

Research Quest: Critical Thinking through Video Games & Interdisciplinary Collaboration

Matt Jensen, Tallie Casucci, Madlyn Runburg, Kirsten R. Butcher, Ryan Bown, Roger Altizer
University of Utah
50 S Central Campus Dr., Room 3190, Salt Lake City, UT 84102
801-581-5460

CaptainKnightfall@gmail.com, tallie.casucci@utah.edu, runburg@umnh.utah.edu,
kirsten.butcher@utah.edu, ryan.bown@utah.edu, roger.altizer@utah.edu

ABSTRACT

Critical thinking, especially complex levels, is a challenging skill set to cultivate in traditional classrooms using typical curriculum materials. A serious game called *Research Quest: Dino Lab*, developed as part of the Natural History Museum of Utah's new prototype critical thinking curriculum *Research Quests*, was designed to facilitate higher levels of critical thinking in junior high school students.

In *Research Quest: Dino Lab* students create a custom dinosaur, the test it in different situations to determine if it would survive, and utilize critical thinking skills to analyze results.

Categories and Subject Descriptors

K.8.0 [Personal Computing]: Games

General Terms/Keywords

Critical thinking, education, curriculum, video games, serious games, game design, iteration, paleontology, dinosaurs, collaborative design, Design Box

1. INTRODUCTION

Currently, middle school education in the United States lacks enough meaningful methods and tools to teach and apply higher levels of critical thinking in the classroom. Added to this, teachers are increasingly required to ensure their students develop these skills in order to be well prepared to enter the workforce and engage in their communities. Specifically, the higher levels of critical thinking most challenging to support are evidence based evaluations, flexible thinking, information seeking, and interpretation. Over the years, numerous scholars and educators recognized this problem, [2, 3, 4, 5, 6] and some have argued higher levels of critical thinking are ignored by both educators and students [3].

There have been many attempts to address this gap and encourage higher levels of critical thinking in students. Failed attempts are usually attributed to time burdens, class structure, and curriculum constraints. Despite this struggle, critical thinking skills *can* be taught, when the appropriate structures are in place and teachers stimulate it. These “appropriate structures” are usually outside of the “traditional classroom”. One non-traditional classroom activity is incorporating serious games into the curriculum.

In this project, the curriculum was transformed to include the newly created serious game. The serious game, called *Research Quest*, is the non-traditional classroom structure. *Research Quest* allows students to learn and apply their critical thinking skills in an authentic and engaging way.



Figure 1. Build Your Own Dinosaur Interface in Research Quest: Dino Lab

2. GAME AND CURRICULUM DESIGN

This project combines both the traditional classroom setting with the non-traditional structure, the serious game. In the classroom, students are introduced via video to a paleontologist. The paleontologist asks for the students help to evaluate a large dinosaur quarry full of fossils. It is up to the students, as newly recruited “research assistants”, to examine the fossils and form hypotheses about the dinosaur bones. The paleontologist is interested in two specific questions: what type of dinosaur it was, and what happened where it died.

During *Research Quests*, students watch videos, read documents, and view 3D scans of the fossils. In so doing, students are encouraged to work in collaborative groups to create hypotheses regarding the two questions, discuss their ideas with one another, and search for evidence supporting their hypotheses.

Using this model in the classroom is very beneficial, because without ever saying a word about critical thinking, the skills are already being implemented by the students, instilling the foundational skills through doing, rather than a teacher instructing students to think critically. Early analysis indicates this work results in measurable and significant change in students' critical thinking.

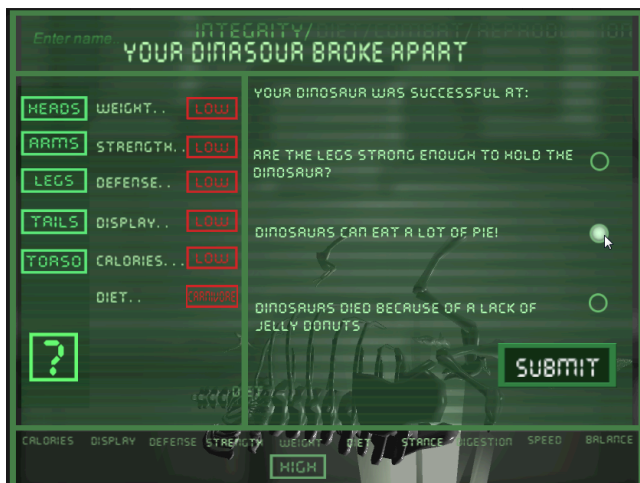


Figure 2. Analysis Screen in Research Quest: Dino Lab

The second part of *Research Quests* involves the serious game, *Dino Lab*. Students are often more successful at developing critical thinking skills through prolonged practice using it in meaningful ways [4]. By supporting the classroom portion through use of a video game, it reinforces the skills that the students have already learned.

Research Quest: Dino Lab is set in a futuristic university where the players become a paleontology research assistant. This experience is similar to the curriculum, but different enough to not be repetitive. Instead of discovering dinosaurs, the students are tasked with building dinosaurs of their own creation, and testing them in key situations.

The first task for the students is to build a customizable dinosaur. While the player can certainly recreate actual dinosaurs, such as the tyrannosaurus rex or brachiosaurus, the goal of this game is not accuracy, but critical thinking. The player is free to choose how the dinosaur will look and what parts it uses.

After the player creates a dinosaur, the simulation portion of the game begins. First, the player's dinosaur will be tested to see if it can stand on its own. Structural integrity is the first of four checks. For example, if the dinosaur created has incredibly small legs, but a gigantic body, head, and arms, it will "fail" the first round. If it is structurally sound, then it will "pass" to the next level. The second round determines if the dinosaur will survive; this translates to whether the dinosaur can eat enough. The third level is the "combat" round. Would the dinosaur survive against another dinosaur, either aggressively or defensively? The final round evaluates if the dinosaur will successfully reproduce. This round answers the question, "it survived, but will it thrive?"

While these levels are the playful moments of the game, the truly important sections revolve around what happens between rounds. After every round, players are given three questions concerning that round. Players are tasked with answering the questions based on dinosaur knowledge and deducing information through critical thinking.

Whether a player "passes" a round's challenge is largely irrelevant. Since *Research Quest* is played during school, it is important that failure never hinders the player. As discussed earlier, time constraints are a constant struggle in education. Instead of starting over in traditional routes of failing results, players continue onto the next level regardless of the results.

The true test is if students can explain *why* the dinosaur passed or failed the challenge. The player must think critically, research their creations and dinosaurs in general, and form hypotheses about the created dinosaur. Again, failure is not punished in the questions; however, if the student successfully answers the questions, more dinosaur parts are given to the player and they are rewarded with a bronze, silver, or gold dinosaur. More dinosaur parts enables players to create even more unique creations.

In the end the student is able to see their dinosaur and choose to save and print any version created at various stages of playing the game, as an incentive for completing *Research Quest: Dino Lab*.

3. GAME DEVELOPMENT PROCESS

The Natural History Museum of Utah, in collaboration with The GApp Lab, had a singular goal for this game, to advance critical thinking in middle school students. In order to achieve this goal, the team utilized the Design Box method, which was created in an effort to help game designers collaborate in participatory design with partners and focus on the project's need. Subsequent meetings with various stakeholders included museum leadership, teachers students, paleontologists, and game creators.

After six Design Box sessions with teachers, students, and stakeholders, the game design team began to develop *Research Quest*. Through the use of Scrum development process, the team created six iterations of the game. The team found the sixth iteration to match the goals of all audiences and stakeholders.

4. FUTURE DIRECTIONS

Research Quest is still a prototype and is not currently available to the public. In fall of 2015, it will be released in local public schools for further play-testing and evaluation. The team hopes to see improvement of critical thinking skills in middle school students. Furthermore, through play-testing the team expects to see opportunities for further iteration and improvement to achieve the overarching goal.

5. REFERENCES

- [1] Altizer, Roger & Zagal, Jose P. 2014. Designing Inside The Box Or Pitching Practices In Industry And Education. In *DiGRA '14 - Proceedings of the 2014 DiGRA International Conference, 2014. Volume: 8.* (Snowbird, UT, August 3-6, 2014).
- [2] Bonk, Curtis J. 1988. *The Effects of Convergent and Divergent Computer Software on Children's Critical and Creative Thinking.* Annual Meeting of the American Educational Research Association, New Orleans, LA.1988.
- [3] Burns, Eeva. 2009. *The Use of Science Inquiry and Its Effect on Critical Thinking Skills and Dispositions in Third Grade Students.* Doctoral Thesis. Loyola University Chicago.
- [4] Legant, Laura M. 2010. *A Case Study Examining Critical Thinking in an Elementary Service-Learning Project.* Doctoral Thesis. Walden University.
- [5] McCall, Ava L. 2011. Promoting Critical Thinking and Inquiry through Maps in Elementary Classrooms. *Social Studies* (May/Jun2011), Vol. 102 Issue 3, p132-138.
- [6] Pandya, Jessica Zacher. 2012. Mandating and Standardizing the Teaching of Critical Literacy Skills: A Cautionary Tale. *Theory Into Practice* (2012) Vol. 51, p20-26.