Video instruction will be made easily accessible for reference in a final consolidated "Resources" section, made available upon completion of the "Level 1 Badge" course. Job aid references with static images and text will also be created and made readily available for online and physical in-person access. These job aids will incorporate carefully 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). Authentic activities with software design and the vinyl cutter machine will optimize transfer.

SME Katy Scott facilitated access to professional videography tools and Innovation Lab resources. Videos already in place for tools like the 3D printer are simple, but effective. These video templates, existing training, and feedback from the MBA team provided support for optimization of scripting and production of instructional videos. Initial Innovation Lab vinyl cutter course filming was completed on the 14<sup>th</sup>, 16<sup>th</sup>, 18<sup>th</sup>, and 20<sup>th</sup> 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." Storyboards for these 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.

This capstone training culminates in authentic experiences. Hands-on interactions with the software tools Adobe Illustrator and CutStudio are facilitated. The final training and sign-off takes place with the vinyl cutter in the Innovation Lab.

### **Instructional Strategies and Activities**

#### **Agenda Explanation**

The agenda of this course is informed by an 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 the next item. Confirming or corrective feedback is provided after each miniature assessment. The opportunity to retry is provided after each question. 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, simple software design, and hands-on vinyl cutter use.



## Agenda

1. Introduction (4 min): Present example projects and introduce Liberatory Design.
2. Course Objectives (3 min): Inform students of the course goals and what they will know and be able to do after completing the course.
3. Vinyl Cutter Uses (3 min): Introduce students to general vinyl cutter uses and types of products that can be made with the vinyl cutter.
4. Vinyl Cutter Parts and Their Purposes (8 min): Educate students on each of the individual vinyl cutter parts and the purposes of those parts.
5. Materials You Can Use with the Vinyl Cutter (6 min): Educate students on what materials are appropriate to use with the vinyl cutter.
6. Vinyl Cutter Safety (6 min): Educate students on important vinyl cutter safety protocols.
7. Vector Files and the Vinyl Cutter (4 min): Introduce students to the concept of a vector file and provide education on why this type of file is needed to make vinyl cutter products.
8. Choose a Vector File (4 min): Provide students with a curated folder of Aquarium style vector files and guide them through selection of a file.
9. Design Transfer (4 min): Introduce students to CutStudio and walk them through the steps of transferring a design.
10. Resize a Design (3 min): Educate students on how to use the vinyl cutter to resize a design with the aid of a pre-cutting preparatory steps checklist.
11. Basic Vinyl Cutter Use (15 min): Educate students via demonstration how to perform basic vinyl cutter functions.
12. Sticker Transfer (3 min): Educate students via demonstration how to transfer a sticker.

13. Frequently asked questions (FAQs) and Troubleshooting Tips (15 min)

- a) Adobe Illustrator FAQs
- b) Roland CutStudio FAQs
- c) GS-24 vinyl cutter FAQs

14. Final Sign-off (24 min): Innovation Lab hands-on demonstration and sign-off with supervision

15. Resources (3 min): Learning points summary, links to resources introduced in the course, access to further learning resources (e.g., MBA Adobe Illustrator course)

### **Teaching/Learning Activities**

***Introduction (4 min):*** Present example projects and introduce Liberatory Design

The introductory module addresses the first step of the “5-Step Model for Structuring Training” that Stolovitch and Keeps (2011) prescribe: *rationale*.

Gaining learner attention is facilitated via the presentation of example projects in video format. These examples communicate the purposes for which the vinyl cutter may be used and serve as inspiration. A brief introduction to Liberatory Design philosophy within the context of vinyl cutter product creation is included. A closing slide reiterates vinyl cutter uses and LD philosophy tenets within the context of the presented examples, allowing for critical information review. A two-question check-in quiz evaluates the learner’s understanding of vinyl cutter uses and of LD to facilitate engagement.

***Course Objectives (3 min):*** Inform students of the course goals and what they will be able to do and understand after completing the course.

The second of the five steps Stolovitch and Keeps (2011) recommend is *objectives*. 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 will be provided in a video, followed by summary slides. The video format aims to convey information in a memorable fashion, while the slides reiterate important data and provide a resource for review. The Innovation Lab participants, upon completion of this course, will be able to design and cut vinyl cutter products with supervision and access to job aids.

The target audience’s age ranges from 11-year-old to 65-year-old learners. It is important to instruct to the lowest level of understanding. Encouragement alongside clear guidelines aim to speak to audience members from novice to expert. The training will clearly state that, regardless of experience level, successful completion of training is required to use tools within the Innovation Lab.

***Vinyl Cutter Uses (3 min):*** Introduce students to vinyl cutter uses and types of products that can be made with the vinyl cutter.

Depending upon content covered in other modules this module may be deemed unnecessary. The possibility of this module’s exclusion has been discussed with SMEs and final determination will be made with SME input. If the initial module’s presentation of example projects and the explanation of products within the context of the “Materials You Can Use with the Vinyl Cutter” module are determined insufficient, this module will concisely list vinyl cutter uses in video and slide format. Two to three understanding check-in questions will follow content presentation to elicit learner engagement.

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

After an introductory slide, a video introduces the learner to 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. A job aid version of this slide will be made available online in the final section of the module. A physical job aid will also be available in-person in the Innovation Lab directly beside the vinyl cutter.

The module concludes with five understanding check-in questions, including drag-and-drop and multiple-choice format, eliciting active participation 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 quizzes 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" and "practice exercises" rather than "quizzes" or "tests" to mitigate the fear response the latter terms can elicit (Stolovitch & Keeps, 2011).

***Materials You Can Use with the Vinyl Cutter (6 min):*** Educate students on what materials are appropriate to use with the vinyl cutter.

A video presents materials that may appropriately be used with the vinyl cutter after a slide with voiceover audio has introduced the module. Simple, concise slides review the content introduced in the video. A job aid version will be linked in the final section of the module. A physical reference will also be available in-person in the Innovation Lab directly beside the vinyl cutter.

A three-question understanding check-in quiz follows the review slides. Confirming or correcting feedback follows each quiz question, along with the opportunity to retake incorrectly answered questions.

***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 provides education on the importance of adhering to vinyl cutter safety protocols and reviews the most important safety “Do’s” and “Don’ts.” Review slides reiterate safety information. These safety protocols will be made available as a job aid in the final “Resources” module.

The seven-question prerequisite safety quiz at the end of this module must be completed with 100% accuracy before the participant is permitted to proceed. This quiz includes a mixture of multiple-choice, drag-and-drop, and hot-spot clickable questions. Confirming or correcting feedback is provided after each question is answered. The quiz may be reattempted an unlimited number of times until 100% accuracy is achieved.

Examples of successful and unsuccessful adherence to safety standards may be provided to elucidate the importance of provided directions. For example, it may be reasonable to incorporate a non-example of a broken device or a failure to maintain safety standards that resulted from improper use of the vinyl cutter, bolstering motivation to complete safety training. The advisability of non-example inclusion will be discussed with SMEs.

***Vector Files and the Vinyl Cutter (4 min):*** Introduce students to the concept of a vector file and provide education on why this type of file is needed to make vinyl cutter products.

Learners will be provided explanatory information in video format of how a vinyl cutter works. This will include an explanation of what vector files are and why they are compatible

with the vinyl cutter. The activities to follow will be informed by the understanding this section provides.

***Choose a Vector File (4 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 *experience* and *autonomy* are consciously incorporated in this module (Stolovitch & Keeps, 2011). Specific supportive guidance will be provided, but if participants have prerequisite experience, they will be encouraged to create designs as complicated as their skill level permits. All learners, regardless of experience, will be provided with multiple vector file options to choose from, incorporating a degree of autonomy. These sample vector files were primarily obtained from Pixabay.com, a site with royalty-free stock media. A screencast video educating learners on how to find a desired vector graphic on Pixabay.com may also be included. The option to self-select from near unlimited options may be curtailed in this “Level 1 Badge” course; it may be reasonable to await higher badge level training to introduce the ability to search and identify vector files online.

In addition to *experience* and *autonomy*, this activity also successfully integrates the adult learning principle of *action*. The admonition of Stolovitch and Keeps (2011) to “Above all, keep...training active” (p. 126) is honored. Most subsequent modules also require active engagement from participants.

The prior *experience* of learners will be acknowledged in noting that learners may alternatively use CorelDraw or InkScape if they are familiar with these software tools. If learners have home access to these software, they may choose to use them.

***Design Transfer (4 min):*** Introduce students to CutStudio and walk them through the steps of transferring a design.

The third step in Stolovitch and Keeps' (2011) "5-Step Model for Structuring Training" is *activities*. Hands-on procedural engagement with software is required as learners follow simple step-by-step guidance to transfer their selected vector file from Adobe Illustrator, CorelDraw, or InkScape to CutStudio.

***Resize a Design (3 min):*** Educate students on how to use the vinyl cutter to resize a design with the aid of a pre-cutting preparatory steps checklist.

Continued hands-on engagement with CutStudio will be facilitated in this activity module. In a March 2023 meeting, SME and Innovation Lab manager Luis David Calderon communicated the importance of this module's inclusion to facilitate conscientious preservation of materials. Encouragement to use resources wisely and prevent waste is incorporated throughout the course. This training section will guide learners to resize designs, making use of materials that might otherwise be discarded.

***Basic Vinyl Cutter Use (8 min):*** Educate students via demonstration how to perform basic vinyl cutter operations (Loading the material, turning the machine on, removing the vinyl background, and shutting down the machine)

A carefully scripted and shot video will demonstrate the steps of vinyl cutter operation. Review slides will follow the video. A job aid that lists the demonstrated steps will be included. A link to this job aid will also be included in the final consolidated "Resources" module. A physical job aid will be made available in-person in the Innovation Lab directly beside the vinyl cutter.

A five- to six- question multiple choice quiz will follow the video. Confirming or correcting feedback will follow quiz completion with the opportunity to retake the quiz.

***Sticker Transfer (3 min):*** Educate students via demonstration how to transfer a sticker.

At a capstone planning meeting in March 2023, subject matter experts Katy Scott and Luis David Calderon recommended division of the vinyl cutter use demonstration videos into “basic steps” and “sticker transfer” modules. This information chunking will be done to facilitate generative processing while preventing cognitive overload.

***Frequently asked questions (FAQs) and Troubleshooting Tips (8 min):*** Adobe Illustrator FAQs, Roland CutStudio FAQs, and GS24 vinyl cutter FAQs

Short videos will provide simple troubleshooting tips and techniques for Adobe Illustrator, CutStudio, and the GS-24 vinyl cutter machine. Quiz questions will follow the videos. Answers will be met with confirming or correcting feedback and the opportunity to retry until success is achieved.

“Frequently asked questions” (FAQs) will be reviewed in these videos and will be summarized in slide format. These FAQs will be made available as job aids, included in the final “Resources” module. Instructions to reference the manual with an included GS-24 manual link will also be included (Roland DG Corporation, 2015).

This module will include a basic troubleshooting challenge scenario. The learner will be provided a worked example with step-by-step guidance on how to find steps to address a problem that arises. SME input will be elicited to determine an ideal common troubleshooting scenario.

***Final Sign-off (24 min):*** Innovation Lab hands-on demonstration and sign-off with supervision

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 this final sign-off learning activity participants will complete hands-on training and sign off with certified supervisory personnel with the Innovation Lab vinyl cutter.



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 the supervisor with the support of a structured performance checklist to assess if the learner has met objectives. Existing instructional materials include a performance checklist for final sign-off. This form will be reviewed and optimized for use with SME support.

***Resources (3 min):*** Learning points summary, links to resources introduced in the course, access to further learning resources (e.g., MBA Adobe Illustrator course)

A final summary module will succinctly list the content covered in the course. It will provide links to course videos, job aids, and the GS-24 vinyl cutter user’s manual (Roland DG Corporation, 2015).

Instructions on how to access guidance in the Innovation Lab via personnel, online guides, and physical job aids will be provided.

A brief introduction to the succeeding badge levels and how to obtain them will be provided, encouraging further engagement if the participant is motivated and interested.

The Innovation Lab’s education team intends to create a full course on Adobe Illustrator use. Once the Adobe Illustrator course is complete, a link will be added to this final “Resources” module, providing interested participants with the opportunity for further engagement.

Congratulations will be provided on successful course completion. Learners will be encouraged to return to these materials as often as needed for support. Pending feedback from SMEs, it might be reasonable to incorporate links to example projects, the MBA Instagram’s

repository of completed projects, and a challenge to the learner to incorporate Liberatory Design principles in creative projects they are now prepared to take on.

### **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, keeping 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 stark, but as Keramida (2015) argues, 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 tenets are foundational. Knowledge acquisition is facilitated in the forms of discrimination of machine components and the

association of linking desired behavior with positive outcomes (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 inviolable, 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 an acknowledgement of the complex mental processes that learners undergo 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 acknowledges.

### ***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 and in-person demonstration 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 will be provided to learners. Physical supervisory models (teachers) will 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, will be followed by “mastery experiences.” Students will assume authentic physical challenges 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.) recommends introducing content with an attention-grabbing short video, a question that primes the learner, or a relatable story. The introductory module for this course will provide inspirational example products created with the vinyl cutter in the context of a scripted and well-shot video.
- 2) **Inform students of the objectives:** The second module will present students with clearly stated declarative and procedural objectives. LaMotte (n.d.) recommends increasing

engagement by framing objectives as questions or challenges. This recommendation may be implemented with the goal of optimizing intrinsic motivation.

- 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 course might ask learners to think of other creation projects they have undertaken (e.g., drawing a picture, writing a letter, building a sandcastle, etc.). Their understanding of the importance of basic safety protocols might be touched on via examples with which they are already familiar (e.g., avoiding touching a hot stove, wearing your seat belt). 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.
- 4) **Present the stimulus:** The “stimulus” makes up the bulk of the course. In this case, modules 4 – 13 provide directions within the context of examples, videos, slides, demonstrations, and hands-on learning activities. As LaMotte (n.d.) advises, multiple formats are utilized to optimize content provision and learner engagement.
- 5) **Provide learning guidance:** Much of the curriculum will be 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 will guide and support learners. In-person Innovation Lab supervisors will support the hands-on sections, and eLearning module navigation if needed. As learners communicate their current knowledge level, education personnel in the Lab will be able to tailor their scaffolding 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:** After the introductory, explanatory, and declarative learning modules are complete, learner performance is elicited via active engagement with the software programs Adobe Illustrator and CutStudio. The final hands-on vinyl cutter sign-off requires active performance, overseen by supervisory personnel with the aid of a performance checklist.
- 7) **Provide feedback:** Knowledge checks are integrated throughout the course. These questions 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 vinyl cutter portion of the course, learners will be provided 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 results in obtaining a physical "Level 1 Badge" for vinyl cutter use. If standards are not met, students will receive notification of this result and will be provided the opportunity to retake the course if time permits.
- 9) **Enhance retention and transfer:** Online and physical job aids will be made easily available to students. The final "Resources" module will provide access to links related to covered content, education on where to access physical job aids, and information on how to access related learning opportunities (e.g., the Aquarium's Adobe Illustrator course, higher badge level certification courses). Encouragement to request support from

supervisors in the Innovation Lab will be given. Participants will be set the challenge of taking on vinyl cutter design and creation projects within a Liberatory Design framework.

### **Constructivism**

A constructivist curriculum is not necessarily designed to build towards a planned outcome. Teachers support learners in constructing their own mental models. From a Vygotskian social constructivism standpoint, this world view construction 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 complex 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, thought challenges will be integrated to provoke creative individual assessment of how the vinyl cutter might be used to benefit society, 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 will be implemented. After being presented with examples of how vinyl cutter use has benefitted previous learners, integrating a cultural element in alignment with social constructivism, learners will be challenged to reflect on their own previous experiences with creation (e.g., clay modeling, Lego construction, illustration, storytelling, etc.) to facilitate connection building. 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. Learners will be guided to consider this possible use of 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). Students will be challenged to consider what products they might create and be encouraged to share these creations – in the lab or on the Monterey Bay Aquarium’s Instagram page – if they feel comfortable doing so. The final section of the vinyl cutter course might include a link to the MBA’s Instagram profile, providing the opportunity to view products created by previous students and informing how work might be shared.

Community interactivity is integral to course design. The penultimate module requires a 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 opportunity to share final products allows for peer interaction and feedback. The learning accomplished via the group will lead to individual and community development (Harasim, 2017). 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.

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. It is possible that an online discussion and sharing forum might be integrated into the course based upon SME feedback.

### **Multimedia Principles**

Multimedia eLearning principles guide 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 aim 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 inhibit 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 item that audio narration is describing is highlighted and the portion of the vinyl cutter that is being discussed is 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 optimizes efficient learning. Feedback is displayed on the same screen as the practice question (or the practice question content is included in the feedback), directions for practice exercises are made available on the same screen where those directions are to be applied, and text related to graphics is 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 whenever possible. Narration was scripted and approved by SMEs prior to incorporation, 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 “pinch rollers” are introduced in the “Vinyl Cutter Parts and Their Purposes” video, the term also appears 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 serves to minimize visual channel cognitive overload.

To facilitate accessibility, learners will be provided with the option to receive information via on-screen text *or* audio, but they will not be presented the option to include both. This will prevent learners from selecting a format that does not best facilitate their cognitive processing.

### **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 might 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.

It is thus essential to elucidate learning objectives prior to embarking on design. Careful selection of congruous elements then serves to minimize 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 distract from learning. The identification of instructional goals for this capstone with the support of SMEs supports adherence to the coherence principle. Any “words, graphics, or sounds not central to the instructional goal” (Clark & Mayer, 2016, p. 168) are 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 has facilitated the breakdown of modules into smaller chunks to avoid overwhelming learners.

Of relevance to this capstone, Clark and Mayer (2016) recommend that instruction be designed to pause at fitting junctures. Not only is it the responsibility of the instructor “to present information, but also 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. Presenting the course in microlearning module sections aims to support essential and generative processing.

### **Personalization Principle**

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’s modules utilize 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. Select screencast instructional videos include video of the narrating instructor.

### **Development Plan**

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. Communications with SMEs guided content design throughout the following semesters.

The final capstone deliverable is projected for completion between early to mid-November 2023, facilitating user testing in the latter half of that same month. Implementation data analysis and final reporting will follow in December 2023 preceding December graduation from the MIST (Master's in Instructional Science and Technology) program.

The capstone proposal's first draft was finalized in the Spring 2023 IST 520 course. Spring 2023 also saw the creation of three modules, including 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 optimizations and informed continued course creation efforts.

## **Project Deliverables & Schedule/Timeline**

### **1. Learning Objectives**

#### *a. Status: Ongoing*

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 and Innovation Lab manager Luis David Calderon confirmed the appropriateness of proposed learning objectives.

- b. *Estimated finalization date:* Initial approval obtained March 2023. Final confirmation projected for September 2023.
- c. Ongoing communications as portions of the course are built will facilitate optimization, but general approval for proposed learning objectives has been obtained from the SMEs.

## **2. Storyboarding the Fourteen Proposed Course Modules**

- a. *Status:* Ongoing
- b. *Estimated finalization date:* April – October 2023
- c. The proposed vinyl cutter course includes fourteen eLearning modules with integrated assessments and learning activities. Storyboards for each of these modules will detail the script, visual video content, quiz questions and assessments, guided activity instructions, and linked resources. These storyboards will be 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.

## **3. Module Draft and Pilot Test**

- a. *Status:* Completed
- b. *Completion dates:* June – July 2023
- c. The creation of three modules following the approval of storyboarded strategies developed in the proposal was completed in the Spring 2023 semester (see Appendix

A). Formative evaluation testing was conducted in July 2023 to ensure instructional methods aligned with learning objectives and to assess the ease of module navigation. Innovation Lab program assistants and volunteer distance learners supported this formative evaluation process. Elicited feedback guided optimization revisions to modules and directed further course development decisions.

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 this formative evaluation testing’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 testing 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.

As work on the final 14-module “Level 1 Badge” vinyl cutter course continues, results and feedback from this prototype assessment will be applied to future modules



to optimize learning outcomes. Module improvement recommendations – including the addition of signaling cues, and course look and notification improvements – have been implemented. Modules planned for creation, including a start-to-finish vinyl cutter project demonstration and a “Troubleshooting Tips/Frequently Asked Questions” module, will be made, supporting learner requests.

#### **4. Finalized Course**

- a. *Status*: Upcoming
- b. *Estimated finalization date*: November – December 2023
- c. The final course will reflect the feedback obtained from the test pilot participants, SMEs, and Innovation Lab stakeholders. I will collaborate with the Monterey Bay Aquarium’s education team via the SMEs to obtain final approval and course launch dates.

#### **Potential Challenges & Contingency Planning**

While the Monterey Bay Aquarium’s education team currently faces many demands, primary SME and Education Programs Director Katy Scott has been generous with her time and support. Multiple face-to-face meetings, a tour of the Innovation Lab, introduction to Innovation Lab team members, and online Zoom meetings have been facilitated by Katy. Senior Education Specialist and Innovation Lab manager Luis David Calderon has also been a reliable source of assistance and feedback. While it is reported that consistent SME communication can be one of the greatest challenges students in the MIST program face, SME support has been 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 has offered advisement as needed.

Despite these advantages, it is wise to anticipate time management as a possible challenge. In collaboration with my MIST program capstone advisor, Dr. Sarah Evanick, it is planned to communicate with the Innovation Lab's education team well ahead of time. This will ensure that timelines for preliminary modules provision, usability testing, and final deliverables are known. Providing ample time for coordination will allow for contingency arrangements if unforeseeable circumstances necessitate rescheduling. Having deadlines in place with a degree of time cushioning will prevent unforeseen technology malfunctions, emergencies, etc. from derailing plans.

A compelling reason for my personal interest in the MIST program was a desire to build technical competence. With limited experience, one of my greatest anticipated hurdles was attaining proficiency with the technologies utilized to create eLearning modules. The introduction to multiple relevant tools in IST 501 and IST 511 under Professor Beem's tutelage, and the orientation to multiple eLearning authoring tools and web design in IST 526 and IST 541 by Dr. Miguel Lara, have been invaluable. Not only has a baseline understanding of available software and their functions been provided, but completing hands-on assignments has imparted an understanding that answers to questions that arise are available via software guides and the internet community.

### **Implementation Plan**

The final eLearning course will be made available through the Monterey Bay Aquarium's learning management system Thinkific, or a possible new LMS identified by the MBA. The online portion of the vinyl cutter course will allow 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 ideal timeframes,

however often they feel is necessary. Virtual accessibility will additionally cut down on time and personnel resource utilization in the Innovation Lab, maximizing efficiency.

The course's second to last module is 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 will be provided to students by the 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 is the Monterey Bay Aquarium Education Programs Director Katy Scott. She is the main point of contact and is responsible for coordination throughout and provision of final sign-off. It is possible that other MBA Innovation Lab team members, including Senior Education Specialist and Innovation Lab manager Luis David Calderon and Vice President of Education Dr. Jenny de la Hoz, may also be involved in the final sign-off process.

The course's design plan includes the creation of multiple instructional videos. Katy Scott and Luis David Calderon have made professional videography tools and support available through the MBA. Initial Innovation Lab filming was completed on the 14<sup>th</sup>, 16<sup>th</sup>, 18<sup>th</sup>, and 20<sup>th</sup> of April 2023. Future filming days will be scheduled in the Fall 2023 semester. Katy Scott supported the scheduling of in-person instructional video beta testing in the Summer 2023 term, facilitating direct feedback on course modules.

The final section of the course requires hands-on vinyl cutter sign-off with certified instructors. The degree of training required to prepare the certified personnel to support this

portion of the sign-off needs to be determined. It is possible that this training is already integrated into higher Badge Level sign-offs and may not require this capstone work's support. Minimally, arrangements to coordinate supervisor availability will be necessary. Supervisors will need to be available for meetings that finalize the sign-off process. A schedule will need to be built to establish supervisors' availability for in-person sign-offs.

### ***Other Implementation Requirements***

The majority of the course's modules will be completed online and will be made available in the Thinkific LMS Innovation Lab training section. The penultimate module must be completed in the Innovation Lab via the established field trip program.

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

### **Evaluation Plan**

The course has undergone and will continue to undergo multiple formative evaluations. A summative evaluation will be conducted to guide final optimization.

SME and Innovation Lab team members' feedback has comprised a significant portion of formative evaluation data. Their recommendations and insight will continue to inform course creation decisions in the final Fall 2023 semester. Innovation Lab program assistants and distance learner volunteers provided valuable user feedback in the initial test pilot completed in July 2023. Summative evaluation will be conducted in the final stage, projected for November 2023, facilitating final modifications in December 2023 before delivery.

### **Formative Evaluation**

Formative module evaluations have taken place, and will continue, throughout the creation process. Rothwell et al. (2016) describes four major formative evaluation methods. The intention is to implement the formative evaluation strategies they describe of (1) expert reviews by SMEs and (2) individual and (3) group pilot testing.

Storyboards, scripts, and drafted proposals will continue to be presented to SMEs for feedback. Regular meetings with SMEs will facilitate communications that guide early corrective action. As Rothwell et al. (2016) advise, SME feedback will be elicited on course materials, audiovisuals, case examples, and content. Catching mistakes and areas that require modification early in the process will minimize the need for massive revisions late in development.

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

### **Summative Evaluation**

The Kirkpatrick Four-Level Evaluation framework 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)** will be evaluated via learner surveys administered upon completion of the 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).

Summer 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).

Prototype testing will be completed again in November 2023, eliciting further feedback, and guiding final revisions.

- **Learning (Level 2)** is evaluated throughout the course via check-in quizzes and the final procedural skill sign-off facilitated by supervisors. Data collected from

these quizzes and behavioral checklists performance may be utilized for statistical analyses.

Pre- and post-testing conducted in the Summer 2023 term evaluated learning. As described in “Project Deliverables & Schedule/Timeline: Module Draft and Pilot Test” (p. 39 – 41), 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. Effect size analysis with Cohen’s d formula demonstrated great practical significance (see Appendix B). These statistical analyses support the implementation of 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 will be carried out in November 2023 for the entire “Level 1 Badge” vinyl cutter course.

- **Application (Level 3)** is unlikely to receive systematic evaluation. Learners may be encouraged to provide feedback on their future projects within the Innovation Lab. Documentation of created works after training completion could provide data on the degree to which learning was implemented. Continued communication with SMEs and the Innovation Lab team will determine if and how they would like to gather this type of data.
- **Impact (Level 4)** may 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 fully create online training 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 is largely student-created, it is hoped that the ROI benefits the organization.

As Rothwell et al. (2016) assert, the resources and effort that evaluation requires increases as the levels rise. Communication with SMEs and key stakeholders will determine the degree to which evaluation of reaction, learning, behavior, impact, and ROI are desired.

### **Evaluation Summary**

The development, implementation, and evaluation of this course on safe and effective vinyl cutter use for MBA Innovation Lab participants is ongoing. Multiple videos have been shot and edited, and module creation work is ongoing. This capstone proposal provides a framework around which goals and timelines will continue to be organized.

Creation of storyboards, initial modules, and preliminary mock-ups facilitated initial formative evaluations that dictated modifications. Feedback from SMEs and stakeholders in the Innovation Lab will continue to be critical for direction, as will the results of full course summative evaluation in November 2023.

The depth of desired summative evaluation will be determined with the SMEs and Innovation Lab team members. Their input will direct if assessment is to go beyond the initial levels of “Reaction” and “Learning.”



The development, implementation, and evaluation of this course will be conducted in a collaborative fashion. Efforts are ongoing to create storyboards, film videos, and create modules. It is hoped that the creation of this course will benefit the Monterey Bay Aquarium's Innovation Lab team and many Innovation Lab participants in years to come.

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## **Appendix A**

Prototype module links

[Module 4: Vinyl Cutter Parts and Their Purposes](#)

[Module 5: Materials You Can Use with the Vinyl Cutter](#)

[Module 6: Vinyl Cutter Safety](#)

## Appendix B

### Summer Term Prototype Testing Statistical Analyses

**Table 1**

t-Test: Paired Two Sample for Means

	<i>Pre-Test Score</i>	<i>Post-Test Score</i>
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**

<i>Pre-Test Score Descriptive Statistics</i>	
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**

<i>Post-Test Score Descriptive Statistics</i>	
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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

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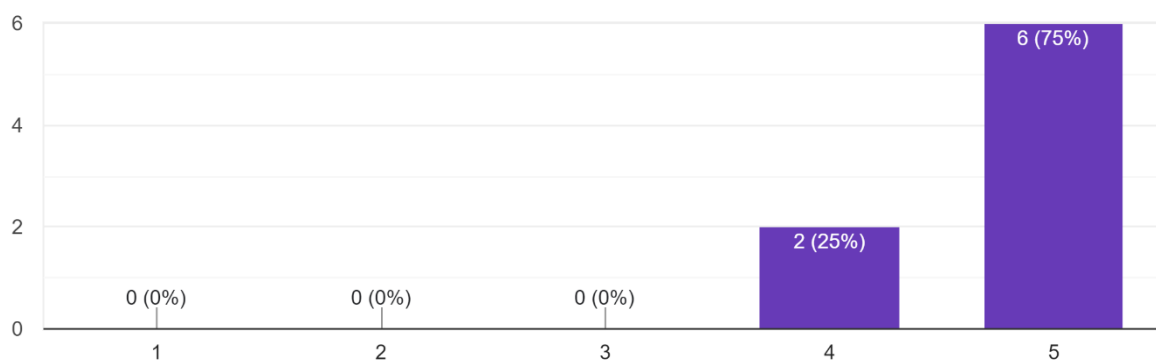
## Appendix C

### Summer Term Usability Survey Results

#### Question 1 Responses

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

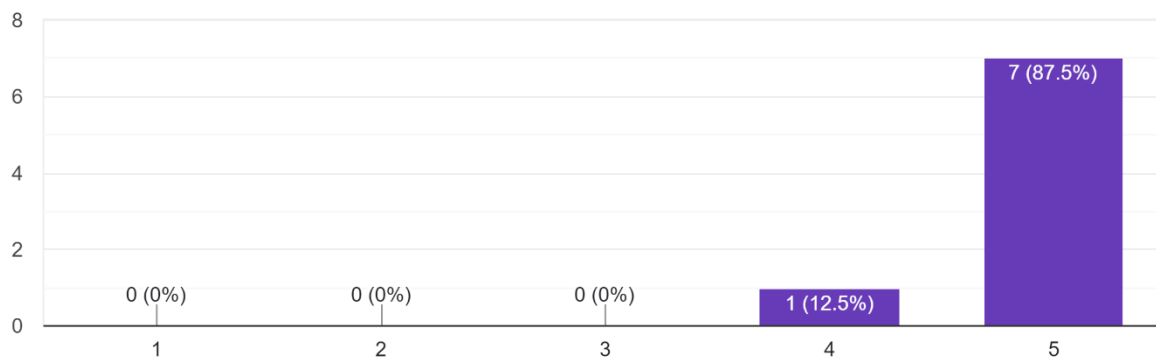
8 responses



#### 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

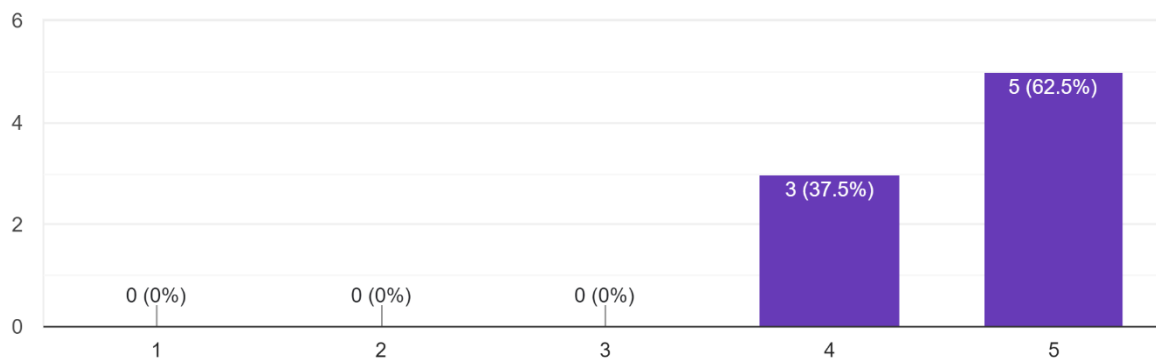
8 responses



#### 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

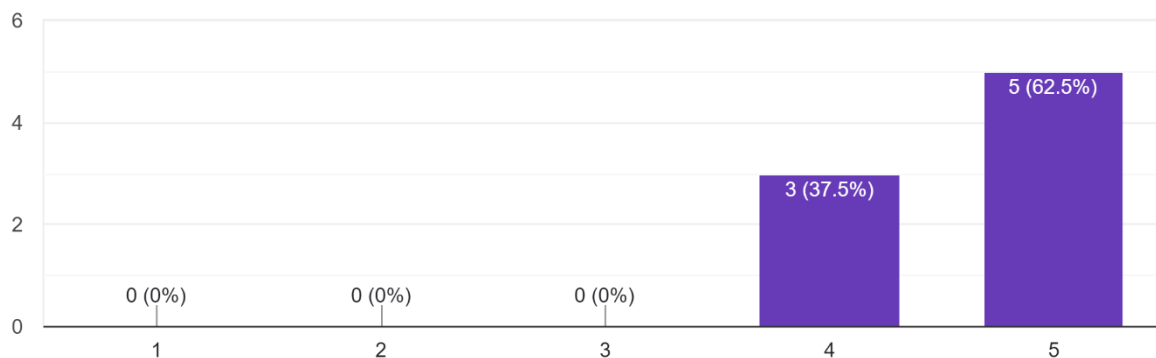
8 responses



#### 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

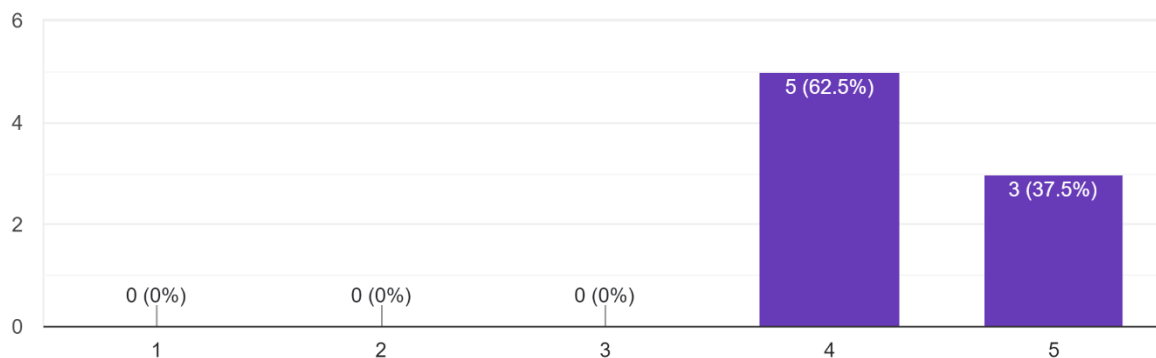
8 responses



#### 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

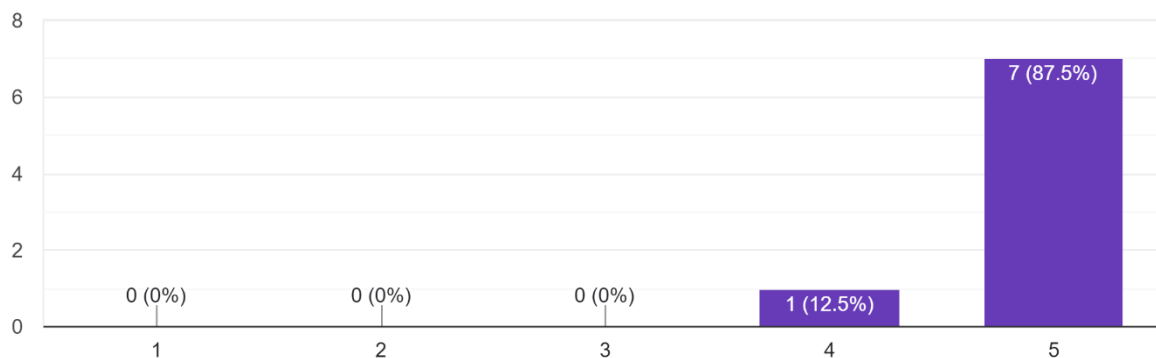
8 responses



### 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

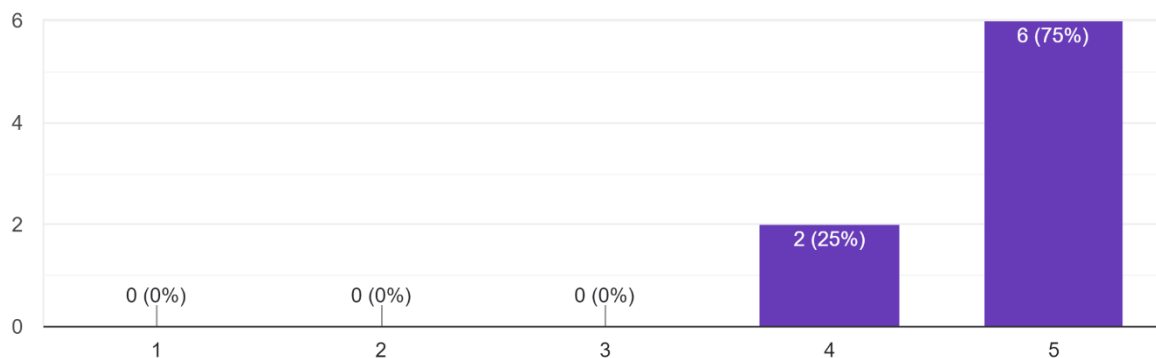
8 responses



### 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 remember 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!!