CGS Brain Busters: A K-16 Dynamic Educational Boxing Game

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Abstract

This paper presents the design and development of an educational boxing game that provides the user with the ability to edit the educational game content with minimal programming experience. The overall objective is to design and implement an easy-to-use game interface in which educational elements can be incorporated to help improve the player's core knowledge in any critical subject area. The boxing game is geared towards upper level high school to beginning college students; however, the design can accommodate any level of content from pre K – 16.

Introduction

In order to master any subject area, a solid grasp of the fundamental concepts of that area is required. It is imperative to present material to the student in a way that allows him/her to assimilate the information with as little difficulty as possible. 'Identification' and 'Association' (I&A) are simple ways to learn core concepts in a rapid, efficient manner. Used correctly, I&A allow the ability to develop tools that visually engage the player as he/she learns. I&A can be used in subject areas ranging from basic shape identification to complex symbol association. By presenting 'Identification' and 'Association' concepts in a fun user friendly environment, students can be more engaged and minimize any feelings of frustration that would be encountered while practicing fundamental skills associated with any subject area. This paper will present *CGS Brain Busters* (an educational boxing game). *CGS Brain Busters* is intended for high school to college level educational content; however, it can be used for content ranging from pre K – 16.

Background

Video games are generally thought of as leisure activities used to entertain. They use fancy graphics and sounds to keep the game players interested. Video games do have another side, however; they sharpen reflexes and promote immediate decision making. The hours people spend playing video games can also increase skills such as logical and analytical skills as well as problem solving without the player even knowing that he/she is improving those skills.

Educational games

In order to develop a successful game environment, it must be determined which types of Flash based-games are currently available. There are many different types of educational web-based Flash games available for download on sites such as Prongo[1], Class tools[2], and the Problem Site[3]

to name a very few. These games, while presenting basic educational content, lack the curriculum based content presented in a fun unique environment.

Prongo[1] (see Figure 1) contains many games, e-cards, jokes, and brain teasers that have an educational focus. These games are designed for students between the ages of 3 and 12 and cover subject areas such as math and language. One of the more interesting games is *Wally The Stock Ticker*[1] which allows the student to choose a company and view that company's stock symbol, current price, change of price from yesterday, date of last trade, etc. As the student views the information an explanation appears that describes what the student is viewing. This game serves more as an informational tool than a game but the information is laid out in such a way that the student can understand what he/she is viewing.

Figure 1 Prongo stock ticker game[1]

The Lemon Larry game[1] (see Figure 2), is a multiplication game developed using Adobe Flash. Once the player enters and answer it provides feedback on whether it is correct or not. However, it provides the correct answer if the player makes a mistake.

Classtools.net[2] (see Figure 3), "allows you to create free educational games, activities and diagrams in a Flash! Host them on your own blog, website or intranet! No signup, no passwords, no charge!"[2]. Classtools.net allows the user access to template files that can have content entered in them. Once the content is in place, the file can be saved on the user's computer or placed on the Classtools.net server so the template can be embedded in

a wiki, website, or blog. These templates consist of text boxes where the user can add information that is then used in a game. The games range from matching games and flash card games to space invader type games. These games use the definitions and words entered by the user to teach students the content area specified by the teacher.

Figure 2 The Lemonade Larry game [1]

The Problem Site[3] is a collection of educational games and puzzles to help students engage in learning in interesting ways. The games on this site range from math games to word games.

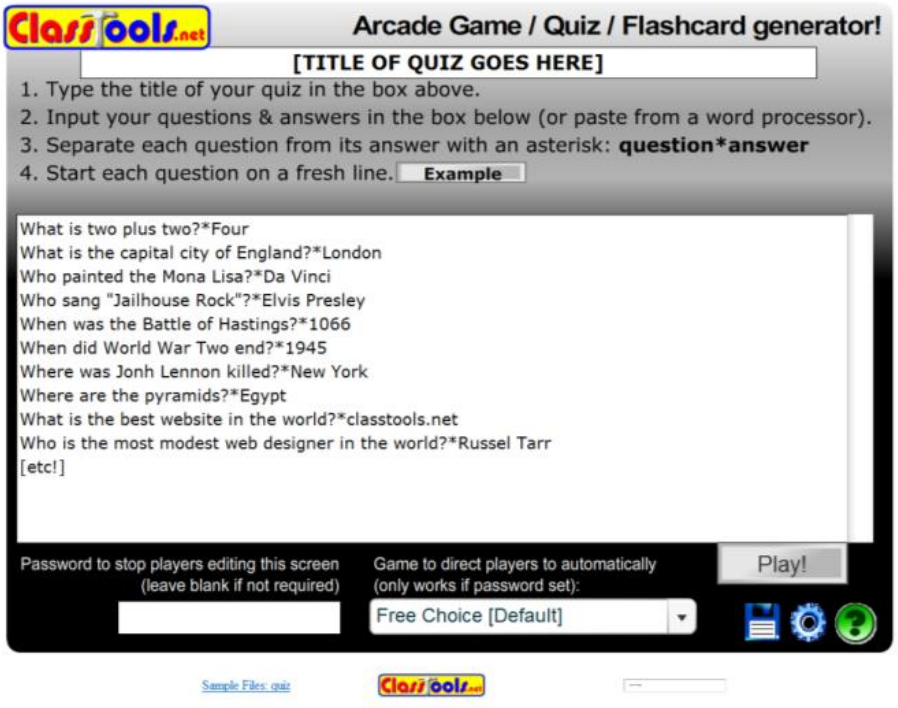

Figure 3 Arcade game generator template[2]

In summary, a review of current K-16 educational Flash-based games on the web found none that mixed unique genres, in particular the boxing game genre, with educational elements in a dynamic content generation setting. This creates an interesting and exciting new area for educational Flash-based games to expand into. The boxing game genre can effectively immerse the game player in the game environment and the story line by allowing the user to actively participate in the game.

CGS Brain Busters

Figures 4 and 5 show the game's main screen and initial menu, respectively. On the initial menu screen (see Figure 5), the player is presented with a list of nine possible opponents. Each opponent has a specific educational proficiency. These proficiencies range from mathematics, to engineering, to languages. Due to the dynamic nature with which the game pulls the educational content, the content can be any subject or topic where the educational aspect is based on 'Identification' and 'Association' (I&A). The current version of the game contains the following educational elements:

- Analog circuit components
- Analog circuit analysis terms
- Digital logic elements
- Electronics lab components
- Periodic table of elements
- Chinese numbers
- Scientific prefixes
- Geometry terms
- Greek alphabet

Figure 4 CGS Brain Busters main screen

Another version of the game, designed for elementary school students, includes content from poetry and geometrical shapes.

CGS game characters

The characters (see Figure 5) for the game are customizable. The characters are designed to be images and animations of real people to provide the feel of realism in the game. This also allows the game to be personalized - the game is designed to allow the teacher to customize the characters in the game. This allows it to be more fun for the student.

Figure 5 Main game menu (characters)

CGS gameplay

The gameplay is intended to fun and carefree. The boxing motions are developed intentionally to be more humorous than real boxing movements to not be promoting violence. The player is presented with a randomly selected educational element for which the player will have to select the response from a list of answers provided. Depending on whether or not the player selects the correct answer, the player will receive a hit from the opponent or gain a hit point. Once enough hit points are accumulated, the player can then attack the opponent by using these hit points (see Figure 6). After exhausting the hit points, the player must identify more educational elements to continue to accrue pints and box. When the player's health points reach zero, the player loses the round and is prompted to continue or quit. If the opponent's health points reach zero before the player's does, then the player progresses to the next opponent. In order to win, the player must defeat six opponents. If the player wins, a congratulatory message is displayed and the game is reset.

After every round, the player is given feedback on his/her progress which can be recorded for further evaluation. The information displayed includes numbers of correct answers, incorrect answers, and the average time taken per correct answer.

Figure 6 CGS gameplay

Game framework

The goal of the *CGS Boxing Game Model* (see Figure 7) is to provide a framework for an educational boxing game where the content developer, with little to no programming experience, can edit or add content using a Flash template file. The framework requires a Flash template file with the graphics appropriately linked and the code files that actually build the application. The game design model allows for dynamic content without access to game play source code. CGS Brain Busters is designed to be used by upper level high school to beginning college students although, with appropriate educational content, it can be used for K – 16 education. This game is designed to allow students to assimilate content and be tested on their knowledge and given feedback on their progress. However, correct responses are not provided. This allows the student to work on identifying where s/he went wrong rather be told what the correct answer is.

Game modules

Educational elements unit

The primary function of the *Educational Elements* unit of the *CGS Boxing Game Model* (which includes both the setup and content modules) is to control the educational elements and user interface including placement, content, and functionality. This unit includes the *Educational Elements Setup* file (which is an external .as file) and the *Educational Elements Content* itself and is the backbone of the game design model that allows for dynamic content and random content item selection.

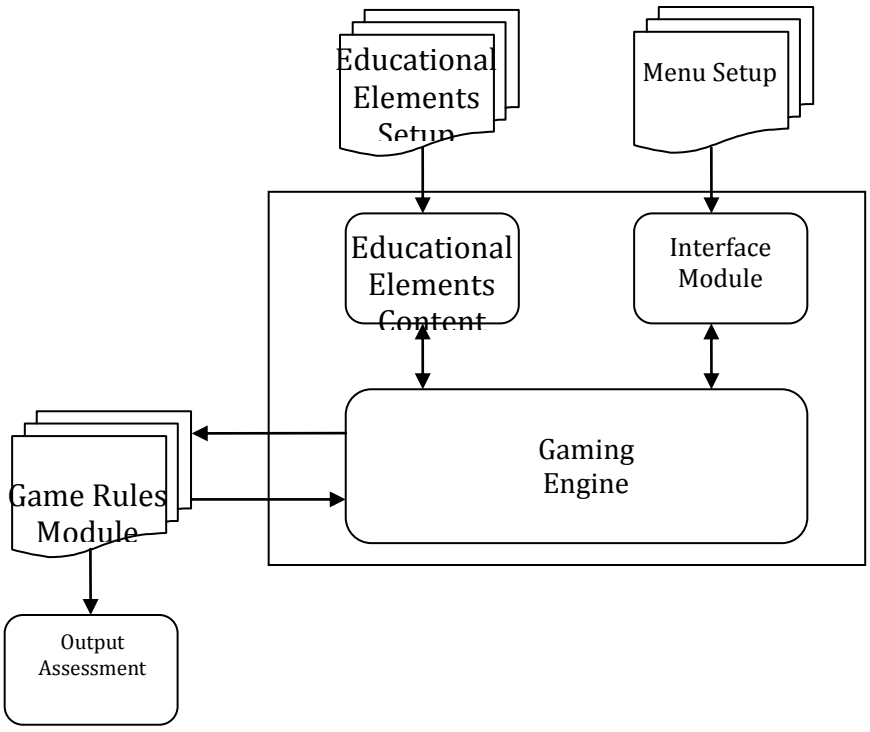

Figure 7 CGS game framework

The educational elements (see Figure 8) are entered by the content developer and are randomly selected by the application for the player to identify. The framework is designed to accept 18 elements per character. These elements can include letters, numbers, pictures, small movie clips, or any module format allowed by Adobe Flash.

Menu setup and interface modules

The *menu setup module* contains the coordinates for the placement of all the elements which appear on the different areas of display on the game user interface. This file also contains the names of each different component that is used to build each game scene. The menu setup file does not affect the educational elements and therefore is not necessary for the framework to run. The contents of this file serve as a way to immerse the player in the game in order to enhance the educational impact of the game. The *Interface Module* assigns functionality to all the components of a game scene. This includes the playing of sounds, and allowing for user interactivity with the components used in the different game scenes.

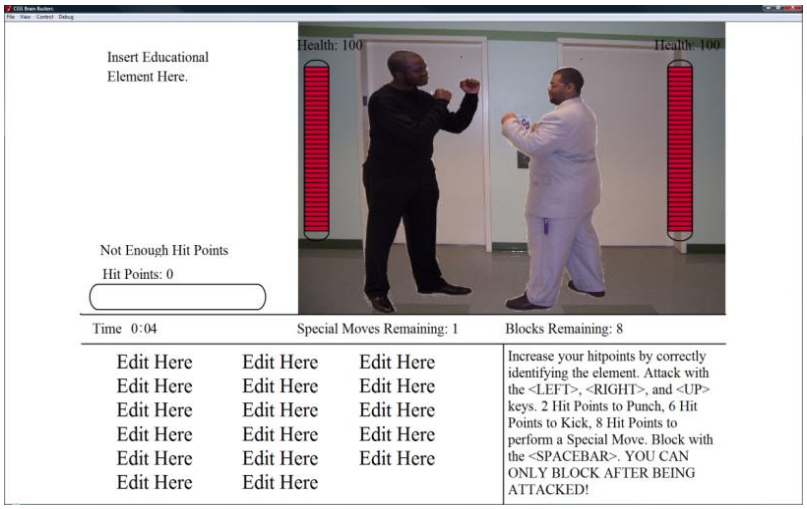

Figure 8 Educational elements screen

Gaming engine

The gaming engine is where the components from the *Menu Setup*, *Interface Module*, and *Educational Elements* portions of the game model are used together to allow for interactivity with the player. For the game interface, the gaming engine attaches the actual graphics from the Flash library to the ActionScript code contained in the external .as files associated with the *Educational Elements Setup* and *Menu Setup* modules. The components contained in the gaming engine include graphics and sounds.

Figure 9 Output assessment screen

Game rules

The *Game Rules Module* contains all the game play rules for the players and opponents. This module defines elements such as user controls, opponent artificial intelligence, and winning and losing.
Output assessment

The *Output Assessment* portion (see Figure 9) provides the user with immediate feedback on the game progression and statistics that were collected during game play.

Conclusion

This paper presented an educational boxing game (CGS Brain Busters) which is customizable with respect to players as well as educational content. The game is designed to train students on content which requires 'Identification' and 'Association' (I&A) which is representative of any core concepts that are expected to be learned in any subject area. Two different versions of the game have been developed so far. CGS Brain Busters is currently at the evaluation phase. Efforts are under way with a local school to pilot the game in the 4^{th} and 5^{th} grade. The primary author is also initiating an evaluation in Digital Logic Design (a college sophomore level course) in Computer Science and Electrical and Computer Engineering degree programs.

Acknowledgements

Our thanks go to the CGS graduate and undergraduate students who agreed to be the CGS Brain Busters game characters.

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