Wrong Game, Wrong Message

Eesh Gupta
Class of 2019
Edison High School
Edison, NJ
eag4013@gmail.com

Nathan Rice
Graduate Research Assistant
Biological Systems Engineering
University of Nebraska–Lincoln
Lincoln, Nebraska
nathanriceunl@yahoo.com

Jennifer Keshwani
Assistant Professor
Department of Biological Systems Engineering
University of Nebraska–Lincoln
Lincoln, Nebraska
jkeshwani@unl.edu

Ashu Guru
Assistant Professor, Teaching & Learning Specialist
4-H Youth Development and Department of Biological Systems Engineering
University of Nebraska–Lincoln
Lincoln, Nebraska
ashu.guru@unl.edu

Abstract

Video games allow students to visually explore new worlds, and have been linked to positive advances in problem solving, fact recall, and motivation. Choosing a game that aligns with educational objectives can be challenging due to the host of games on the market and the balance between education and entertainment. This paper uses a case study to present guidelines for educators on how to evaluate if an educational game accurately represents the learning concepts. Important factors include game imagery, interactions, score, and game-play. Evaluating educational games is a critical step to ensure that students are building the correct mindset.

Keywords: Game-based Learning, Extension, Video Games, Selection Guidelines, Case Study

Introduction

Gaming environments have a long history of being used in extension education (Bauer & Ogg, 2011; Cason, Wenrich, & Lv, 2005; O'Neill, 2008; Rollins & Watson, 2017; Weitzenkamp, Dam, & Chichester, 2015; Wittman, 2010). Grieshop (1987) argued that extension should aggressively explore educational games as they have some advantages over traditional teaching methods. For example, video games allow players to create worlds and govern them by their decisions (Gee et al., 2003). Such autonomy allows students to learn by experimenting (Waddington, 2015). In addition, students show more engagement and enthusiasm about learning

when interacting directly with a virtual reality (Annetta, Minogue, Holmes, Cheng, 2009). Video games have been reported to improve fact/recall processes and problem solving skills (Chuang & Chen, 2009), and previously alienated students were also able to emotionally connect with video games (Squire, 2008).

More educators are searching the market for video games to supplement their curriculum (Johnson, Becker, Estrada, & Freeman, 2014). However, educators are presented with a large number of games from which to choose. The goal of this paper is to develop guidelines to select a game-based learning environment that aligns with classroom learning objectives and prevents content misconceptions. The guidelines include the following constructs (i) imagery, (ii) game interactions, (iii) scoring system, and (iv) game-play. Our assumption is that evaluating games with these constructs is critical for successful implementation of game-based learning activities in the classroom.

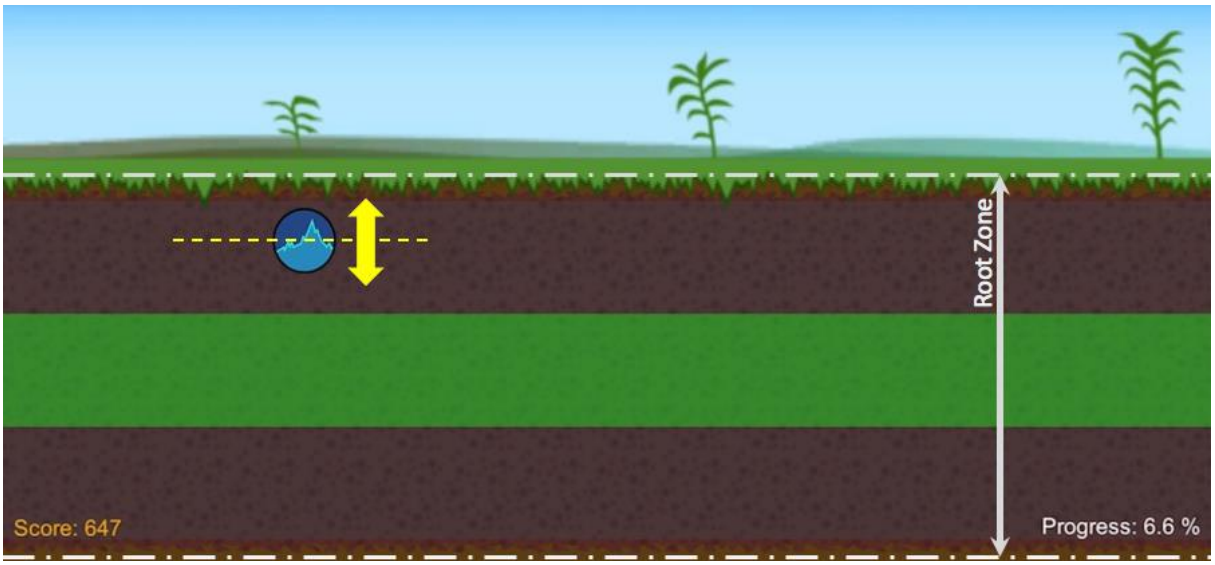
An irrigation game will be used throughout this article as a case example. The game was developed to help students understand the variables that impact irrigation practices including soil type, wilting point, and field capacity.

Imagery

Game imagery consists of a game's graphical content. The graphical content enables players to visualize complex concepts and impacts player engagement. The phrase, "A picture is worth a thousand words," stems from the effectiveness of images to explain a topic, and the ability to remember information in picture form. However, when an image displays incorrect information, these attributes can be detrimental to student learning. The student will associate and visually recall the incorrect concepts. For example, an early iteration of the irrigation game visually misrepresented how soil water saturation behaves in the crop root zone (Figure 1).

Visual flaws can be detected by consulting an expert on the message the visuals impart; a search engine may also be used to find images of the underlying concept within the .edu domain. This is a method of crowdsourcing the opinion of thousands of people on how the underlying concept has been visualized.

Figure 1.
Imagery Misrepresentation



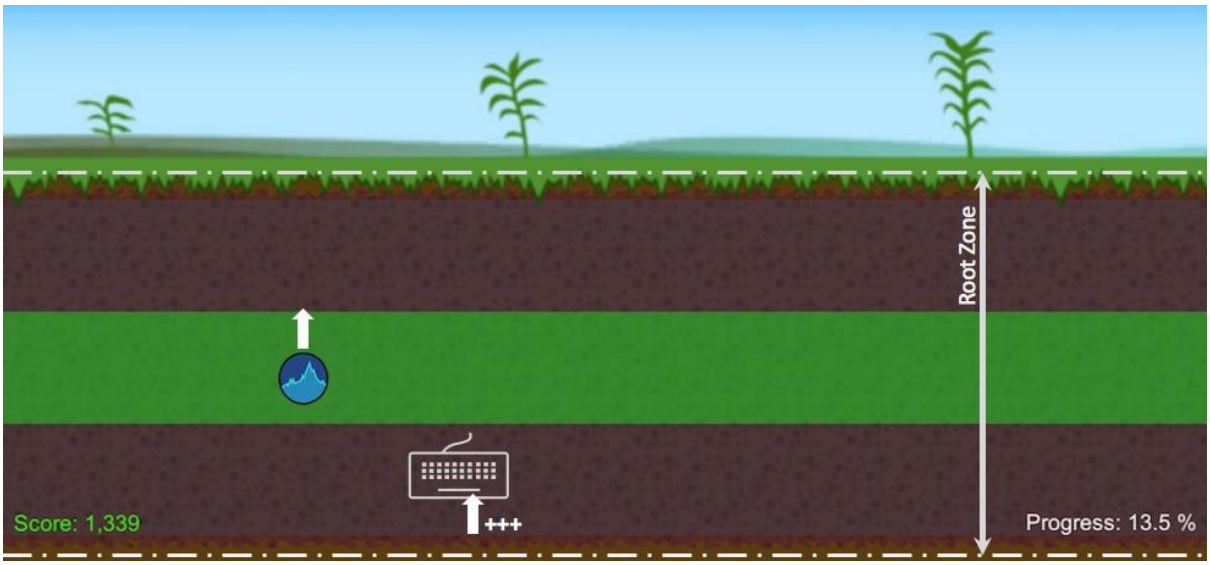
Caption: The blue pin marked the soil water as a percentage. However, the pin moved up and down, making students think this represented a water table line; i.e. everything above the pin is dry and everything below the pin is saturated. In reality, a percentage of the pore space across the soil matrix is filled with water.

Game Interactions

Game interactions consist of the decisions made by the player. Game interactions engage a player by giving freedom to manipulate variables. A universal trend in gaming is to exaggerate real life events to add entertainment or fit the game's spatial/temporal constraints. The key for an educator is to determine when these exaggerations are ok and when they reinforce incorrect information. For example, the irrigation game originally required applying water rapidly to maintain soil saturation (Figure 2). This led students to severely overestimating the number of times during a growing season that farmers irrigate their crops.

It is critical to evaluate the topic of the exaggeration when evaluating if it is acceptable. When a topic is well known to the audience it won't impact their understanding when gameplay is exaggerated. For example, students in the Midwest are familiar with the impacts and frequency of tornados. If the exaggerated topic in a game is focused on tornados, the game players have a baseline understanding of tornadoes and the gameplay exaggeration is inconsequential. However, if the exaggerated topic is more advanced or unknown, such as a microbiological pathway, this could be the players' first experience with the interaction. Maintaining scientific authenticity then becomes essential.

Figure 2.
Game Interaction Misrepresentation

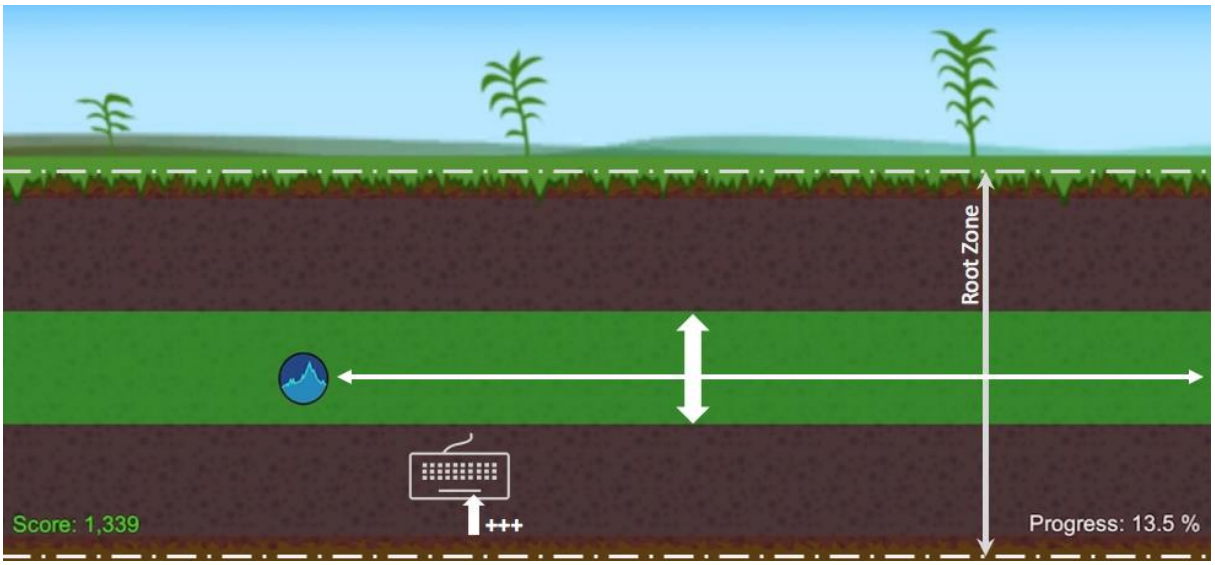


Caption: To increase water saturation, a player presses the spacebar to add water to the soil matrix. Rapidly pressing the spacebar was required to maintain the soil moisture level. This led students without a background in farming to believe hundreds of irrigation events were required for producing crops

Score

A distinguishing characteristic of games is that they contains an attribute that allows game players to know if they won, usually seen as a score. The score gauges "success", and allows players to compare their actions with other players. For most individuals this builds an intrinsic motivation to win. From an educator's perspective, the score dictates a large portion of the player's motivation. Player behavior will trend towards the actions that result in a favorable score. These actions will be emphasized by the game as the "Correct" response and should be the actions educators want the students to perform. Rewarding spacebar pressing speed is an example from the irrigation game of a player action that was contrary to the desired learning outcomes (Figure 3). An alternative scoring system must be developed or a different game needs to be chosen if the actions that lead to the winning score are not the actions the educators would like the players to perform.

Figure 3.
Score Misrepresentation



Caption: The winning score for the irrigation game was the player who could rapidly press the spacebar enough to maintain within the green zone for the longest period of time. This encouraged gameplay with no regard to water usage or the energy requirement for irrigating. Both significant factors for sustainable agriculture.

Play the Game

An important way for an educator to assess the quality of a game for education is to play it. By playing the game, the educator is able to assess what learning concepts are achieved. Overall, it is a good check against potential flaws in all the other constructs that we discussed above and the conceptual game content. If the game is not played by the instructor prior to introducing it to students, the educator risks teaching material that may be tangent to the learning objectives. Similarly, the educator can share the game with non-experts and gain feedback on what they learned. This simulates the students' experience and prevents internal bias from impacting the results. Always remember that no matter how great or terrible a game looks on paper, it is the outcomes of playing that matter.

Summary

When correctly selected, video games are a visual and interactive tool which provide enrichment to the classroom experience. However, choosing a game that aligns with the desired learning objectives can be a challenge. The guidelines presented in this paper identify game factors that have a significant influence on the learning outcomes students receive. Taking the time to evaluate how games are designed is a critical step to ensure information is not being misrepresented to students.

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