Science Learning Games at a Regional Science Center: *DinoQuest* and *DinoQuest Online*

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Building Science Learning Games (SLGs) for Informal Science Education in a Science Center

• On-site physical interaction SLG: DinoQuest
  – Life-size dinosaurs models (T-Rex, Argentinosaurus, Velociraptors)
  – Family-based problem-solving and collaborative learning in physical environment

• Web-based SLG: DinoQuest Online
  – Addresses CA science education standards for K-6 grades
  – Interoperates with DinoQuest
  – Designed for internationalization
  – Developed by UCI GameLab
Fast Facts about Discovery Science Center
• Located in Santa Ana, California
• 80,000 Sq. Ft. inside
• Annual budget: $6,000,000. Earned Income: 82%, Contributed Income: 18%.

At the Center:
• 425,000 annual visitors (2007); 275,000 (2005, before DQ and DQO)
• 88,000 annual student field trip visitors from schools
• Provide in-service science training to 1,100 K-12 teachers/yr.

In the Schools:
• 150,000 annual students in science outreach programs
Discovery Science Center Goals

- Create a physical exhibit that blends:
  • Natural History Museum Collection,
  • Science Center Hands-on Exhibits,
  • Video Game Culture,
  • Science research practices via “collaboratories”

- Create a Cyberinfrastructure for distance learning over the Internet.

- Engage and explain CA Science Education Standards.

- Create electronic performance tracking ability for better evaluation capabilities.

- Support workforce development.

- Create a mechanism that continues to drive visitors between a brick & mortar science center and the center’s Internet/Web site multiple times.

- Increase repeat usage of science center exhibits and increase visitation.

- Create a replicable and sustainable model.
DinoQuest at DSC
Go to Field Station and Select a Mission

8 Educational Missions:
Each aimed at California Science Standards
Mission topics: Predator / Prey, Trace Fossils, Anatomy, Habitats, Identification
Each mission focuses on a different collaboratory
DinoQuest Research Team and Collaboratories
Diverse Scientific Role Models (ethnicity, age, gender)
The IR Transmitter!

• Picking up information throughout the DQ site.
• Tracking visitor’s success on missions.

- IR transmitter, sensor network technology, and interactive media from Creative Kingdoms, Inc.
Technology:
Embedded Sensors and Transmitter Activation
Video Game Mechanics

Uplink data collected to *collaboratories*.

Earn Research Points for each item found.

Obtain fossils with encoded DNA as reward for completing each mission.

Ability to save data and come back another day.
DinoQuest Online

Online Science Learning Games

- Distance learning.
- Additional, in-depth science missions.
- Earn points and Dino DNA by completing missions.
- Level-up into multi-player dinosaur ecology simulation (*Dinosphere*).
DinoQuest Online (released in June 2007)

Four SLG colaboratories
MyLab personal DQO-based collection site
(associates DQ and DQO results like “Dino DNA” samples)

Dinosphere -- Assemble virtual dinosaur via DNA-based body system components

Same scientists as DinoQuest at DSC
Each collab game tied to CA science education standards, but experienced via discovery/exploration-oriented game genres
Multiple Science Learning Games:
*Dinosaur Dig Pit* Field Site CoLab Game

- Differentiated repetitive game play.
- Players act with resource limitations to encourage reflective action.
- Guidance and reflection events provided during play.
Backbones and Ribs

Vertebrae provide structure for the animal and are divided into sections depending on where they are located along the back. Thoracic vertebrae are in the chest area and provide attachment points for the ribs. Ribs make up a bony case that protects many important internal organs, such as the heart and lungs. Bony projections on the vertebrae are attachment points for muscles. The Apatosaurus, being more massive, had larger processes on its vertebrae than the Allosaurus. Many of the larger dinosaurs, such as Apatosaurus and Allosaurus also had "belly ribs," called gastralia, that were not attached to the backbone or the other ribs. The purpose of the "belly ribs" are not specifically known.

In 1987, amateur paleontologist Stan Sacrison discovered "Stan," a T-rex embedded in the Hell Creek Formation in South Dakota. 199 fossilized bones were recovered, including the best preserved and most complete T-rex skull ever found. Stan's bones showed evidence of healed injuries: broken ribs and vertebrae, damaged facial bones, and a large hole in the back of its skull.
DinoQuest Online Reconstruction CoLab
DinoQuest Reconstruction CoLab
(tutorial view)

1. Your goal is to rebuild this.

2. Move the fossils out to the anchors.

3. Rotate objects with this tool.

4. Keep track of your progress here.
Multiple Science Learning Games: *Biomechanical* CoLab Mini Games

- Mass and balance
- Proportion and speed
- Matching anatomical structures to diet
Welcome Beta-test
- Design a working digestive system out of available organs and “connectors.”

- Move Oxygen, CO2, blood cells, and waste through a cardio-pulmonary system.
Multiple Science Learning Games:
Resource Interaction CoLab Game Spaces

**MyLab** - shows missions completed both online and at the DSC

**DinoSphere** – design your Dinosaur with DNA collected from missions, then act to Survive in different ecological niches.

Go back online or go to DSC to obtain different DNA by completing more missions!
Evaluation Framework

DinoQuest and DinoQuest Online allow for the following evaluations:

- *Player Centered*: scores, missions completed, and other variables identify progress and provide feedback in context.

- *Exhibit Centered*: ability to test content comprehension by player quiz pre/post completing mission.

- *Independent Evaluation*: which method is best and why:
  -- physical exhibit
  -- online learning games
  -- both in combination
DSC+UCI working to develop network of SLG-based science centers

Tier 1: Individual player connection: your Internet connection at home.
Tier 2: Local institutional connection: library, science center, school, or museum.
Tier 3: Regional science center provides local exhibit content connected online.
Tier 4: “Gateway” science centers provide open interfaces and content.
Tier 5: Science Center Grid: Massive Multiplayer Online Science Learning Games that span and interlink multiple science centers and museums.
Project Contributors

• *DSC* – Joe Adams (President), Janet Yamaguchi (VP Education), JoeAnna Jenkins (CFO), Kellee Preston (VP Operations), Leslie Perovich (VP Marketing), Creative Kingdoms Inc., and others

• *UCI* – Robert Nideffer (creative director), Alex Szeto (game programming and art), Calvin Lee (database programming), Celia Pearce (design contributions).