The Design and Development of an Educational Game for Upper-Elementary School Children: *Down with Food*

Ohoud Alharbi, University of California, Irvine
Chantal Fry, California State Polytechnic University, Pomona
Martha Han, University of California, Irvine
Qi Shi, University of California, Irvine
Iris Zeng, University of California, Irvine

Short Game Description: *Down with Food* is an educational mobile game developed with the Unity3D game engine. Through an interactive e-book broken up by various mini-games and simulations, *Down with Food* works to address the common misconceptions upper elementary-aged children have about what happens to food after it's consumed and to teach systems thinking.

Introduction

Educational games have many potential benefits, when compared to traditional instructional methods, including increased learner motivation and the encouragement of exploration and risks (Allery, 2014). However, instead of seamlessly integrating learning into the game itself, often educational games take a "chocolate-covered broccoli" approach to learning (Bruckman, 1999). In *Math Baseball*, for example, learners must respond to mathematical equations and based on the correctness of their responses, are rewarded with either a "run" or an "out" accompanied with a change in graphics. The intended learning content has nothing to do with the baseball going on in the background. Furthermore, the engaging aspect of the game does not help the player learn about algebra. The content isn't made any clearer and the baseball aspect does nothing to change the fact that algebra is algebra, or, broccoli is broccoli. The potential of fun in a game such as *Math Baseball* does not compare well to today's popular games such as *League of Legends* and *World of Warcraft*.

Down with Food works to create a game experience that is both fun and educational by actively involving the learner in all parts of the game. Developed to teach systems thinking, an approach focused on the understanding of how parts of a system influence one another within the whole system, *Down with Food* emphasizes that the individual organs in the digestive system interact within and influence a larger system.

Down with Food Game Components

E-book Chapters

The e-book provides continuous context and explanation to the learner. The learner is kept engaged through careful use of humor, a likeable protagonist, interactive animations, collectables, and voice recording.

The plot starts with Mr. Patron being unable to eat the meal that Dr. Chef, a master cook with a degree in Biology, has prepared. Her friend Zyme, a small homunculus creature and the hero, discovers that Anti-Zyme has snuck into Mr. Patron's digestive system and is causing it to fail. With the help of the knowledgeable Dr. Chef and the player, Zyme sets off and enlists the player's help to fix Anti-Zyme's messes and save Mr. Patron.

From here on, the e-book is broken up into chapters, one for each major organ of the digestive system.

Mini-games and Interactive Simulations

Down with Food currently features two fully-levelled mini-games and one highly-interactive simulation. Each mini-game is based on a different popular game genre: the esophagus game is modelled on games in the rhythm genre such as *Dance Dance Revolution*, while the *Small Intestine* mini-game makes use of the tower defense genre such as *Plants vs. Zombies*. Key game components, typical of each respective genre, are mapped to corresponding elements of the digestive system. For example, in the *Small Intestine* mini-game, instead of towers that shoot at enemies, players place enzyme launchers that launch enzymes at oncoming food blobs in order to break down the blobs into their corresponding nutrients.

Each mini-game and simulation focuses on one primary learning objective to enhance systems thinking:

- *Esophagus*: Humans cannot breathe and swallow at the same time.
- *Small Intestine*: Nutrients from food are absorbed in the small intestine.

- *Stomach*: Food requires a highly-acidic environment in the stomach in order to digest; however, the cells on the stomach wall require protection to not be harmed by the acid.

- *Large Intestine* (future development): Optimal amounts of water must be absorbed by the large intestine in order to have healthy bowel movements: too much water results in constipation while too little water results in diarrhea.

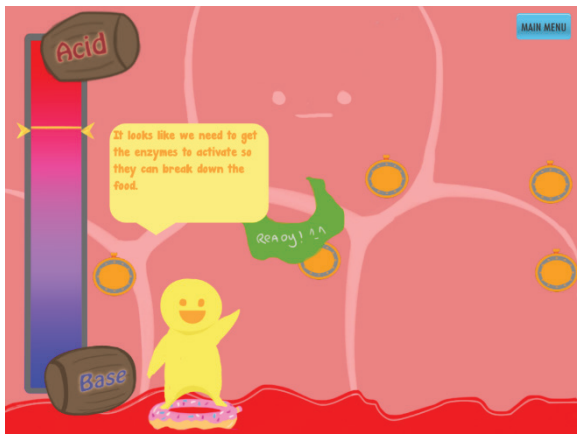

Figure 1: An interactive simulation based on the stomach organ.

Future Development

By the time of the conference, *Down with Food* will progress from the alpha to beta phase of development. At this stage, we will have: (a) completed all e-book chapters including accompanying animations and interactive elements; (b) completed development of the stomach simulation; and (c) designed and developed a game based on the large intestine.

Prototype in Action

Footage of various elements of gameplay are available at http://downwithfood.com/videos/. Additionally, access to a downloadable demo of the most recent build can be requested at http://downwithfood.com/prototypes/.

References

Allery, L. (2014). Make use of educational games. Education for Primary Care : An Official Publication of the Association of Course Organisers, National Association of GP Tutors, World Organisation of Family Doctors, 25(1), 65.

Blizzard Entertainment. (2004). *World of Warcraft*. [Microsoft Windows, OSX]. Irvine, CA: Blizzard Entertainment.

Bruckman, A. (1999, March). Can educational games be fun? Paper presented at the Game Developers Conference, San Jose, CA

Funbrain. (n.d.). *Math Baseball*. [Web Browser]. Boston, MA: Family Education Network.

Konami. (1998). *Dance Dance Revolution*. [Arcade]. Tokyo, Japan: Konami.

PopCap Games. (2009). *Plants vs. Zombies*. [Microsoft Windows, OSX, iOS, Xbox Live Arcade, Nintendo DS, PlayStation Network, DSiWare, Android, Windows Phone, PlayStation Vita, BlackBerry 10]. Seattle, WA: PopCap Games.

Riot Games. (2009). *League of Legends*. [Microsoft Windows, OSX]. Santa Monica, CA: Riot Games.