Education Through the Entertainment of Video Games

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Background

What is Serious Game?

- Serious Game is a branch of video game. Serious Games include an educational scenario with educational objectives for the players. This kind of game aims to allow the player to learn during the game [1].
- The game presented aims to enhance the player's cognitive abilities.
- It looks to improve the players mathematical skills in using mathematical functions such as addition, subtraction, and multiplication while also focusing on algebraic equations.

Game Engine

The Unity Engine

- This game was made using the Unity Engine 2022.30.3f.
  - Unity uses C# as its primary language.
  - All the games code was written using Microsoft Visual Studio.
  - Main Classes: Unity Engine and the MonoBehaviour class.
- Unity makes it easy to import assets, design levels using assets from the asset store and personally designed assets, UI, and Unity's own imported shapes and objects.

```
public void InitializeGrid()
{
    gridHandler = new Grid[MapWidth, MapHeight];

    for (int x = 0; x < gridHandler.GetLength(0); x++)
    {
        for (int y = 0; y < gridHandler.GetLength(1); y++)
        {
            gridHandler[x, y] = Grid.EMPTY;
        }
    }

    Walkers = new List<WalkerObject>();

    VectorInt TileCenter = new VectorInt(gridHandler.GetLength(0) / 2, gridHandler.GetLength(1) / 2, 0);

    WalkerObject curWalker = new WalkerObject(new Vector2(TileCenter.x, TileCenter.y), GetDirection(), 0.5f);
    gridHandler[TileCenter.x, TileCenter.y] = Grid.FLOOR;
    tileMap.SetTile(TileCenter, Floor);
    Walkers.Add(curWalker);

    TileCount++;

    StartCoroutine(CreateFloors());
```

```
public void mathRandomizer2()
    {
        if (isAnswers1)
        {
            rng2 = Random.Range(1, 10);
            rng3 = Random.Range(1, 10);

            randomY = Random.Range(1, Mathf.RoundToInt(bounds));

            secondValue = rng2;
            thirdValue = rng3;

            hiddenAnswer2 = int.Parse(firstNumber2.text + secondNumber2.text);

            if (quizMan.rngMath1 == 1)
            {
                answer2 = (secondValue + randomX) - (thirdValue + randomY);
                result2.text = "(" + secondValue + "X" + ") " + " + " + "(" + thirdValue + "Y" + ") " + " = " + answer2;
            }
            else if (quizMan.rngMath1 == 2)
            {
                answer2 = (secondValue + randomX) - (thirdValue + randomY);
                result2.text = "(" + secondValue + "X" + ") " + " + " + "(" + thirdValue + "Y" + ") " + " = " + answer2;
            }
            isAnswer2 = true;
        }
```

Artworks

Art

- The games Assets were made using Procreate.
- Supplies used
  - Apple Pencil
  - Ipad 10th Gen
  - Procreate

Discussion and Conclusion

Key Mechanics

- Game includes randomly generated numbers and insures players will be able to answer missing value based on the mathematical answer set in the games code.
- Game uses any controller plugged into the computer the game is running on.

Limitations

- Game only has three levels and no official end.
- Game walls, items, and decorations are placed by hand and not randomly generated.
- Game doesn't have complex math equations such as PEMDAS (Order of Operations).

Future Implementation

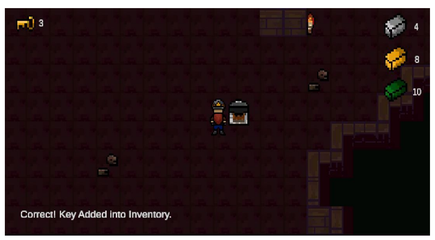
- Implement Start and End UI
  - Add an ending.
  - Add menu to main page.
- Add animations to character module.
- Add a timer
- Assess the game difficulty with human subjects

Game Mechanic

- There are 4 chests that have their own math equations. The equations compose of addition and subtraction in the format of algebra questions. X, Y, and Z uses different types of Gems as it's variable. The least chests uses a diamond instead of the answer.
  - **Chest 1** contents a simple algebra equations such as 2X = 10 for example.
  - **Chest 2** has a equations such as 3X + Y = 60 making the player remember what variable X is.
  - **Chest 3** uses the equation 2X + Y + Z = 45. The game requires you to remember the other two missing variables to solve the equation.
  - **Chest 4** uses all the gem elements for X, Y, Z to solve for the answer instead of the missing variable.
- Key will be added to the players "inventory" indicated by the text on the bottom left and on the top right.
- A diamond will be added to the players "inventory" when the last chest is solved.
- Each Chest uses Random.Range to determine a random number for the missing variable, the numbers multiplied by the gems, and the answers.

Map

- Map is randomly generated using walkers [6].
  - Walkers are similar to how people walk. Each walker has a set tile to paint on the map.
  - There are a max of 10 walkers
  - Each walker uses different X and Y coordinates randomly generated by Random.Range.
- The walls and items are placed by hand.
- Exit door uses fading dialogue to prevent the player from continuing without solving the puzzles. [7]
- Door transfers using Enter and Exit triggers to the next level [3].



Controller

- Game uses a Xbox One controller to move and interacts with things in the game [8].
  - The Joystick moves the character around in a 2D top down format [2].
  - "A" interacts with the door.
  - "X" interacts with the chest.
  - "B" exits out of the equation panel after interacting with the chest.

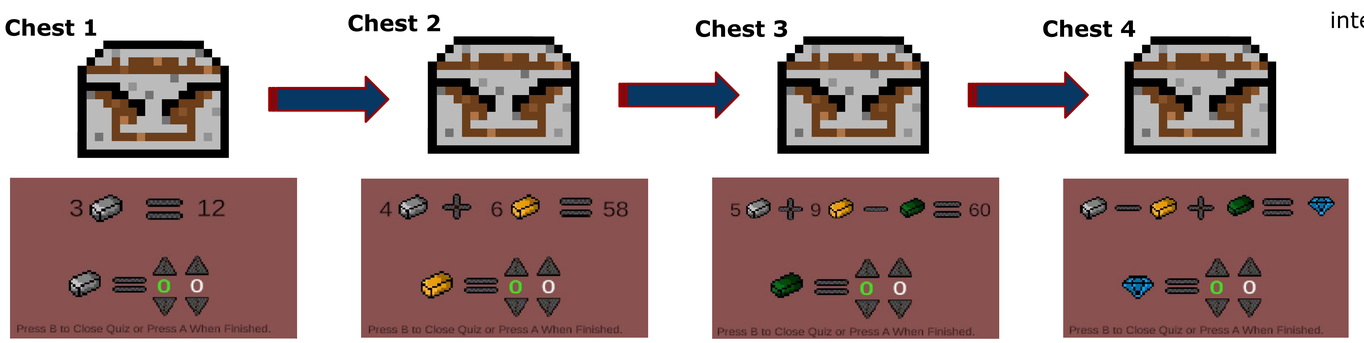


Image 1

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Reference

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2. Brackeys. "Top down Movement in Unity!" *YouTube*, 11 Aug. 2019, youtu.be/whzomFgjT50?si=gh5t9PK8Zqsl7oia.
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6. Coffee Cup Dev. "Unity Tutorial - How to Create a Fade Away Text Display." *YouTube*, 12 July 2023, youtu.be/WiUUW9RSa5Y?si=jxUEDnXHHunSaaGu.
7. Young, Eric. "Simple Math Game in Unity Tutorial." *YouTube*, 15 Dec. 2021, youtu.be/8NxRarssxnA?si=Uq5SxMsMfH9U65uU.
8. Image 1 - PDP Controller Wired Controller for PC and Xbox One, 2018

Unity C# math code base on reference [7]
Unity C# code for assets [2-6]