MARVE LEARNER STUDY

I. ABSTRACT
We performed a learner study to determine if MARVE effectively met its learning goals and to obtain supplementary information for the product redesign. Five users (representative of the potential audience) tried the product, under the direction of MARVE’s creator, who acted as a Teacher Assistant. An authentic environment was produced for the observation, and data was gathered using several instruments, such as pre- and post-test questionnaires, a debriefing section, and audio and videotapes. We summarized, analyzed and used this data to identify areas for potential improvement.

- The lack of clear goals and instructions guiding the activities.
- Confusion in use of the interface and navigation tools.
- Absolute dependency on the strong involvement of the TA.

We also obtained comments on the positive aspects of the current version of the product. These include:

- An appreciation of the graphic design and the attractiveness of the videos.
- Enjoyment in constructing the map.

The findings of this study will guide the redesigning phase.

II. LEARNER STUDY

Objective of the study
Assess the effectiveness of MARVE as a learning tool in the field of oceanography for non-science majors.

Learning Goals for User Study
1) Learn if MARVE accomplishes its educational goals
2) Identify MARVE’s effective features
3) Discern areas for potential improvement

Questions Considered

Question 1: Does MARVE accomplish its educational goals?

- Goal 1: Understand how scientists conduct research aboard a marine research vessel.
  - Do users form a general understanding of how scientists conduct research?
  - Do they take on the fantasy role?
  - Are they engaged in the fantasy environment?
  - Are they involved in the fantasy environment?

- 2. Goal: Recognize and describe the geologic structure and ecological systems of the East Pacific Rise
  - How much time did users spend exploring and observing the deep ocean floor?
  - How much control did they feel they had when using MARVE?

- 3. Goal: Conduct sampling and water analysis in order to acquire fundamental geologic research skills.
  - Did they understand the educational value of conducting a sample and water analysis?
  - How much time did the users spend conducting the sample and water analysis?
  - Was the sampling and water analysis feature easy to use?

- 4. Goal: Map the underwater environment using artifacts collected through observations.
  - Did they understand the educational value of mapping?
  - How much time did the users spend mapping?
- Was the mapping feature easy to use?

Question 2 and 3: What are MARVE's effective features? What are the areas for potential improvement?
- What degree of motivation (intrinsic and extrinsic) did the features produce in each user?
- Is the level of motivation related to the expertise of the user?
- How effectively did the different media (audio, video and text) produce interest and learning?
- Do the feature’s embellishments add or distract from the learning?

Other Relevant Questions:
- Do users form a general understanding of oceanography?
- How does collaboration affect the learning goals?
- Does the information provided contribute to learning?
- What is the emotional response to each activity or goal?

### USER PROFILES

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<tr>
<th></th>
<th>User 1</th>
<th>User 2</th>
<th>User 3</th>
<th>User 4</th>
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</table>

### METHOD

Test plan:
- Participants in study: 5 users, 5 experimenters, 1 teaching assistant (who is also the CD-ROM developer)
- Location: A geology computer lab (authentic user environment)
- Duration of test: 1 hour for testing, 30 minutes for debriefing
- Software/Hardware: Four computers loaded with MARVE
- Role of experimenters: Coordinator/lead experimenter (Joanne)
  Recorder (Salvador)
  Observers (Amy, Anuja, Laura)
- Forms prepared to conduct the observation:
  - Release forms to be signed by the subjects, stating their willingness to participate.
  - Guidelines for conducting observations
  - Protocol to coordinate the observations.
  - Form to record the observations in detail.
  - Pre and post-test questionnaires to assess the impact of the experience on the users’ learning process.
- Plan on how to conduct and record the study:
  - Record and videotape the session.
  - Ask users to think aloud at predetermined times.
  - Pair at least two users on one computer.
  - Allow the instructor the freedom to conduct the session as authentically as possible, without interruptions from the experimenters.
  - Interact directly with students at specified times only.
- Let instructor, not experimenters, provide assistance on how to operate the software.
- Ask users to fill out a lab report (authentic materials accompanying the software).
- Present users with the software and introduce the instructor.
- Leave users free to maneuver through the software.
- Provide snacks and drinks before and after the section lab.

**Schedule for the session**
1. Sign release forms
2. Complete pre-test questionnaires
3. Introduction by the coordinator
4. Introduction by the instructor
5. Section lab
6. Complete post-test questionnaires
7. Debriefing

**Analysis of data:**
Extract information to support conclusions from several sources:
- Audio tapes
- Videotapes
- Questionnaires
- Formats for observation
- Debriefing session
- Summary of overall impressions (contributed by each experimenter)

**FINDINGS**

Does MARVE accomplish the following educational goals?:
Define novice v. expert

**1. Goal: Understand how scientists conduct research aboard a marine research vessel.**

**Results:**
- Novices did not proceed to the next step in the CD-ROM until given instructions by the teaching assistant.
- Novices spent lots of time (do we have any stats on this?) trying to understand how to maneuver the controls.
- Novices displayed body language that indicated boredom and frustration. (see video clip)
- Experts displayed body language that indicated engagement and interest. (see video clip)
- (Expert describing tour of Atlantis) “It’s pretty cool. I like being able to scroll around and see everything. I don’t think it is very confusing. Everything seems to be pretty self-explanatory.”
- Both experts and novices spoke in the first-person when describing their explorations. Novice: “We went down a wall. I think there is a wall over here. I don’t know. Let’s find out.”
- The experts used the lab questions to guide them through the tour, and were intent on answering the questions.
- The novices did not use the lab questions.
- Did not understand the connection between the tour of the Atlantis and the deep-ocean dive. This learning problem was exacerbated by the interface that made it difficult to transition between Atlantis and Alvin.

L1: Do we go to Alvin?
L2: I don’t know. I guess. (sounds confused) Should we click here?
TA: So you guys feel like you have seen the ship?
L1: Yeah, we are trying to go into the next section.
L2: We are trying to get into Alvin. (sounds confused)
C: Hit the exit button.
L1: Oh. (sound of comprehension)

Discussion:

- Both experts and novices took on the fantasy role, as indicated by their use of the first-person narrative.

  “We went down a wall. I think there is a wall over here. I don’t know. Let’s find out.”

- Despite the authenticity felt by all users, novices displayed body language that indicated boredom, frustration, and confusion. In contrast, the experts leaned in close to the screen, indicating engagement.

  (see video clip)

- Neither experts nor novices understood the educational value of the tour of the Atlantis.

  post-questionnaire and debriefing data: users described the tour of the Atlantis as “extraneous”, “boring”, and lacking good information.

- Students experienced difficulty transitioning between the tour of the Atlantis and the deep ocean. This contributed to the failure of users to have an understanding of how scientists conduct research.

2. Goal: Recognize and describe the geologic structure and ecological systems of the East Pacific Rise (discovery)

Results:

- Did not understand the goals of the exploration process during the deep ocean simulation.
  L: “I am not quite sure what I am supposed to do. My reaction, and maybe it is because I am not a geologist type of person, but I don’t know quite what I am looking at.”
  Only at Began to use vocabulary associated with geology.
  Displayed some body language and used words to express enjoyment at discovering the sea creatures.
  “Whoops, there’s another octopus! I’m not (video clip of watching the video)
  Students got lost in the discovery process and became confused.
  “Oh, another octopus. But it’s the same one. I am going the wrong way.”

Discussion:

Although the discovery process was designed to enhance the learning experience, this learning method actually slowed down and confused both novice and expert users. The users did not understand the value of the discovery process and expressed frustration that it prevented them from completing activities.

3. Goal: Conduct sampling and water analysis in order to acquire fundamental geologic research skills.

Results:

- Did not know that had to take a water sample at a hydrothermal vent.
Did not understand how to use the interface to conduct a water sample. (did not know to drag the water bottle over)

Did not know that the clipboard displayed the data.

Novices did not know what to do with the data.

“I did a sample. Oh, there we go. I am not quite sure what I am supposed to do with the water sample.”

Discussion:
Users did not understand the value of sampling and conducting a water analysis. Post-questionnaire data revealed that users had only moderate interest in sampling and that only one out of three users was actually understood the sampling. These results occurred because of the lack of explanation in the CD regarding when, where, and how to take a sample. Unless the expert TA told users what exactly to do, both experts and novices were lost in the process.

4. Goal: Map the underwater environment using artifacts collected through observations.

Results:

• Did not understand how to use mapping feature until the teaching assistant provided instructions.
  “So are we supposed to map something here? I am not really sure what we are supposed to be doing. I am not sure if we are supposed to go around and see what we could find or proceed through step-by-step. It might be easier step-by-step.”

• Had difficulty understanding the icons.
  (Experts) “We mixed up our symbols. We put the east wall where we should have put the west wall.”

• Constructed detailed maps once understood the procedure and indicated some enjoyment during this process

• Novice learners did not understand the purpose of making a map.

• Once mapping, seem to enjoy the process.
  “That looks like something I can put on my map. Fish no, Crab no, Clam no. Whoops, there’s a fish.”

• Did not understand the pink dots were hyper-drive.

• Did not understand that the graph below the chart displayed elevation.

Discussion:
The mapping exercise also gave rise to confusion among both novices and experts. According to questionnaire and audio data, the symbols for mapping and the goals for mapping were unclear. This confusion caused the users to simply travel around placing objects on the map, but not understanding elevation or the purpose of the map.

RECOMMENDATIONS

Improving the Product

General Recommendations:
• Provide clear goals that connect the activities to content.
• Provide explicit instructions on how to proceed through the activities.
• Provide explicit instructions on how to use the tools to make charts and maps.
• Simplify the navigation tools.
• Simplify the interfaces.

Specific Recommendations:
• Build a collaboration process into MARVE.
• Use audio narration, instead of text, to guide students through the deep ocean simulation.
• Direct the user to the main features (mapping, water sampling).
• Introduce more self-explanatory mapping symbols.
• Use supplementary materials that correspond to the flow of the CD-Rom and help the user learn fundamental facts.
• Provide more content in the Atlantis tour through more interesting and detailed crew interviews.
• Convert the questions that appear in Atlantis to hyperlinks that provide additional information.
• Provide clear self-explanatory instructions on the use of the pink spots as hyperdrives in the mapping section.
• Improve the quality of the audio.
• Provide students with headphones to hear the audio.
• Users inquired about a starfish icon.