

How Kids Inform the Development of a Science Game

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Abstract: *Down With Food* is a game designed to teach upper-elementary school students about the intricacies of the human digestive system. Using design-based research, we document the process by which children's motivations for playing, as well as their interactions with and understanding of the game, influences the game design and drives further user testing. We detail the misconceptions players have in early prototypes, discuss the overarching principles of these misconceptions, and propose design solutions to address these misconceptions. Specifically, we redesigned the user interface and graphics to address visual misinterpretations and are adding a narrative layer to help children contextualize what is happening in the mini-games with the corresponding biological functions and processes.

Overview of the game

Down With Food is an educational iPad game, composed of a story narrative, that links a series of mini-games, each corresponding to an organ in the digestive system. Each mini-game integrates inherently enjoyable aspects of non-educational games directly with educational content. For example, the small intestine mini-game uses game mechanics commonly found in Tower Defense games: players place enzyme towers and release enzymes at oncoming blobs of food to absorb nutrients. Specific towers must be strategically placed to correspond to the types of nutrients that pass, such as proteins and carbohydrates.

Insights from user testing

The focus of the user testing sessions was to understand whether players understood how the tower defense game mechanics connected to the biological function of the small intestine. During user testing sessions, 19 participants (ages 7-10) played our prototypes. Research assistants tested participants individually or in pairs. Participants were asked to think aloud as they played the game and research assistants subsequently interviewed participants about their interests and intentions. Below, we describe examples in which our intended outcomes did not occur and how we are addressing them in current research and game revision.

Problem: Contradictory Schemas

Previous knowledge and perceptions can affect how players learn game mechanics and how they understand what is happening in the game. For example, we used a Tower Defense paradigm in which players strategically place towers to ward off oncoming enemies as the game mechanic for our small intestine game. In our game, players need to place towers along the small intestine and release enzymes at oncoming food to absorb nutrients. This contradictory schema of nutrients not being an "enemy" but rather an "ally" posed a problem. During the user testing sessions, players frequently referred to the enzyme towers as "killing the blobs" that then "disappear" and "die." Re-designing the game to take these players' previous experiences into consideration is the next step in our work.

Potential Solutions: Refining In-Game Visualizations

In order to correct for these misconceptions, our new designs focus on presenting the process of absorption as a positive gain in reaction to the user's interventions. One solution has been to modify the visualization of nutrient absorption by adding plus signs as the nutrient particles are absorbed. Another solution under development is having the nearby villi glow, signifying nutrient absorption in a localized area (see Figure 1).

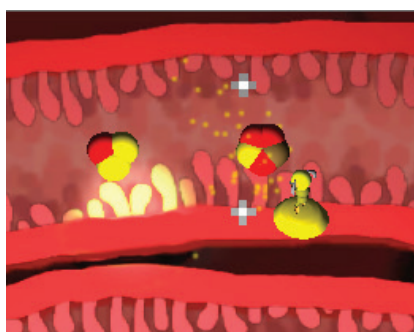


Figure 1: Plus signs appearing and villi glowing as nutrients are absorbed.

Developing an E-book layer

In our new game design, we are introducing a narrative structure in the form of an e-book layer to address the misconceptions discovered in previous user testing sessions and to illustrate connections between the mechanisms of the games and those of the physical human body. The e-book is an interactive storybook narrative that acts as a demonstrative guide, providing context for the mini-games. The narrative of the e-book is structured to match the biological digestion process, following a journey from the mouth to the large intestine. The goal of this added context is to break the schema that the food blobs in our game are an oncoming enemy.

The e-book will also juxtapose the digestive process with its representative game mechanic (see Figure 2). For example, the pages in Figure 2 illustrate that the nutrient blobs featured in the small intestine game are symbolic of real food particles. While reading about the digestive process, children can experience what they have learned by playing the interactive games. By forging this connection, we hope that children will better understand the digestive process as they play the game and become more familiar with the game mechanic.

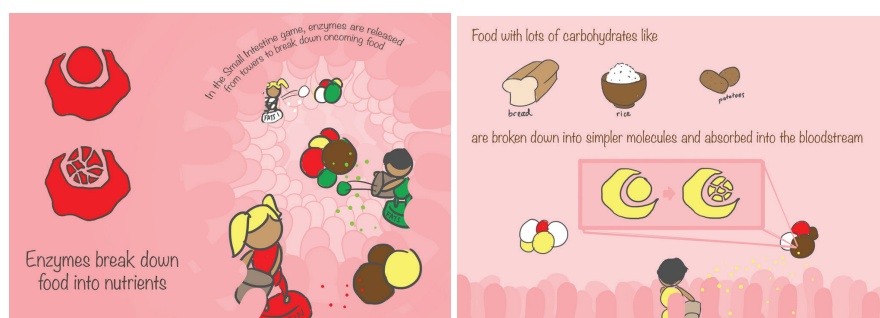


Figure 2: Pages from e-book detailing nutrient absorption.

Current Research

We recognize that young children do not enjoy reading large blocks of text when playing a video game. However, this e-book is designed to integrate seamlessly with the game, reflecting the game's stimulating visuals. In current play sessions with children, we are determining how children respond to the new visuals and how effectively the e-book presents information. Our new findings will be used to further develop our game, as well as give insight on elements to consider when developing other educational games. Updates to our research and development are at www.downwithfood.com.