Motivating Programming Learners through Game Development

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● Information Technology Specialist
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  (2004 ~ Present)

- MS in Information and Computer Sciences
  (2009)
- MED in Learning Design and Technologies
  (expected 2019)
Poll: *Do you have any experience with coding?*
Agenda

1. Rationale of this Project
2. Module Design
3. Module Evaluation
4. Questions
1 Rationale of the Project
Introduction

- A 13% increase in employment of computer and information technology occupations from 2013 to 2026 in the U.S. (US Bureau of Labor Statistics)
- Many undergraduate students struggle with coding in the first core Computer Science (CS) course.
Game Development  
For Coding Practice  
To Motivate Learners

Students will learn effectively if they are motivated, and they will be able to maintain their motivation if they have the confidence to achieve their goals (Jenkins, 2001).
Statement of the Problem

The purpose of this instructional design project was to design and evaluate a game development-based coding module to provide a motivational introductory programming experience for undergraduate students at University of Hawaiʻi at Mānoa.
Literature Review

- Game-based Learning
  (Prenskly, 2003; Kiili, 2005)
- Game Development-based Learning
  (Wu & Wang, 2012)
- John Keller’s ARCS model
  (Keller, J. M., 1987; Alhazbi, 2015)
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Module Design
Game Development-Based Learning

- Learners will experience Javascript coding by building a simple 2D platform game in step by step process.
- Building motivation and confidence in coding
- Basic coding concepts are introduced.
- “Learning by Doing” (Dewey, 1922, 1997)
Game Development-Based Learning

- Screencast
- Coding Editor
- Game Preview
- Code Assistance
Stage 1 – Getting Started with Game Development Tasks

Welcome to the first stage! In this stage, let’s familiarize yourself now with the coding tool used in this module. Our first coding is adding a background image to the game.

Estimated Time: 10 minutes

Video Tutorial

Tips and Hints

```javascript
var config = {
  type: Phaser.AUTO,
  width: 800,
  height: 600,
  physics: {
    default: 'arcade',
    arcade: {
      gravity: { y: 300 },
      debug: false
    }
  },
  scene: {
    preload: preload,
    create: create,
    update: update
  }
};

var player;
var gems;
var ghost;
var platforms;
var cursors;
var score = 0;
var gameOver = false;
var scoreText;
var game = new Phaser.Game(config);

function preload() {
    this.load.image("background", 'assets/background.png');
    this.load.image("ground", 'assets/ground.png');
    this.load.image("platform", 'assets/platform.png');
    this.load.image("gem", 'assets/gem.png');
    this.load.image("ghost", 'assets/ghost.png');
    this.load.spritesheet("fox", 'assets/player.png', { frameWidth: 66, frameHeight: 66 });
}
```
Stage 1 – Getting Started with Game Development Tasks

Video Tutorial

Tips and Hints

```javascript
var config = {
  type: Phaser.AUTO,
  width: 800,
  height: 600,
  physics: {
    default: 'arcade',
    arcade: {
      gravity: { y: 300 },
      debug: false
    }
  },
  scene: {
    preload: preload,
    create: create,
    update: update
  }
};

var game = new Phaser.Game(config);

function preload()
{
  this.load.image('background', 'assets/background.png');
  this.load.image('platform', 'assets/platform.png');
  this.load.image('gem', 'assets/gem.png');
  this.load.image('ghost', 'assets/ghost.png');
  this.load.spritesheet('fox', 'assets/player.png', { frameWidth: 66, frameHeight: 64 });
}

function create()
{

}
```

---

Do not change code above this line!!

function update()
{

}

var gameOver = false;
var score = 0;
var scoreText;
var player;
var gems;
var platforms;
var cursors;
var ghost;
var scoreText;
var score = 0;
var scoreText;
var game = new Phaser.Game(config);

function preload()
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  this.load.image('ghost', 'assets/ghost.png');
  this.load.spritesheet('fox', 'assets/player.png', { frameWidth: 66, frameHeight: 64 });
}
Stage 1 – Getting Started with Game Development Tasks

Video Tutorial

Tips and Hints

- If you did not see the blue background image, something must be wrong with the code. Please check the line you entered and try one more time.
- I know it is very overwhelming to see lots of unfamiliar programming code. Most of the pre-written code is coming from Phaser Game engine, and as you become familiar with the function of Phaser, it will start making sense. So for now, please focus on adding code in the create function.
Stage 1 – Getting Started with Game Development Tasks

Video Tutorial

Tips and Hints

- If you did not see the blue background image, something must be wrong with the code. Please check the line you entered and try one more time.

- I know it is very overwhelming to see lots of unfamiliar programming code. Most of the pre-written code is coming from Phaser Game engine, and as you become familiar with the function of Phaser, it will start making sense. So for now, please focus on adding code in the create function.
Your Code vs. Complete Code

Welcome to the first stage.

Estimated Time: 10 minutes

Video Tutorial

Tips and Hints

Stage 1 – Getting Started

Welcome to the first module.

Estimated Time: 10 minutes

Video Tutorial

Tips and Hints

Your Code:

```javascript
//-----Do not change the code above this line!!!-----
function create() {
}
function update() {
}
```

Complete Code:

```javascript
//-----Do not change the code above this line!!!-----
function create() {
  this.addImage(400, 300, 'background');
}
function update() {
}
```
Stage 1

- Basic Introduction
- Add a background
Stage 2

- Creating a fox
  (Player character)
- Adding Platforms

ARCS Relevance
Stage 3

- Moving the fox with keyboard events
- Conditional IF statements
Stage 4

- Adding animation
- Sprites
Stage 5

- Creating gems (Reward items)
- Crating a ghost (Enemy)
- FOR Loops

ARCS Confidence
Stage 6

- Adding a score
- Define game rules
- FUNCTION

ARCS Satisfaction
3

Module Evaluation
Research Questions

- How will the game development-based instructional module be able to promote learners’ motivation?
- How will the game development-based instructional module be able to contribute building learners’ confidence in programming?
Participants

- A total of 19 people, 13 females and 6 males
- LTEC Students, Alumni, and University employees
- Age range: 30-49
- Technology skills: Intermediate to Advanced
- Prior Coding Experience: Yes=11, No=8
Evaluation Procedure

1. A recruitment flyer was sent to LTEC mailing list
2. A direction Email with informed consent
3. Module testing
4. Survey questionnaire
5. Data analysis with Excel
   a. Descriptive statistics
   b. Paired sample t-test
   c. Correlation
# Module Usage Data Results

<table>
<thead>
<tr>
<th>Module Section</th>
<th>Average Session time</th>
<th># of Participants used Answer Button</th>
<th>Completion Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stage 1</td>
<td>0:06:49</td>
<td>1</td>
<td>84.21%</td>
</tr>
<tr>
<td>Stage 2</td>
<td>0:11:40</td>
<td>2</td>
<td>94.74%</td>
</tr>
<tr>
<td>Stage 3</td>
<td>0:11:26</td>
<td>3</td>
<td>68.42%</td>
</tr>
<tr>
<td>Stage 4</td>
<td>0:11:16</td>
<td>5</td>
<td>68.42%</td>
</tr>
<tr>
<td>Stage 5</td>
<td>0:08:15</td>
<td>5</td>
<td>52.63%</td>
</tr>
<tr>
<td>Stage 6</td>
<td>0:11:45</td>
<td>3</td>
<td>73.68%</td>
</tr>
</tbody>
</table>
Moulde Usage Data Results

Video controls covered the programming code.
Evaluation based on ARCS

<table>
<thead>
<tr>
<th>Domain</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attention</td>
<td>4.11</td>
</tr>
<tr>
<td>Relevance</td>
<td>3.72</td>
</tr>
<tr>
<td>Confidence</td>
<td>3.75</td>
</tr>
<tr>
<td>Satisfaction</td>
<td>3.95</td>
</tr>
</tbody>
</table>

> 3.7
Retrospective Survey Results 1

Paired sample $t$-test

Before | After
---|---
Confidence | 2.63 | 3.37
Knowledge | 2.63 | 3.47
Confidence vs. Knowledge Levels

$r = 0.93$
Retrospective Survey Results 2

Graph showing paired sample t-test results for Motivation and Interest comparison.
Games can be used to gain attention of learners and create learning situation (Kiili 2004).
LEARN TO CODE
WITH SELF-PACED CODING MODULES!!!

- Looking for participants to try an instructional module to provide introductory programming experience.
- You will be asked to go through the online module, work on coding tasks, and fill out a survey. It will take about 1-2 hours to complete entire activities.
- You can complete this online module and survey anytime at your convenience.
- You will receive a Starbucks gift certificate for your time and effort in participating in this research project.

SIGN UP
http://go.hawaii.edu/Gyl
What is the optimal way to evaluate the module's impact on motivation?
Overall Module Rating

4.37

I liked the organization of the module where stages were divided into manageable chunks.

I liked the build-in coding environment. The syntax highlighting helped me finding errors!

The instant preview of the game was fun and engaging.

0 Poor

Excellent 5
Summary

- Evaluation based on ARCS model indicated that the module supported four motivation conditions.
- The retrospective survey showed increases in learners’ motivation and interests; however, the increases were not statistically significant.
- Further study is needed to find an optimal way to evaluate module’s impact on learners’ motivation and interest levels.
- The module was able to increase learners’ knowledge and confidence.
- Learners’ knowledge and confidence levels are correlated. For further improvement of learners’ confidence, building learners’ knowledge will be essential.
- Overall the module was able to provide a positive learning experience.
Any questions?
Thanks!

You can reach me at: genta@hawaii.edu
To try the module, go to:
https://codefox.dreamhosters.com
(Username: demo, Password: demo)