

CYBER-ENABLED TEACHING AND LEARNING THROUGH GAME-BASED, METAPHOR  
ENHANCED LEARNING OBJECTS (CYGAMES)

FINAL EVALUATION REPORT

Prepared for the Center for Educational Technologies (CET)  
at Wheeling Jesuit University

By Victor M. Hernandez<sup>1</sup>

August 15, 2014

---

<sup>1</sup> Victor M. Hernandez holds a doctorate in Educational Research and Evaluation, is Associate Professor at the University of South Florida, and served as External Evaluator on the CyGames project.

# **CYBER-ENABLED TEACHING AND LEARNING THROUGH GAME-BASED, METAPHOR ENHANCED LEARNING OBJECTS (CYGAMES)**

## **FINAL EVALUATION REPORT**

### **Executive Summary**

The *Cyber-Enabled Teaching and Learning Through Game-based Metaphor Enhanced Learning Objects (CyGaMEs)* is a principled approach to instructional game design and embedded assessment. The goal of the project was to facilitate and measure student intuitive understanding of science concepts through an interactive videogame environment. The project built upon the integration of cognitive science and instructional game design to develop a robust videogame with informatics system components featuring assessment methodologies that measure and report learner growth.

### **Evaluation Approach**

The evaluation of the project had three components: (a) a formative component to monitor project progress with annual and overall summative analyses, (b) review of intellectual merit focusing on the integrity of research and development activities, and (c) analysis of broader project impacts. Project reports were analyzed to determine progress, while data triangulation was accomplished through contact with project staff and review of the developmental “documentation trail”, and analysis of project results.

Progress and compliance meeting anticipated project work and milestones were determined using three categories adapted from the NASA reporting system: (a) Green Status indicating full compliance, (b) Yellow Status reflecting compliance in progress, and (c) Red Status corresponding to problematic compliance. In turn, the evaluation of quality of research and development activities was informed by guidelines on the assessment of intellectual merit identified in the NSF-REESE program solicitation. Further, the examination of broader impacts focused on evidence of: Development of curricular products and materials, contributions to cyberlearning, collaborative partnerships, dissemination and outreach, and project sustainability.

### **Evaluation Findings**

Overall, based on the project timeline, proposed activities, and observed results, the project complied with anticipated operational timelines and milestones associated with each of its research and development objectives. Regarding the quality of results and products designed to improve cyberlearning, the project generated research evidence supporting the merits of the design and learning experience. Further, the project developed an outstanding record of synergistic research and development activities contributing to broader impacts in the areas of videogame development, using embedded assessments, and dissemination of results. A summary of evaluation findings is presented below around the evaluation foci.

**Efficacy of project implementation and completion.** Overall, development and research activities were on *Green Status* upon completion of the project. That is, related activities, events, or products were completed on schedule and all milestones anticipated in the project plan were met.

- **Design and development activities.** At the end of the project, the Selene has been transformed into a reliable game-based environment that can be used for research purposes to assess and report how people learn science concepts through gameplay. The game is available in English and in Spanish on the project's website. Further, the project designed, developed, and released an informatics infrastructure that provides immediate feedback to players, allows educators to assess learner performance, and permits researchers access and analyze gameplay data.
- **Research activities.** At the end of the project, activities associated with related objectives were also deemed to be on *Green Status*. That is, research activities were completed as anticipated building upon a growing pool of recruiters and players to ensure data collection, producing a data management system, conducting studies on perceived experience, mutual alignment, and knowledge discovery; and continuing with the refinement of analytical procedures. In addition, the project demonstrated how a videogame environment could be used for data collection to study players' learning during gameplay using embedded assessments and a reporting system. Using a Timed Report approach to measure gameplay and player's progress toward the game goal at 10-second intervals, the game Flowometer posts scores on skill and challenge. The use of embedded assessments allowed for the study of motivation, engagement, and learning.

**Quality of research and development work.** The quality of research and development activities was characterized by a strong conceptualization capacity leading to the transformation of the Selene game into a robust research instrument, and contributions to the shared understanding of important mediating factors in cyberlearning.

- **Design and development activities.** Two quality factors contributed to the successful completion of related activities: Conceptualization strategies and the design and development approach. The intellectual capacity behind the conceptualization of the CyGaMEs project stemmed from strong interdisciplinary and synergistic work of senior staff bridging research and development in instructional design and content knowledge in lunar science. Further, the project built upon internal and external interdisciplinary capacity for design and development. The quality of the design and development approach was also based on a focus on the integrity of design work, the project's design and development capacity, and the iterative cycle of development.
- **Research activities.** In general, research activities reflected broader contributions to the advancement of discovery and understanding of science education through cyberlearning. The quality of research activities was reviewed using two indicators: The research capacity to meet related project goals, and the nature of research outcomes. To that end, the project built upon unique interdisciplinary expertise and

collaboration with partners in the field contributing to the quality of the project's research capacity. Further, based on the nature and totality of research results, the project contributed to the shared understanding of important factors in cyberlearning through the use of embedded assessments. In addition, the project produced a reporting system that allows educators monitor player's progress and results, and project researchers access game data for research purposes.

**Broader impacts of project activities.** Project outcomes and accomplishments resulted in broader impacts on the development of research-based educational materials, contributions to research in cyberlearning, establishment of collaborative partnerships, and dissemination and outreach. The project also ensured sustainability beyond the end of grant funding support.

- **Development of research-based educational products/materials.** Three primary products were developed and delivered over the duration of the project including a bilingual version of the Selene game, an informatics infrastructure system, and curricular materials for parents and educators. The game is available in English and in Spanish on the project's website. Concurrently, project staff designed and developed a data management system, which will remain available as part of the Selene game upon completion of the project. In addition the project developed curricular and hands-on activities available online for parents and educators to engage students in science learning through lunar observation and fieldwork.
- **Contributions to research in cyberlearning.** The broader impacts of research activities align with contributions to emerging evidence that instructional video games advance conceptual understanding and can motivate students' interest in science learning. Project results also established the value of embedded assessments to provide feedback to players (i.e., learners), educators, and researchers interested in understanding how players experience cyberlearning. Project work aligns with and contributes to recent calls for conducting research and development about how embedded assessment technologies can be used to engage students in learning and assess what and how they learn (U.S. Department of Education, 2010; NRC, 2011).
- **Establishment of collaborative partnerships.** Collaborative activities were established internally with CET and WJU units and externally with other institutions nationally and internationally. Overall, the project established an impressive network of partners with several organizations including public schools, universities, research centers, and outreach agencies. The project also established international collaboration with the University of Vic, which spearheaded the translation of the Selene environment into Spanish and added to evidence of potential broader impacts in the field.
- **Dissemination and outreach.** Overall, in this area project staff was very productive in disseminating the results of work related to core objectives. Project staff and contributing partners collaborated in the production of a robust record of dissemination including 22 publications and numerous conference presentations and

other dissemination activities. Dissemination activities were also conducted through outreach activities using a variety of formats such as the NASA portal website, the NASA's education resource network, and the project's website which provides public access to background information, testimonials, and directs to other resources associated with the Selene game.

- **Ensuring project sustainability.** To ensure project sustainability beyond grant funding, institutional support was secured from Wheeling Jesuit University. With this agreement for institutional support, the Wheeling Jesuit University data management system will continue to provide public access to CyGaMEs data upon expiration of grant funding.

Overall, given the efficacy of project implementation and completion, quality of research and development work, and assessment of broader impacts in the field, there was consistent evidence supporting a representation of exemplary project performance.