Project: *What's The Difference*

Last update: 30 September 2005

This report documents the project's objectives, deliverables, outcomes and ongoing progress. It also describes the project's plans for deployment, evaluation and continuation. This is a living document – it is modified and updated as the project progresses.

Project Objectives

1. Provide easy-to-use software that uses richly visual and highly interactive comparisons to teach science and math concepts.
2. Enable the software to allow easy addition of new information sets by curriculum developers.
3. Provide three full data sets for the software.

Customers

1. Curriculum and educational content developers.
2. K-12 students and their teachers.
3. Educational software application developers.

Use Cases

1. Elementary school students use *What's The Difference?* independently or in groups to comparatively explore data sets such as the features of planets, the domains of the animal kingdom, prokaryotes and eukaryotes, and the scientific concept of equilibrium, among others.
2. Curriculum developers create new, themed content for interactive discovery, coupled with other curriculum elements such as lessons, activities and games.
3. Educational software developers incorporate *What's The Difference?* in their curriculum to illustrate key distinctions between items or concepts, and to allow the user to interactively discover or explore these differences.

People

- Project Manager: Christina O'Guinn,
  NASA Ames Research Center,
  650.604.2891, Christina.M.Oguinn@nasa.gov
- Alternate Contact: Geoffrey Bruce,
  NASA Ames Research Center,
  650.604.2587, gbruce@mail.arc.nasa.gov

Partnerships

- Ames Educational Technology Team (AETT)
- NASA Astrobiology Institute
- Australian Centre for Astrobiology
- Classroom of the Future (COTF)
- NASA Explorer Schools

- NASA Higher Education Collaborative

Deliverables and Schedule

- 15 Nov 2004 – Evaluation and deployment plans
- 1-4 March 2005 (and ongoing) – Provide technical support to Australian Centre for Astrobiology, as they integrate astrobiology data into WTD
- 30 April 2004 – Feature Enhancements, to include:
  - Full screen-to-windowed to work concurrently with other apps
  - Re-sizing of graphics
  - Authoring documentation and step by step process in software
  - Way to easily input other datasets from other machines
  - Captions under images or movie - from ADA text
  - Launch application to a given WTD content
  - Nested folders within media file folder
  - Get back to authoring from WTD application
  - Adjust image size within window
  - Import feature on glossary and ADA text
  - An area to link to additional resources
- Content Integration: Research, gather, integrate
  - 1 March 2005 – Solar System
  - 30 September 2005 – Pilbara/Astrobiology
- 15 July 2005 – Domain expert evaluation

Dependencies

- Continuation and formation of the above partnerships.

Assumptions

- Stable requirements and funding.
- Timely specification of partners' content needs.

Accomplishments

All the project's accomplishments and deliveries are captured here:

1. October 2004 – Annual Performance Plan delivered.
2. February 25 2005 – Solar System Data set updates completed (early).
3. March 1 2005 – Major user interface and feature enhancements completed (early).
4. March 4 2005 (since Feb. 28) – Completed full week of full-time curriculum building, consulting and teacher evaluation with Australian Centre for Astrobiology and its curriculum project.
5. June 9 2005 – Decision to forgo the planned Volcano dataset in favor of creating dataset material for the ACA Pilbara Astrobiology Curriculum project.
6. June 23 2005 – Geoffrey to Australia to gather and create curriculum content.
7. 1 September 2005 – Geoffrey has created a virtual-reality walk-through of the Pilbara site and science.
8. 30 September 2005 – Project has completed all requirements and deliverables.

Deployment and Evaluation Planning

This section identifies how the project specifically addresses NASA's six Education Program Operating Principles. These principles are described in the NASA Learning Technologies Phase 2 Requirements Specification (a.k.a. the NLT Project General Requirements).

Customer Focus

As noted in the evaluation section below, "What's the Difference?" has been successfully tested and evaluated by a diverse range of students and teachers. It's open-ended flexibility allows it to be used with any content teachers may need. By partnering with Classroom of the Future and a wide distribution entity, such as Pearson Scott Foresman, teacher and curriculum development can be accomplished and utilized to its fullest. WTD can be disseminated across multiple platforms to reach a wide audience.

Elementary school students will use "What's the Difference?" independently or in groups to comparatively explore science-related topics such as: planetary comparisons, volcanoes of our Solar System, domains of the animal kingdom, prokaryotes and eukaryotes, and the scientific concept of equilibrium, among others. Curriculum developers can create new, themed content for interactive discovery, coupled with other curriculum elements such as lessons, activities and games. Educational software developers can incorporate "What's the Difference?" in their applications to illustrate key distinctions between items, concepts or variables of an experiment, and to allow the user to interactively discover or explore these differences.

WTD is based on research and principles of inquiry-based learning by promoting an open investigation in which students explore concepts in a non-linear path, as they compare, contrast and categorize content. There are multiple solutions that will work. The focus of the product is on learning standards-based concepts rather than memorizing facts.

Content

"What's the Difference?" open-ended nature allows it to take extensive advantage of NASA content, facilities and people. Already, NASA content-based curriculum is being developed through the workings of a summer IISME teacher who is utilizing NASA scientists and researchers as well as USGS partnerships for locating content and resources. The development team is exploring the use of Earth Science content from another LT project for use within WTD. In addition, the development team has presented the software tool to the mission directorate education leads on two separate occasions to receive their input and to make them aware of the tool for use with a wide variety of NASA datasets. One content idea proposed by education leads at this meeting is to compare and assess the differences between various flight test environments such as shuttle and high altitude balloons. Another suggestion is to build a comparison activity of Mars and Earth rocks to identify evidence of liquid water.

Pipeline

The initial student testing of WTD found a statistically significant change in students' science self confidence and attitudes toward STEM careers. Although tested with grades 4-6, the open-ended nature of WTD allows it to house any content and to be used with students at all age levels.

By engaging students in inquiry explorations using actual, graphically-rich data sets, students are highly engaged and gain a positive attitude about working in STEM areas. The open-ended nature of the product allows a wide variety of content to be used to expose students to a wide variety of scientific areas. It also allows the possibility for career information to be incorporated and compared. The team works closely with the Human Resources division to feature careers that are in high demand, when careers are featured, and always looks for diverse role models.

Diversity

"What's the Difference?" has been developed with components addressing the ADA requirements for the visual and hearing impaired. The requirements for an audio component to be added to the data set files for the visually impaired have been built into the authoring portion of the software. Additionally, WTD allows a content developer or teacher to add a supporting text description of the dataset that will be close captioned for the hearing impaired. "What's the Difference?" supports multiple languages and multiple formats to the datasets being imported, thus enhancing the potential for diversity of the end product and the users it serves.

In evaluation, we have tested with diverse schools with over 50% of underrepresented students. In fact, for the user test that we conducted of the prototype, we tested with one class of limited English students. The visual nature of the program made this program very effective with this audience. This ensures that products are accessible and effective with students of all backgrounds.

Evaluation

The measurable goals of WTD are:

- To produce standards-based supplementary curriculum support products and unique resources that employ NASA's research and careers, are engaging and age-appropriate and fit well with teachers' curriculum.
- To improve students' attitudes toward STEM subjects and careers.

During the first year of development, "What's the Difference?" was seeded with planetary data. This prototype, Solar System Explorer, was tested and evaluated through two separate mechanisms: a teacher focus group and student testing. The teacher focus group was comprised of teachers from seven public schools, one home school and one private school and encompassing multiple grades, 7 multiple subjects. The teachers anticipated teaching a student population that included 23% underrepresented populations, 17% on free or reduced lunch and 15% who are Limited English Proficient. The focus group covered 45 minutes on the computer using the lessons, a 20-minute anonymous survey and a 30-minute discussion. Feedback was

overwhelmingly positive with the highest marks in: content fitting well with curriculum, likeliness to use lessons in classroom, and recommending the software to colleagues.

Student-user testing was comprised of 2 classes (62 students), one main-stream 6th grade class and one limited English grades 4-6 class. 52% of the students were on free or reduced lunch and 40% were English language learners. The major findings were: statistically significant learning occurred between the pretest and posttest and a statistically significant increase in students science self confidence and attitudes toward STEM careers. In addition 88% said they enjoyed the application, 85% said they learned a lot and 77% said they would do it again. There are additional plans are for testing with content developers and a comparative pilot test on learning impact conducted by Classroom of the Future (COTF).

Partnership & Sustainability

One of the most exciting design features of "What's the Difference?" is its flexibility in allowing any number of developers and/or end users to create comparison-based content applications. The overall flexibility of the authoring component lets anyone use its capabilities. Recently, an Industry Initiative for Science and Math Educators (IISME) teacher developed a lesson on volcanoes with WTD. Classroom of the Future (COTF) was leveraged to verify that the curriculum and process is in line with effective instructional processes. WTD is partnered with the NASA Ames Educational Technology Team to develop other standards-based curriculum content and has presented to the mission directorate education leads to make them aware of the tool's availability and capabilities for use with their content. The team will also support the LTP partnership with the Australian Centre for Astrobiology in the creation of two astrobiology data sets.

The development team has numerous partnerships that assist with evaluation and dissemination. Both the Center for Education Technology and the Collaborative for Higher Education[1] are using WTD in teacher workshops. WTD will also be disseminated through the NASA Explorer Schools. The Collaborative for Higher Education is also supporting the development team by providing faculty reviews of the product, evaluating the team's evaluation process and providing input on how to improve this process and leveraging the tool in other funded grants through entities such as NSF and California Academic Partnerships Program. In addition the Collaborative has established a computer lab in Fair Middle School as a test bed for user testing. (African- American, Hispanic, Native American and Filipino/Pacific Islander students represent 69% of Fair Middle School's population, and another 72% participate in the National School Lunch Program. 37% are English Language Learners.)

Actions in Response to the NLT Annual Project Review

This section indicates how the project's FY2005 plan addresses the comments received from its FY2004 LT Annual Project Review.

[1] Collaborative for Higher Education is a partnership of public higher education institutions in Silicon Valley - San Jose State University, the University of California at Santa Cruz and the Foothill De Anza community colleges that works closely with NASA Ames and is part of the NASA Research Park, a world-class, shared-use research and development campus in association with academia, industry and non-profit organizations.

Comment:
A major concern of the reviewers was the degree of difficulty a teacher would have in creating a new dataset for WTD. It would apparently take significant documentation and several examples to describe and demonstrate how to create and assemble WTD material into a topic unit. Provision should be made for providing this in the FY2005 funding year.

Solution:

WTD was initially developed to be used by content developers and *then* given to educators once the data had been input. The goal was to allow a group such as COTF to develop content and then disseminate the complete application and data set to the educators as a bundle. In addition the developer interface has been made simpler and drag and drop options are being looked at.

Comment:
Almost all reviewers found it surprising and disconcerting to start the WTD experience by being placed initially within the authoring environment and immediately asked to decide whether they want to create, edit or view a dataset. Almost all users of WTD will invoke it to do only the latter. The initial experience should therefore assume a user who is only viewing a dataset and who will never have reason to modify an existing dataset or assemble a new one. This is seen as a critical requirement to several reviewers.

Solution:

This has been the plan from the beginning and was discussed with Tom prior to the review on the options to make this happen. This is a first priority in the early development stages of 2005.

Comment:
One reviewer was frustrated by the inability to "drill down" further with WTD. Essentially WTD provides a mechanism for presenting graphic information selected by specifying two parameters. (Planet + composition, for example.) Reviewers and evaluators have requested that there be a means to further select by using a third parameter. The project team should investigate the utility and feasibility of this, and whether any additional complexity required to use it would detract from the basic utility of the software.

Solution:
This was discussed with Tom prior to the review as well. This was brought up with the curriculum developer and is being looked at as a third level of drill down from within the comparison windows. Initially a text box will reside below the image, which will also bring greater clarity and additional data to the content. A link into the data is being discussed and time assessed for development in 2005.

Comment:
Additional observations and comments were made by the curriculum developer over the summer.

Solution:

These have been taken into consideration and discussed with the LT project office on which should be address in 2005. Those that warranted development are slated within the schedule.

Continuation Plan

The continuation plan identifies plausible scenarios for transition of the project's technology and deliverables to a sustainable mechanism when NLT Phase 2 funding expires.

The team:

1. Is working with the Australian Astrobiology team in which that team is making WTD a major component of the curriculum.
2. Has met with COTF to discuss possible proposals as a result of the scheduled evaluations of WTD.
3. Is discussing the options for working and disseminating WTD with Pearson Technologies by providing them with 2-3 datasets within WTD.
4. Has proposed with NES to add math data sets within the Solar System Data set. Middle school pre-algebraic concepts such as measurement, data analysis, problem solving, ratios and proportions would be addressed, if funded.
5. Is looking at the scenarios for combining WTD volcano datasets with AstroVenture Geology mission sections.