Monterey Bay Aquarium IDD Content Analysis Worksheet

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IST522: Instructional Design

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October 11, 2022

Brief Introductory Info

Your Name	Amanda Philbrick
Your IDD Topic	Facilitating Engineering Discovery Learning
Organization	Monterey Bay Aquarium Innovation Lab
Learners	Innovation Lab Volunteers

An Introductory Note

Monterey Bay Aquarium's (MBA) mission to inspire conservation of the ocean environment resonates with me, and I aspire to support their work. I was fortunate to be in put in direct contact with former MIST student and current MBA Director of Learning and Engagement, Brianne Fitzgerald. We discussed several potential capstone projects, and it was suggested that I might expand on the Financial Stewardship Series, currently under construction by MIST capstone students Mona Antonious and Yerlany Mendez. My needs, learner, and context analyses focused on this possibility.

Brianne recently followed up to connect me with MBA's Education Programs Director, Katy Scott, indicating that Katy will be the subject matter expert (SME) for a project associated with the Innovation Lab, shifting the focus of my MBA capstone project.

The Innovation Lab is a maker space within Monterey Bay Aquarium's Bechtel Family Center for Ocean Education and Leadership (Monterey Bay Aquarium, 2022c). Their projects grant young people the opportunity to engage in discovery learning, building a sense of their power to positively impact the world and combat climate change.

Establishing the gap, target users, and solutions for the Innovation Lab project is pending updates from my SME, Katy Scott. As I await details, the following content analysis addresses a hypothetical project based on the information I have. The proposed project is creation of an instructional module with the target audience of MBA Innovation Lab volunteers who work with teenagers. The goal will be to prepare these volunteers to confidently facilitate engineering discovery learning. Adequately prepared volunteers will support reopening of the “Design for the Ocean” teenager program. MBA’s mission to inspire conservation of the ocean environment will be bolstered, as will their community presence.

Data Collection

First Source (MBA Employees: Director of Learning and Engagement and Education Programs Director)

The MBA Director of Learning and Engagement, Brianne Fitzgerald, networked on my behalf to identify a project. She put me in contact with the MBA Education Programs Director, Katy Scott. Katy communicated to me that the Innovation Lab has a project that would benefit from an instructional design capstone project.

Second Source: Internet Research on the MBA Innovation Lab

With the knowledge that the MBA Innovation Lab is interested in an instructional design product, I searched the Internet to learn more. Among their many projects, the Innovation Lab supports teachers in creating maker spaces that allow for exploration and design. My SME, Katy Scott, is quoted as stating that the Innovation Lab’s next goal is to “bring engineering- and design-oriented volunteers into the lab to work side by side with teens” (Monterey Bay Aquarium, 2022c, para. 18).

On further exploration I noted that the “Design for the Ocean” after-school program – in which teenagers use engineering skills to design ocean conservation solutions – is currently on hold (Monterey Bay Aquarium, 2022a). With limited knowledge, I have assumed that lack of adequately prepared volunteers to run this program has contributed to a temporary pause.

Third Source: MBA Engineer Volunteer

While I have not yet had the opportunity to discuss the details of Innovation Lab project with Katy Scott, I was able to speak with a mechanical engineer who volunteers weekly at the Monterey Bay Aquarium. He relayed that an engineering subject of ongoing inquiry is how to best mimic the ocean tides to preserve the MBA's kelp forest exhibit. Currently, pumps push thousands of gallons of sea water a minute through this exhibit with surge machines (Monterey Bay Aquarium, 2022b). Optimization and understanding of this engineering topic might be a subject presented to teenager Innovation Lab participants.

Fourth Source: Internet Research on Discovery Learning

STEM (science, technology, engineering, and math) volunteers tasked with guiding teenager participants through discovery learning engineering scenarios will require education on discovery learning and opportunities to practice its tenets. In the absence of SME input at this time, I identified resources that delineate the basics of discovery learning and that provide recommendations on how to guide students through a discovery learning environment.

Content: The Big Picture

Content Overview

The content of the proposed instructional design project will address declarative and procedural components of facilitating engineering discovery learning.

The initial module will introduce learners to the five principles of discovery learning. After tenets are introduced, concrete examples of implementation in STEM will be provided. Basic understanding will be assessed with multiple choice and short answer questions.

Volunteers will be presented with a gamified discovery learning scenario in the second module. Based on their understanding of discovery learning principles, learners will be required to adeptly interact with teenagers tackling an engineering challenge, such as the designing machines that mimic ocean tides for kelp forest preservation. Providing consequential feedback after failure, a facet of the fifth principle of discovery learning, will be a primary focus in this module (Pappas, 2014).

It is relevant to acknowledge that the results of discovery learning are difficult to measure. As van Joolingen states (1999), while the premise of discovery learning is that it will result in higher level student comprehension, “it has been very hard to find solid evidence for this hypothesis” (p. 386). The challenge of identifying measurable outcomes is present when assessing the skill of instructors implementing these tools. The gamified simulation scenarios will represent the unpredictability implicit when working with individuals in a learner-directed environment. Volunteer success will be demonstrated when they consistently make choices within the scenario that align with discovery learning tenets.

The final module will address how to access discovery learning support tools and research, empowering volunteers as they tackle the challenge of facilitating discovery learning. As the discovery learning format demands well-prepared instructors, readily accessible guidance will promote success (Pappas, 2014).

This modular content plan will likely undergo significant modification when SME input is obtained. We may find that the proposed content is difficult to fully address in a one-hour instructional module; it will be critical to ascertain what components stakeholders deem most crucial. It is also possible that the Innovation Lab project Katy Scott proposes will consist of entirely different content.

Essential Declarative Knowledge (Things People Should Be Able to Talk or Write About)

At the conclusion of training, volunteers should be able to independently describe discovery learning and its five principles. They should be able to articulate the purported value of this type of learning, noting that it contributes to comprehending abstract concepts and increasing persistence and creativity (Honomichl & Chen, 2012). Learners should be able to articulate basic principles and reasons for use without reference to support materials.

Essential Procedural Knowledge (Things People Should Be Able to Do)

Volunteers should recognize discovery learning in action. When provided with examples, they should consistently identify when discovery learning tenets are being implemented and when they are not. They will be deemed successful when accurate identification takes place 90% of the time.

Volunteers will be able to provide guided discovery learning support to teenager Innovation Lab participants. To accomplish this, they will require procedural knowledge of how to formulate probing questions, strategically present materials, and provide consequential feedback (Honomichl & Chen, 2012). Possession of this procedural knowledge will be assessed within a simulated scenario. Success will have been achieved when volunteers act in accordance with discovery learning tenets 80% of the time.

Volunteers should possess procedural knowledge on how to access support tools and resources to address questions about discovery learning that arise. Volunteers will demonstrate successful knowledge acquisition when they can demonstrate this skill to an observer upon request.

Procedural Task Analysis

Objective: The volunteer learner will be able to create, send, and access results of a survey. The survey will contain probing questions that assesses baseline understanding of engineering concepts by Innovation Lab students.

This procedural task analysis provides guidance on creation of a Google Forms survey specifically. It assumes that users possess a Gmail account, and that they have the email addresses of their students. Further data collection will confirm if Innovation Lab volunteers and students are provided with their own Monterey Bay Aquarium Gmail account.

Definition of Learning: The volunteer learner successfully creates, sends, and accesses results of a probing questions survey to Innovation Lab participants, assessing baseline understanding of engineering concepts.

Access Google Forms:

1. Open web browser of choice (Internet Explorer, Firefox, etc.)
2. Type “gmail.com” into the bar on the top of the screen and press the “Enter” key.
3. Type your Gmail username and password into the appropriate labeled sections.
4. Select “Next.”
5. In the top right of the screen, click on the 3x3 waffle design. (When the mouse is hovered over this image, the text “Google apps” appears.)
6. When the waffle design is clicked, a list of drop-down options will appear. Click on the “Forms” option.

Create Google Form Survey:

1. Under the “Start a new form” section, click on the box labeled “Blank.”
2. Click on the “Untitled form” section at the top of the new screen that opens. Backspace to delete “Untitled form.” Type a title that accurately reflects the content of your survey.
3. Click on “Untitled question.” After you click, a section that states “Multiple choice” with a downward pointing arrow will appear to the right of “Untitled question.”
4. Click “Multiple choice.” A drop-down menu will appear. Click on “Paragraph.”

Create probing questions:

1. Type a question that probes a learner’s understanding of an engineering topic. Questions might begin with “Please describe,” “Explain why,” or “How,” for example.
2. Imagine to yourself how a student might respond to eliminate close-ended questions.
3. To add additional questions, select the “+” button to the right of the question you last created. Create additional probing questions.

Send survey:

1. Select “Send” at the top right of the screen. A pop-up entitled “Send form” will appear.
2. Enter your students’ email addresses in the “To” section. Include commas in between email addresses.
3. Once all desired emails have been added, click the “Send” button at the bottom right of the pop-up.

Access results:

1. Log-in to your email and access the Google Form section by following the steps listed in the “Access Google Forms” portion of this procedural task analysis.
2. Under the “Recent forms” section you will see the survey you created. Click on the survey to open.
3. At the top of the screen, click on “Responses.”
4. To view the response results, scroll down.
5. To view responses in sheet form, select the green square at the top right of the response section. When you hover over this box, the text reads, “View responses in Sheets.”

Concept Analysis

Concept Name and Definition

Scaffolding is a Vygotskian concept that requires guidance be provided to learners in response to their current experience and abilities (Honomichl & Chen, 2012). Appropriate implementation of scaffolding means that a volunteer provides greater support to a less experienced learner. A more prepared student is provided with less feedback.

Critical Attributes

The skill of student assessment is a critical attribute. It will be essential that volunteers know how to determine the current understanding and abilities of a teenager Innovation Lab participant. The ability to gather baseline student data should not pose difficulty. It is only with an understanding of the individual learner that the critical components of discovery learning can be implemented.

Variable Attributes

The methods utilized to gather baseline student data, and to provide scaffolded feedback, might vary. A volunteer might individually interview Innovation Lab students, email surveys, or observe how teenagers initially interact with their environment to assess baseline skills. Scaffolded feedback might be provided by guiding a student to navigate a database, asking a probing question that directs student inquiry, or providing a relevant example or story.

Clear & Obvious Examples

Discovery learning should be well-designed to include various formats for provision of scaffolded education, including stories, games, visual aids, and curiosity-inspiring technologies (Mirzoyan, 2021). Many resources, educational tools, and objects for design must be available, which volunteers can point learners toward as they explore their environment. For example, a volunteer might provide multiple possible tools for a student to explore in response to a question a teenager asks. As Honomichl and Chen (2012) assert, diversity “can have a robust effect in facilitating the discovery learning process” (p. 617).

Examples That Might Be Confusing

Volunteer learners may be confused as to what qualifies as scaffolded discovery learning feedback versus traditional instruction. An example might be a teenager seeking to understand surge machines who makes an error that leads to an incorrect conclusion. In this case, “explicit feedback…is necessary to scaffold further improvements” (Honomichl & Chen, 2012, p. 617). Discovery learning feedback differs from traditional instruction in that scaffolding only follows the learner’s efforts to explore. Additionally, discovery learning feedback is not accompanied by detailed elaboration on underlying concepts (Honomichl & Chen, 2012).

Summary

The goal of this instructional design project is to ensure Innovation Lab volunteers tasked with facilitating discovery learning for teenagers understand discovery learning and are prepared to guide discovery learning activities. They will be required to demonstrate declarative knowledge of discovery learning principles and reasons to use this form of learning. They will be able to procedurally demonstrate their understanding within a simulated scenario and be able to correctly identify discovery learning in action. They will also possess procedural knowledge on how to access discovery learning support tools. Ultimately, they will be able to independently facilitate engineering discovery learning in the Monterey Bay Aquarium’s Innovation Lab after-school “Design for the Ocean” program, promoting MBA’s mission to inspire conservation of the ocean.

References

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