

Touching Triton: A New Direction for Biomedical Serious Games

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Introduction

The field of genetics is no stranger to simulation and serious games. A recent count of the number of interactive games and simulations at one of the most popular sites for online genetics content, <http://learn.genetics.utah.edu/>, produced no less than 22 different online activities for students. Other online gaming environments like Phyllo (<http://phylo.cs.mcgill.ca/>) (Kawrykow A., et al., 2012) and eterna (<http://eterna.cmu.edu/web/>) are designed to bridge gaming and scientific research. Many of the serious games about genetics that have been developed thus far focus on Mendelian genetics, simple inheritance patterns and/or structures of molecules involved in inheritance. Although these games align with traditional teachings that occur in many middle school, high school and college classrooms, there is much room for expansion in complex genetics and complex disease. Using, common good practices of simulation, social interaction and student feedback (Swanson, 2014), Touching Triton was developed as a serious game focused on common complex disease and how genetic factors, environmental factors and family history all play a role in a lifetime risk of developing these diseases.

Game Design

The initial idea for an activity to engage students in an exploration of the genetic, environment and family history factors that play a role in the development of common complex disease was formed during the summer of 2009 by an experienced educator and a group of summer interns working for HudsonAlpha Institute for Biotechnology. The activity, Risky Business, used a large printed sticker, magnetic foam flags and a magnetic white board to which the sticker was attached (see Figure 1). Hundreds of students pilot tested the activity in this form with great success. However the activity was material intensive limiting the ability to use it in area schools. A National Science Foundation Science Education Partnership Award (NIH-SEPA) was awarded in 2010 to make the transition from material intensive activity to computer-based interactive. In May of 2010, two members of the grant team attended the annual NIH-SEPA meeting and were introduced to good practices of online interactives and games. The decision was quickly made that Risky Business could not simply be reiterated on a computer screen, but needed major redesign in order to bring it into the world of serious games.



Figure 1: Material intensive Risky Business activity.

The redesign of Risky Business began with creating an engaging storyline, characters and theme for the activity. This provided some challenge in portraying cutting-edge technology, not overselling the clinical utility of current genomic risk assessments for complex disease, and minimizing the possibility of genetic discrimination. The decision was reached to design the storyline around a 20 year round-trip space flight mission to a moon of Neptune called Triton for six crew members. Given the new direction, the name was changed to Touching Triton.

At Touching Triton's core are four core learning concepts: 1) Many genetic and environmental factors interact together in a complex manner to influence health and disease risk, 2) Genomic data can be used to determine a quantitative disease risk for an individual, 3) Current knowledge about genomics and risk factors for disease is ever changing, and 4) Personalized disease risk can inform decisions regarding lifestyle and medical interventions. Touching Triton asks the player to analyze three types of data (genomic data, family history and medical records) related to a crewmember and make an assessment of his/her lifetime risk of several complex diseases. Then players are asked to use their assessment to make medical packing recommendations to help mitigate risk

and potentially treat each of six common complex diseases, ultimately packing and launching the spacecraft on the 20-year mission.

During programming it was critical for students to engage with actual scientific data and for data used to determine mission outcome to be based in scientific research data as well. To that extent, a complex algorithm including population risk data, genomic risk data, and data about the effectiveness of packing options on mitigating and treating disease was used. Educators can obtain real-time data on student progression via a specially designed teacher portal. The teacher portal shows individual student performance and decision-making during play making a gradable dataset easily accessible (see Figure 2).

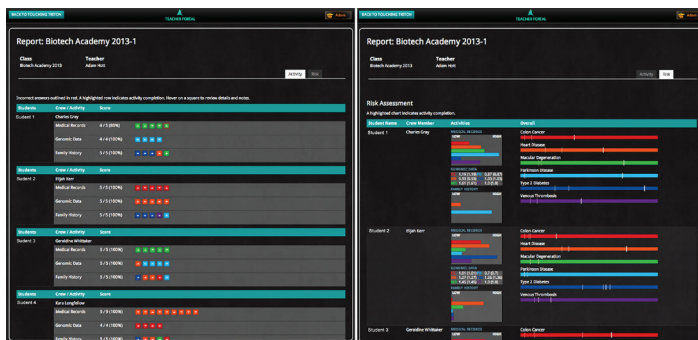


Figure 2: Teacher portal and student data report.

Touching Triton features 91 live-action videos; including end sequence videos portraying each possible combination of crewmembers returning to earth from the mission. Other videos include content advisors (PhD Scientist, Physician and Genetic Counselor) and a pedagogical agent providing just-in-time learning of key content. Both short and long interviews with each of the crewmembers and a 1.5-minute trailer have also been included to provide an additional level of engagement in the storyline.

Testing and Outcomes

A comprehensive, mixed methods evaluation has been taking place on Touching Triton for the past three years. Initially, evaluation was focused on very early alpha and beta versions of the application collecting data on student interactions. Many of the final visuals and sequencing was influenced by that data. Formal evaluation of Touching Triton in classrooms across the state of Alabama began during the 2013-2014 academic year. Evaluation was conducted using a set of early adopting teachers that were trained on implementation of the activity during the summer of 2013. Sixteen classrooms across the state of Alabama have participated in the evaluation of Touching Triton.

Early analysis of data indicates teachers think that Touching Triton not only fit into their existing genetics curriculum (77%), but also were very likely to recommend the application to their colleagues (79%). Student familiarity with the terms “Genomics” and “Odds Ratio” increased significantly compared to controls. Other vocabulary familiarity gains were also seen, especially relating to terms connected with careers like, genetic counselor and pharmacologist. Additionally, a content survey showed a significant difference in student ability to correctly answer questions regarding complex traits after playing Touching Triton than in controls. Touching Triton is meeting expectations and delivering complicated content material to students in an effective and engaging manner.

References

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