

ED53G-0684: Partnering and teamwork to create content for spherical display systems to enhance public literacy in earth system and ocean sciences

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Why create content for spherical display systems?

Spherical display systems, also known as digital globes, are technologies that, in person or online, can be used to visualize global datasets and Earth system processes. Using the InterRidge Vents Database and imagery from deep-sea vehicles, we created content for spherical display systems to educate and excite the public about dynamic geophysical and biological processes and exploration in the deep ocean. The “**Global Viewport for Virtual Exploration of Deep-Sea Hydrothermal Vents**” is a collaboration between the Woods Hole Oceanographic Institution and the Ocean Explorium at New Bedford Seaport, hosting a Magic Planet and Science On a Sphere® (SOS).

Deepest known hydrothermal vent, ~5000 m (3.1 miles), Mid-Cayman Rise, frame grab from ROV Jason II, Dive 613

Iterative design and development

We developed our content through a process similar to an iterative software development process, in which: “*A use case is a collection of possible sequences of interactions between the system under discussion and its Users (or Actors), relating to a particular goal*” (Fox and McGuinness 2008).

Use Case: Our Use Case was to develop a dataset and educational package for spherical display systems that would excite the public while teaching several literacy principles.

Small team, mixed skills: Our core team is composed of a lead scientist, educators at both institutions, graphic artists, and a professional evaluator.

Analysis: To scope the data and related resources, we assessed available HD imagery from deep-sea vehicles and georeferenced the imagery to hydrothermal vent fields in the InterRidge Vents Database.

Develop model/ontology: We adopted several Earth Science and Ocean Literacy Principles, determined by the broader geosciences & education communities as important for public scientific literacy.

Use tools: We used a variety of software, ranging from Matlab to GIS to video editing to online survey software.

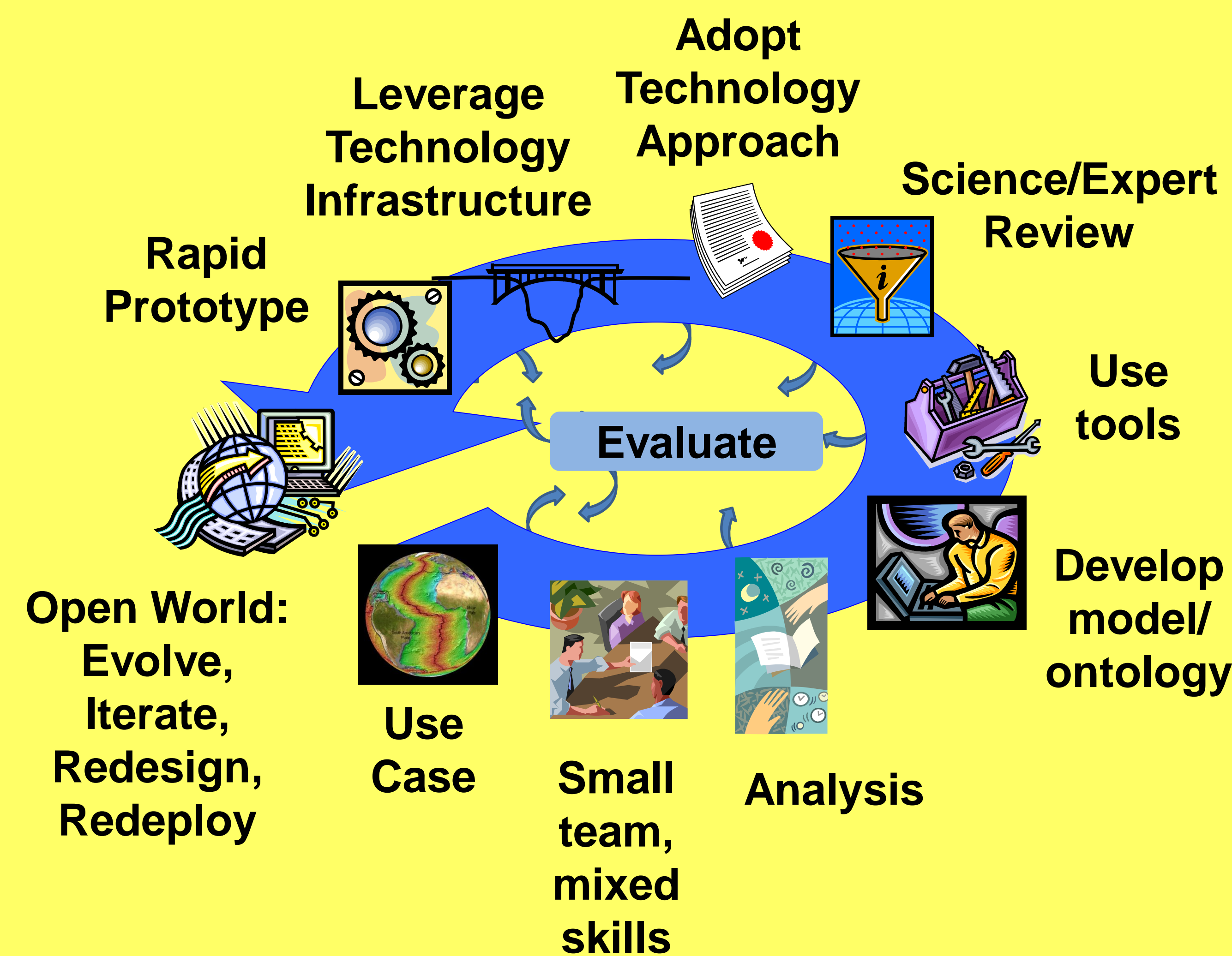
Science/expert review: We involved scientific colleagues to review each site-specific movie and script.

Adopt technology: We worked with the NOAA SOS Technical Team to develop the content for layering and annotation in SOS Version 4.

Leverage infrastructure: We integrated our new content with existing datasets available to the SOS Users Network.

Prototype iteration: We completed 3 cycles: Nov. 2012, April 2013, and Aug. 2013. Our front-end evaluation was completed at the end of the 1st cycle.

Evaluate: The most important consideration in our formative evaluation related to: “*Any system behavior that is irrelevant to the Actors should not be included in the use case.*” Basically, all content needed to pertain to the chosen literacy principles and be presented in an engaging design that effectively used the spherical display platform.



Adapted from Peter Fox and Deborah McGuinness, Slide in Semantic eScience course, RPI
Fox and McGuinness (2008) http://tw.rpi.edu/web/doc/TWC_SemanticWebMethodology

New content tied to Earth Science and Ocean Literacy Principles

We produced two educational movies, each matched to a scripted, interactive, docent-led presentation – and each focusing on a different set of three literacy principles.

“Life without sunlight”

ESLP 3.2: Earth is a complex system of interacting rock, water, air, and life. All Earth processes are the result of energy and mass moving between Earth's systems, including Earth's interior.

OLP 5.g.: There are deep ocean ecosystems that are independent of energy from sunlight and photosynthetic organisms. Hydrothermal vents rely only on chemical energy and chemosynthetic organisms to support life.

OLP 7.a.: The ocean is the last and largest unexplored place on Earth. This is the great frontier for the next generation's explorers and researchers.

Linked to public SOS presentation: “Primary Productivity” and K-12 field trip program: “Energy and living things”

“Smoke and fire underwater”

ESLP 4.5.: Many active geologic processes occur at plate boundaries. Plate interactions affect the locations of volcanoes and the distribution of resources and living organisms.

ESLP 6.9.: Life occupies a wide range of Earth's environments, including extreme environments at seafloor vents where hot fluids escape from the oceanic crust.

OLP 7.d.: New technologies, sensors, and tools such as subsea observatories and unmanned submersibles are expanding our ability to explore the ocean.

Linked to public SOS presentation: “Dynamic Earth” and K-12 field trip program: “Earth Science”

Evaluation of two impact categories for informal science education

Our survey questionnaire focuses on two impact categories in NSF's *Framework for Evaluating Impacts of Informal Science Education Projects*: “**Awareness, knowledge or understanding**” and “**Engagement or interest.**”

Our experimental design is “Quasi-experimental Study, Post-test Only Intact Group Design” with quantitative data based on self-reporting on a Likert scale.

In addition to inquiring about knowledge gained for the literacy principles above, we ask about a standard term, “excited,” on the Positive Affect Negative Affect Schedule (PANAS): “After today's presentation, how **excited** are you about the great unexplored deep ocean frontier and the exploration and research of deep-sea vents?”

Our data will be used to test “*the contention that the public learns science in settings and situations outside of school*” (Falk & Dierking 2010, *The 95 Percent Solution, Am. Sci.*). We are especially interested in comparing the results between Users who watch a stand-alone spherical display movie vs. live docent presentations with the SOS.

Respondents, who remain anonymous, also provide demographic information related to age, home town, and educational attainment. For those respondents who are professional educators, we ask whether they are likely to use what they learned in their educational activities.



The Global Viewport exhibit at the Ocean Explorium will be open through summer 2014. Here, Meredith, our professional evaluator, and Kathy, manager of WHOI's Ocean Science Exhibit Center, are pointing to the kiosk at which the online survey is available on-site, just outside the sphere auditorium.



Additional plans include formatting the two educational movies for the Magic Planet (shown here at WHOI's Ocean Science Exhibit Center), and conducting two teacher professional development workshops, two family science nights at the Ocean Explorium, and a visitor exchange with WHOI.