Coding a simple web-based game

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Overview

When this course is complete, the student will be able to build a complete web-based game as part of a team and individually. The course will be delivered in a computer lab environment, supported by a course web page that includes a class forum. The student will code their own complete game individually from the reading and homework, and work as part of a development team to collaborate on a creative class project.

Needs and Learner Analysis

A 2018 Stack Overflow survey shows that JavaScript is the most commonly used programming language (Stack Overflow, 2018). HTML5 developers are in demand, and game development covers a wide range of topics, including using the canvas, interactivity, and multimedia. This course will prepare the student to work proficiently with JavaScript and other software development concepts, including code reviews, code repositories, and other application development practices.

The students of this instruction should be familiar with the Windows operating system, including creating, editing, and saving new documents on a computer. They should also be able to work with a web browser. The instruction is aimed at post-secondary learners of any age.

To better understand the needs and preferences of the student, a series of questions was presented to a sample audience of adult learners in the form of a survey. This questionnaire was delivered through an online survey application to a group with an interest in this subject. The focus of the survey was to establish the demographics of the potential students and provide a learning environment that addressed their preferred learning styles and preferences, as well as any cultural or accessibility features needed. (Brown & Green, 2016, p. 76) The goal is to provide multiple activities that allow for different learning styles and provide an equivalent learning experience for all students. The questions are based on Mager's approach (Mager, 1988).

The survey was distributed through Survey Monkey and can be viewed here.

https://www.surveymonkey.com/r/6THT3LF

I received three replies with the following responses:

- What is your gender – 3 Male, 0 Female
- In what country do you live? – 3 US
- What is your primary language? – 3 English
- What is your age? – average age 38 (38, 38, 23)
- What is your race? – 3 White or Caucasian
- What is your experience with HTML, CSS, and JavaScript?
    - 1 answered. I am somewhat familiar with HTML, CSS, and JavaScript.
    - 2 answered. I use HTML, CSS, and JavaScript daily in my profession.
- Please rank the reasons you might take this course from most important at the top to least important at the bottom. You can drag and drop the order.
    - Score – 3.00 To become familiar with the practice of software development.

  - Score - 3.33 To learn how to develop a game.
  - Score – 2.00 To learn and apply basic computer science principles.
  - Score – 3.67 To learn how to develop and deploy a web application.
  - Score – 3.00 To learn how to use HTML, CSS, and JavaScript.
- Approximately how often do you use social media?
  - 2 answered More than five times per day.
  - 1 answered. I don't use social media frequently.
- How often do you use technology like a computer, laptop, or tablet? I use technology almost constantly at work and at home.
  - 3 answered. I use technology almost constantly at work and at home.
- Do you have any physical or cognitive disabilities?
  - 1 answered Epilepsy

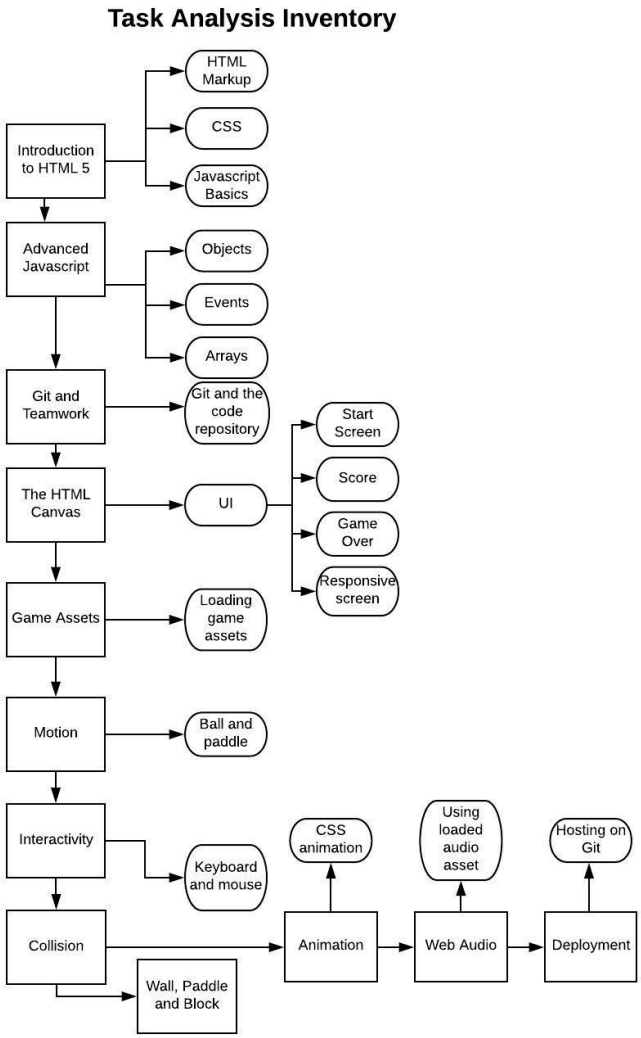
Although three responses are not enough to draw many conclusions, this sample did match a few assumptions that I made while designing the course before receiving the survey results. I assumed that many learners would be technically savvy and frequent users of social media. I also assumed that many users would be more interested in the soft development skills like game design and web development, rather than the details of HTML5. This assumption matches well with my decision to add a creative project and cover other software-related topics like using repositories and having code reviews. Based on this response, I would not alter the instructional strategy until user feedback was received.

Because a student replied that they are diagnosed with epilepsy, I would recommend extra attention be applied to making sure the videos, website, and other media do not have epileptic seizure triggers.

Task Analysis

Programming and design fall under cognitive and declarative skills. Based on this, I chose to follow a topic analysis method to establish and order the content for the course (Brown & Green, 2016, p. 62). In Figure 1.1 below is an inventory of the tasks needed to be able to build a simple web-based game. Subtasks are called out where needed, and the tasks are in the order needed to complete the game.

Figure 1.1 Task Analysis Inventory



Goals and Performance Objectives

Goal 1 - The student will be able to identify the components needed to build a simple and complete web-based game.

- **Objective 1A** – The student will be able to identify the three components of HTML5 in a multiple-choice question with 100% accuracy.
- **Objective 1B –** The student will be able to describe the major game components covered in this course in one sentence with 100% accuracy.
- **Objective 1C** – The student will be able to list the steps to publish an HTML5 game from an unordered list of steps with 100% accuracy.

Goal 2 - The student will be able to code the components for a web-based game.

- **Objective 2A** – The student will be able to solve simple logic problems in JavaScript through code challenge questions with 100% accuracy.
- **Objective 2B** – The student will be able to verify the description of an HTML5 feature through a true or false question with 100% accuracy.

Goal 3 - The student will be able to work as part of a team, creating a web-based game.

- **Objective 3A –** The student will be able to describe the features of a code repository in a single sentence with 100% accuracy.
- **Objective 3B –** The student will be able to describe the purpose of a code review in a single sentence with 100% accuracy.

Instructional Strategy and Plan

The instruction will be provided in a computer lab setting, including supplied computers and a high-definition projector and screen for instructor presentation. The course is also supported by a secure website providing a forum with post voting capabilities, video capabilities, and a Git repository server or access to GitHub.

I chose to apply the universal design for education approach, as the purpose of this course is to reach as many adult learners as possible (Brown & Green, 2016, p. 76). Two cultural challenges that are addressed by the plan include differences in age as well as access and comfort with technology. Instruction is provided through several modes, including reading, instructor presentation, and lecture videos. Younger students with a preference for technology might prefer the forums and videos, and some older students might prefer a direct interaction through instructor presentation and code reviews. The website used for the class will conform to WCAG 2.1 guidelines for accessibility purposes. The videos will have downloadable text transcripts available as well as video captions for those who would benefit from reading along and the hearing-impaired.

As proposed by Ellis and referenced in Brown and Green, the student will work cooperatively on a final project while completing homework each session based on the individual features listed in the task analysis inventory (Ellis, 2005). Each session, all the students individually develop one of the feature components as part of the homework to practice what they have learned through reading and lectures for that session. From the homework, and as suggested by Dean, Ross Hubbell, Pitle, and Stone, each week the student is asked to develop a written hypothesis of how the feature would be constructed and integrated into the overall application. (Brown & Green 2016, p. 131) The result is then code reviewed by the instructor and the class. (Brown & Green

2016, p. 131) The class then works together to develop the final feature that is completed at the end of each week for the cooperative project. During the course, an online forum is maintained where students can pose questions to each other on the homework. The student who posed the question can then select an answer as most helpful. At the end of each week, as suggested by Dean, Ross Hubbell, Pitler, and Stone, the student who has been most helpful on the forums receives a reward from the class (Dean, Ross Hubbell, Pitler, and Stone, 2012).

I involved the SME early in the process to help flesh out and review the task analysis I initially created based on assumptions about content. He responded with clarification on the various tasks and suggestions of elements to add, including details about where in the instruction user interface content would fall. He suggested some elements that we decided not to include because of complexity, but included others like information about controls.

Instruction

To meet the requirements of accessible design, I included multiple modes that would allow learners with varied style preferences to benefit from the instruction in a knowledge-centered learning environment. Each major topic is delivered in a lesson that could be delivered in a workshop or course format.

The instruction is intended to be delivered by an instructor in a classroom. The material for each lesson is delivered live in the class and is also available on the website through video and a transcript. This will allow the instructor to provide immediate feedback to the student. The instruction is also designed to include both directed and open learning opportunities through the directed classroom and a creative project. This will allow a new game developer to gain the

specific knowledge needed for HTML5 while exercising creativity and divergent thinking. (Brown & Green 2016, p. 119)

Instructional Activities

Reading is assigned for each lesson, and the reading content is summarized through the homework assignment. (Brown & Green 2016, p. 128)

Homework will be completed for each lesson to allow practice and application of the lecture and reading materials. Each homework assignment is then code reviewed in the next lesson and may be selected to be added to the creative project. (Brown & Green 2016, p. 129)

On the course page, opportunities for self-testing are provided for each lesson along with the videos.

The students will engage in problem-based learning through a class creative project. The students will work together to apply their new knowledge to a new application and engage in cooperative learning (Brown & Green 2016, p. 125). Each week, a student produces work based on the lesson, and the students decide through a code review which solution is included in the class project. (Brown & Green 2016, p. 121, p. 130)

Online Forums on the course website allow students to interact outside of class and provide a way for students to support each other. When a question is answered, the answer is rated for helpfulness, and each week the student with the highest score is recognized. (Brown & Green 2016, p. 128)

Lesson 1: Introduction to HTML

The students will install Brackets and be able to run a simple website using the live preview feature.

- Installing Brackets and the local web server
    - Install the Brackets text editor from http://brackets.io/
    - Create a simple HTML Index file.
    - Run the page from the live preview button in the upper right-hand corner.
        - In the browser window, it is not possible to load system files from JavaScript for security reasons. By running the Brackets preview, the student is starting a simple web server and serving the page. This allows us access to system files like the audio we will load in Lesson 5.
- HTML Markup and index.html page
    - HTML defines the layout of the page and is contained in the index.html file.
- CSS
    - CSS defines the style of the content, including font, color, and layout dimensions, and is in a file with the extension .css.
- Basic JavaScript
    - JavaScript defines the behavior of the application and is in a file with the extension .js.
    - Load the page with Chrome and the Brackets preview.
- Reading Assignment
    - https://www.w3schools.com/html/default.asp

- https://www.w3schools.com/css/default.asp
- https://www.w3schools.com/js/default.asp

Lesson 2: Advanced JavaScript

- Objects
  - Objects are variables that can hold many other variables. When an instance of an object is created, the values of an object can vary, like defining the value of a car color as “red”.
- Events
  - Events in JavaScript are triggers that allow reactions, such as a “click”.
- Arrays
  - Arrays are used to store multiple values in a single variable.
- Reading Assignments
  - https://www.w3schools.com/js/js_objects.asp
  - https://www.w3schools.com/js/js_events.asp
  - https://www.w3schools.com/js/js_arrays.asp

Lesson 3: Git and Teamwork

GitHub is a file archive where source code can be hosted publicly or privately. The student will log into GitHub and create a free account. The student will create a repository locally and push the results to GitHub. The repository will store the students' work and allow the instructor and other students to view progress. A code review is a quality control activity where humans review the code.

- Reading from GitHub. https://guides.github.com/activities/hello-world/

Lesson 4: The HTML Canvas and UI

The student will create a responsive canvas on the HTML page to display the game. The canvas defines an area on the screen where graphics can be drawn. First, the student will set up a canvas that will respond to the screen size. The student will display the score and number of lives available. This is also where the student will create a start and game-over screen.

- Reading assignment - https://developer.mozilla.org/en-US/docs/Games/Tutorials/2D_Breakout_game_pure_JavaScript/Track_the_score_and_win

Lesson 5: Loading Assets

The browser sandbox prevents access to the file system. To work around this, the student will run the application with the simple server provided by Brackets. They will then load and play the audio files required for the game.

- Reading assignment - https://developer.mozilla.org/en-US/docs/Games/Techniques/Audio_for_Web_Games

Lesson 6: Motion

The student will define a draw loop, draw the ball, and make it move.

- Reading assignment - https://developer.mozilla.org/en-US/docs/Games/Tutorials/2D_Breakout_game_pure_JavaScript/Move_the_ball

Lesson 7: Interactivity

The student will draw the paddle and apply keyboard controls for the paddle.

- Reading assignment - https://developer.mozilla.org/en-US/docs/Games/Tutorials/2D_Breakout_game_pure_JavaScript/Mouse_controls

Lesson 8: Collision

The student will implement collision and build the brick field. The ball will collide with the walls and the paddle. Bricks that the player can destroy with the ball are created through code. When a ball hits a brick, the score will increment, and the brick will be destroyed.

When the ball is lost, the player loses a life. After all lives are gone, the game must display the game-over screen and loop back to the start screen.

- Reading assignment - https://developer.mozilla.org/en-US/docs/Games/Tutorials/2D_Breakout_game_pure_JavaScript/Collision_detection

Lesson 9: Animation

The student will animate text for the game over UI element and loop back to the start of the game using CSS. The student could animate the text color, size, or position.

- Reading assignment - https://www.w3schools.com/css/css3_2dtransforms.asp

Lesson 10: Web Audio

The student will trigger the web audio we loaded in lesson five when the ball hits a brick, the paddle, and the fail area under the paddle.

- Reading assignment - https://developer.mozilla.org/en-US/docs/Games/Techniques/Audio_for_Web_Games

Lesson 11: Deployment

The student will make the game available on GitHub as a fully playable game.

- Deploying to GitHub and hosting
    - Create a new GitHub repository and name it your-username.github.io.
    - Clone the new repository.
    - Enter the new repository and copy your files to this folder.
    - Add, commit, and push your repository.
    - Navigate to https://username.github.io in your web browser.
- Reading assignment - https://pages.github.com/

Assessment and Evaluation

For this instruction, I have assessed the learner's achievement and evaluated the efficacy of the instruction.

This instruction focuses entirely on the learner's knowledge and is criterion-referenced (Brown & Green 2016, p141). Each of the evaluations is performed to determine if the knowledge gap presented in the goals has been closed. To evaluate this condition, I chose to combine multiple objective and constructed response evaluations that align to each of the instruction objectives.

The evaluation document can be found at https://www.surveymonkey.com/r/5SZYPDD .

I presented the instruction module to one example learner who was instructed to review the module and then answer the evaluation questions. The instrument is criterion-referenced and includes a mix of true/false, multiple choice, short answer, and sorting questions were included to cover a range of taxonomy levels (Brown & Green 2016, p. 143).

The following questions were asked that align directly with the instructional objectives:

Question – What component of HTML defines the page style? (Objective 1A**)**

- HTML
- CSS (correct)
- JavaScript

Question: Describe the purpose of the canvas in a short sentence. (Objective 1B**)**

- The canvas defines an area of the screen where graphics can be drawn.

Question: Arrange the steps to host a website on GitHub in order top to bottom. (Objective 1C**)**

- Create a new GitHub repository and name it your-username.github.io.
- Clone the new repository.
- Enter the new repository and copy your files to this folder.
- Add, commit, and push your repository.
- Navigate to https://username.github.io in your web browser.

Question: Arrays are used to store multiple values in a single variable. (Objective 2B**)**

- True (Correct)
- False

Question: Describe in a single sentence the purpose of a code or file repository. (Objective 3A)

- The repository will store the student's work and allow the instructor and other students to view progress.

Question: What is the purpose of a code review?

- A code review is a quality control activity where humans review the code.

The sample learner was able to answer all questions correctly except for the question regarding the steps to host a site on GitHub.

In evaluating this result, this might indicate that more effort should be applied to the web hosting material to make sure the learner understands the concepts involved with hosting and can identify the correct order. It may also indicate the evaluation question might need to be modified to be clearer. Given web deployment scored high on the learner analysis survey, adding more instruction for web deployment should be a high priority as part of a summary revision.

While developing the instruction, I used a few formative strategies to improve it and keep it aligned with the identified knowledge gaps. During the design process, I frequently iterated through the design phases to ensure content remained aligned with goals and objectives. I also asked the SME to review the content early on to verify assumptions I made about the content and identify improvements for the remainder of the design process (Brown & Green 2016, p. 164).

My summative evaluation included identifying where learners had difficulty and where instruction could be improved to close those gaps and meet the goals and objectives in future iterations of the instruction. Based on the student evaluation and learner analysis, one of the first

changes to make would be to revise the web deployment instruction or modify the learner assessment question.

Reference

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SME Information

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Employment

- Teaching Assistant, Wake County Public Schools
- Former Senior Game Scripter, Vicious Cycle Software

Qualification – About 14 years of professional game scripting experience