



NetWorked!

A Gamified E-Learning Mobile Application for Internetworking Course

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Prof. Madya Dr. Abdullah Muhammed



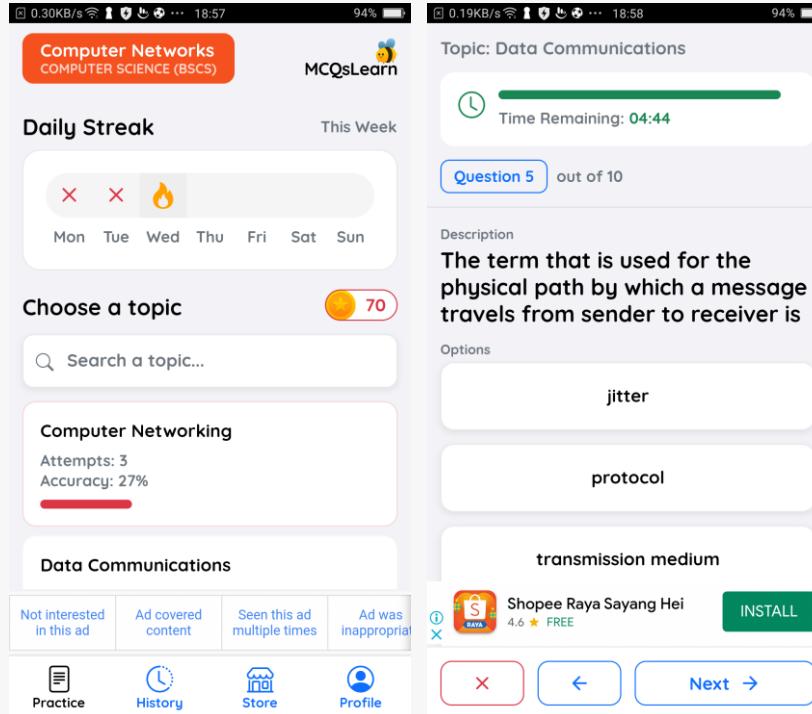
Introduction

NetWorked! is an innovative e-learning game in a mobile application designed to educate computer network students about the five layers of the TCP/IP model.



LITERATURE REVIEW

Apps 1: Computer Networks Quiz⁸



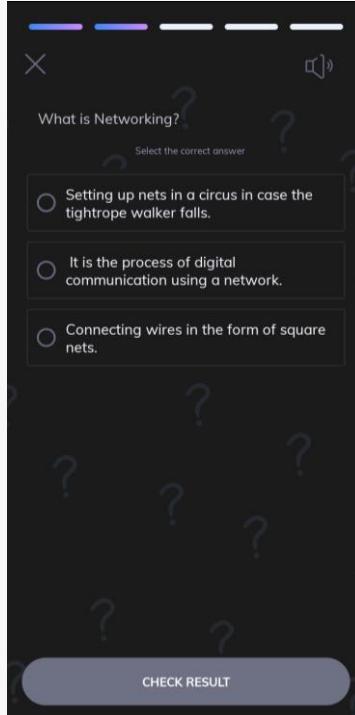
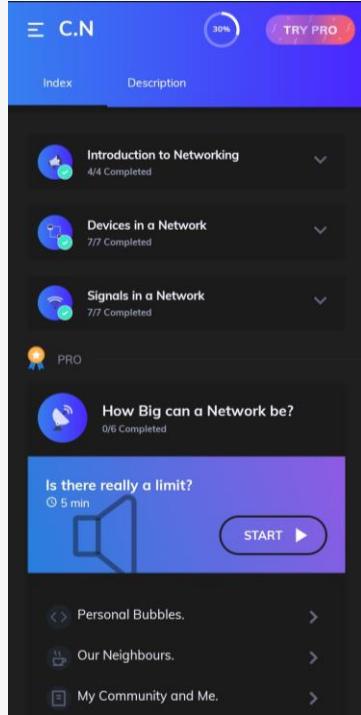
- Released by April 2021.
- Developed by MCQsLearn.
- Game features include points system and timer.
- Provide 32 internetworking topics for quiz.
- 10 questions for each topic.

Apps 2: Computer Networking Quiz⁷

The image shows two side-by-side screenshots of a mobile application. Both screens have a top status bar showing signal strength, battery level (94%), and time (18:59 for the left, 19:00 for the right). The left screenshot shows a 'Choose a chapter' screen with a message: 'There are 12 chapters, each has 20 questions and the total mark is 20. Good luck!' Below this are ten chapter options: 'Intro to computer networks', 'Network devices & OSI model', 'Cables & Ethernet', 'IP addressing & routing', 'Wireless networks', 'Network security', 'Network tools & command-tools', 'Network diagrams & symbols', 'Network troubleshooting', and 'Network abbreviations'. Each chapter name is followed by a circular arrow icon. The right screenshot shows a 'Network security' chapter screen. It displays 'QUESTION 1: Which network security protocol will encrypt the connection between a web browser and a web server?' with four options: 'HTTP' (selected), 'SSH', 'SSL', and 'SFTP'. Below this is 'QUESTION 2: A protocol which forms part in the IPSec is?' with four options: 'Secure Socket Layer (SSL)', 'Security Header (SH)', 'Password Header (PH)', and 'Authentication Header (AH)'. At the bottom of both screens is a blue 'Go Back' button.

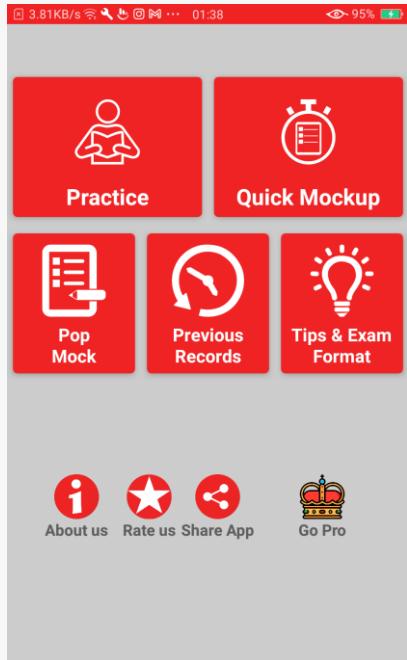
- Released by **March 2017**.
- Developed by **Ali J Developer**.
- Implement **points system** as game features.
- Provide **12 internetworking topics** for quiz.
- Simple and **non-interactive** user interface.

Apps 3: Computer Network Tutorials⁴



- Released by **March 2020**.
- Developed by **Coding and Programming**.
- Use **points system** as game features.
- Provide **10 different topics** for notes and quiz.
- Focuses more on **topic tutorial**.

Apps 4: Computer Network Exam Test Prep⁹

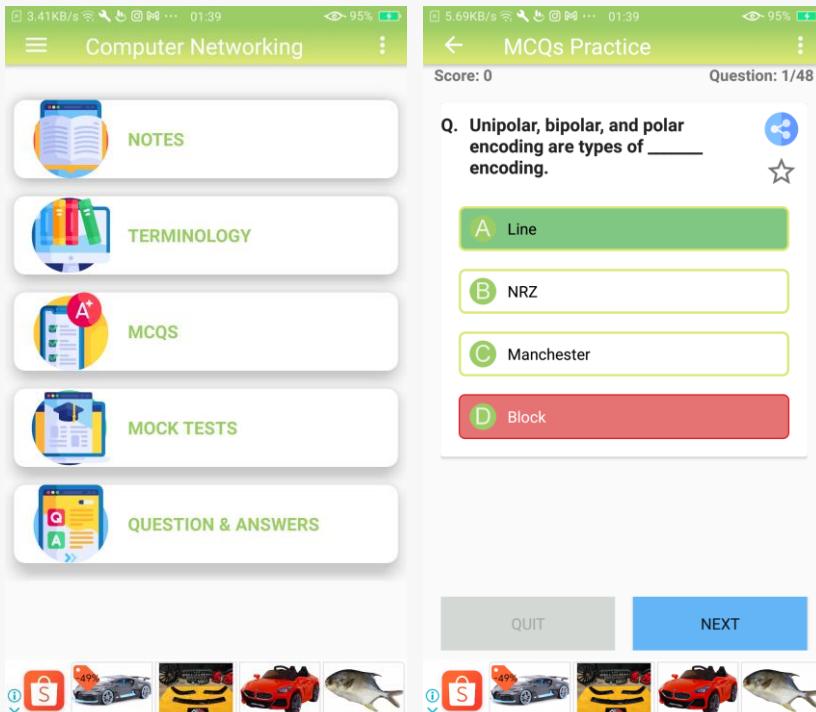
The image shows a question screen from the app. At the top, it displays 'Question: 1/10' and 'Mark: 2'. It has a timer icon showing '17:53' and a 'Finish Mock' button. The main content area contains a question: 'The term 'duplex' refers to the ability of the data receiving stations to echo back a confirming message to the sender. In full duplex data transmission, both the sender and the receiver'. Below the question are four multiple-choice options, each with a radio button:

- cannot talk at once
- can receive and send data simultaneously
- can send or receive data one at a time
- can do one way data transmission only

At the bottom of the screen, it says 'Suggested Time: 108 seconds' and has 'Previous' and 'Next' buttons.

- Released by January 2018.
- Developed by NUPUIT.
- Game features include points system and timer.
- Randomly deliver any topic for the question.
- Focuses more on multiple-choice question (MCQ) test.

Apps 5: Computer Networking Offline⁶



- Released by January 2020.
- Developed by iTSysCo.
- Use points system as game features.
- Provide 12 different topics for notes and MCQ.
- Several number of questions are delivered.

Summary

Application Title	Computer Networks Quiz – BSCS	Computer Networking Quiz	Computer Network Tutorials	Computer Network Exam Test Prep	Computer Networking Offline
Year Released	2021	2017	2020	2018	2020
Developer	MCQsLearn	Ali J Developer	Coding and Programming	NUPUIT	iITSysCo
Point System	Yes	Yes	Yes	Yes	Yes
Character / Avatar	No	No	No	No	No
Storyboard	No	No	No	No	No
Timer	Yes	No	No	Yes	No
Reference	[8]	[7]	[4]	[9]	[5]

Problem Statements

- * Existing e-learning applications for internetworking courses primarily rely **only on quiz game or tutorials.**
- * **Lack of interest, enjoyment and entertainment for students to play the quiz games or tutorials in e-learning application.**

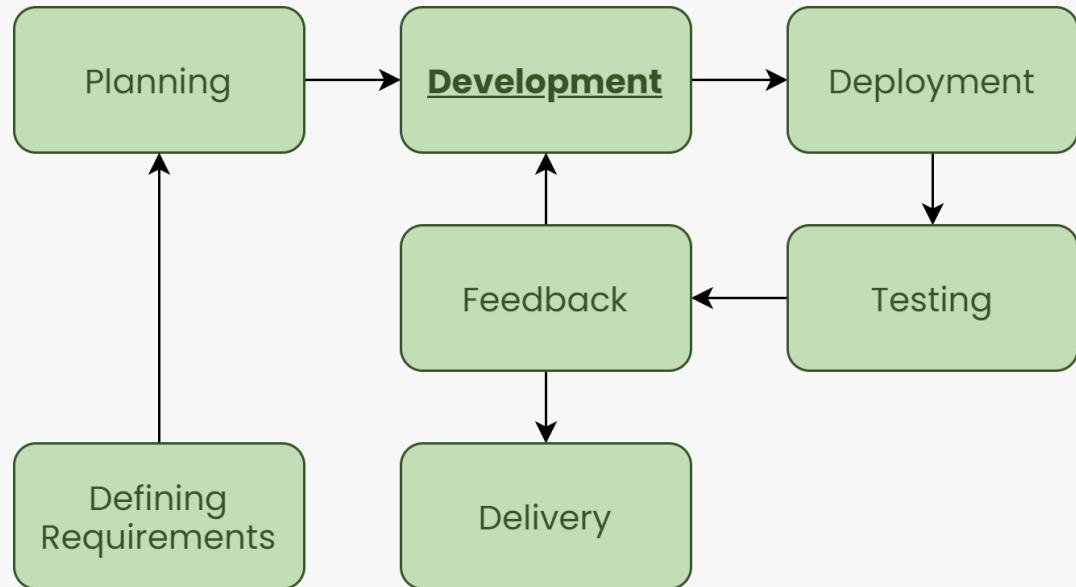
Objectives

- * To develop an immersive and engaging e-learning game of e-learning application for internetworking courses.
- * To design a dynamic and interactive game design elements including points system, character or avatar, storyboards or narratives as well as timers.

Project Scope

- * User scope covers computer science student especially computer network students.
- * Game content will focuses on five TCP/IP layers per game module.
- * Implementing mobile game application environment.

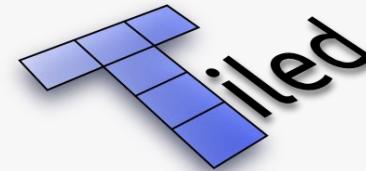
Agile Methodology²



Development Stage

- * Writing storyboard
- * Designing required game assets
- * Building game character
- * Developing game mechanics
- * Designing game interfaces
- * Managing database

Software Requirement



METHODOLOGY

The screenshot shows a workspace in Adobe Illustrator with several documents open:

- 8.95% (RGB/GPU Preview)
- User Interface Panel.ai* @ 35.74% (RGB/GPU Preview)
- Button for ui.ai* @ 71.63% (RGB/GPU Preview)

The main canvas displays the following assets:

- An orange armchair.
- A dark blue user interface panel with a grid of colored dots.
- A desk setup with a monitor, keyboard, and a potted plant.
- A blue and pink television set.
- A bookshelf filled with books of various colors.
- A yellow key.
- A red horizontal bar with five small icons.
- A teal button with a yellow center and two blue handles.
- A green diamond shape.

The right side of the interface shows the **Layers** panel with 81 layers listed, and the **Libraries** panel at the top right.

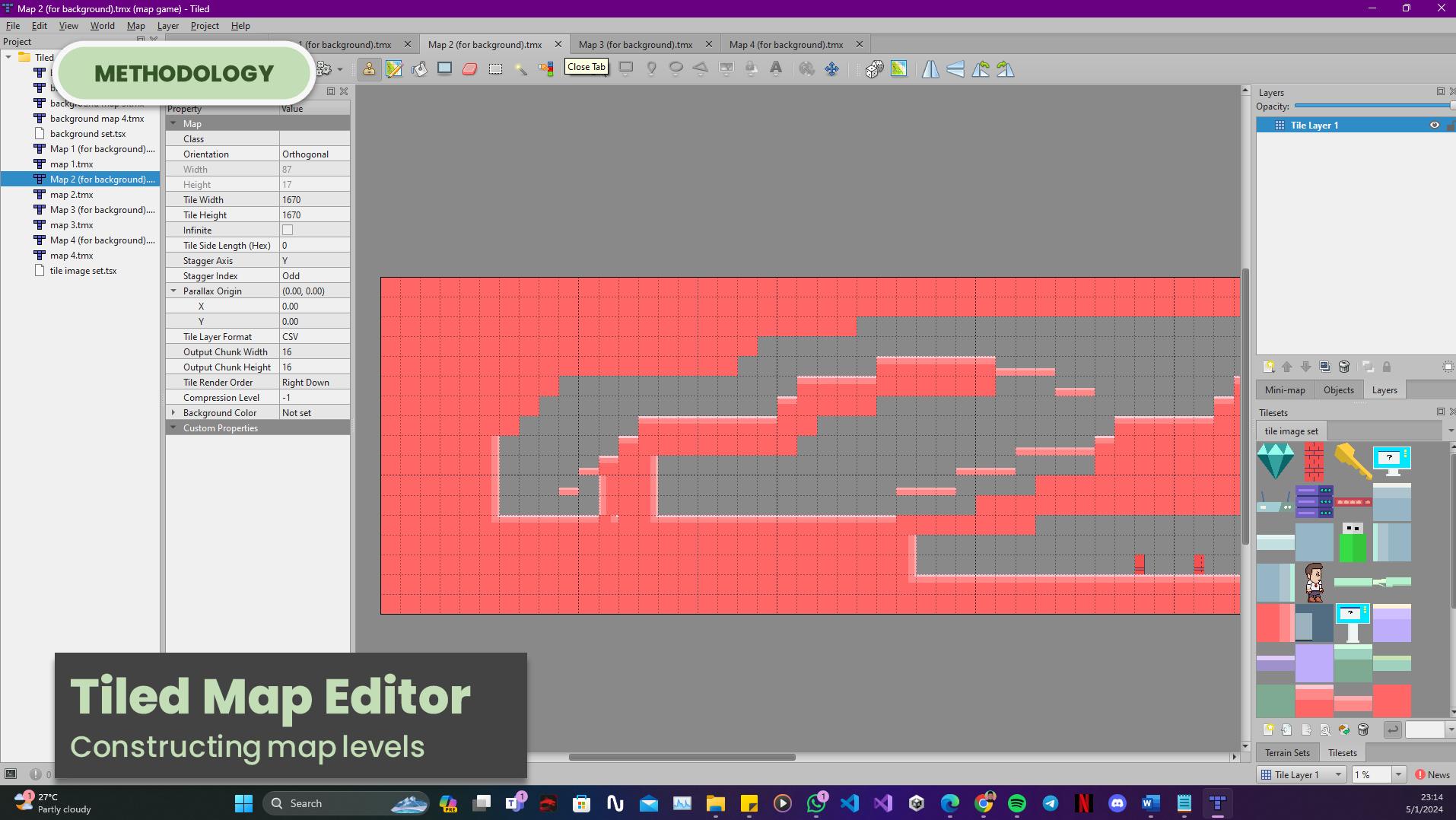
Adobe Illustrator
Designing game assets

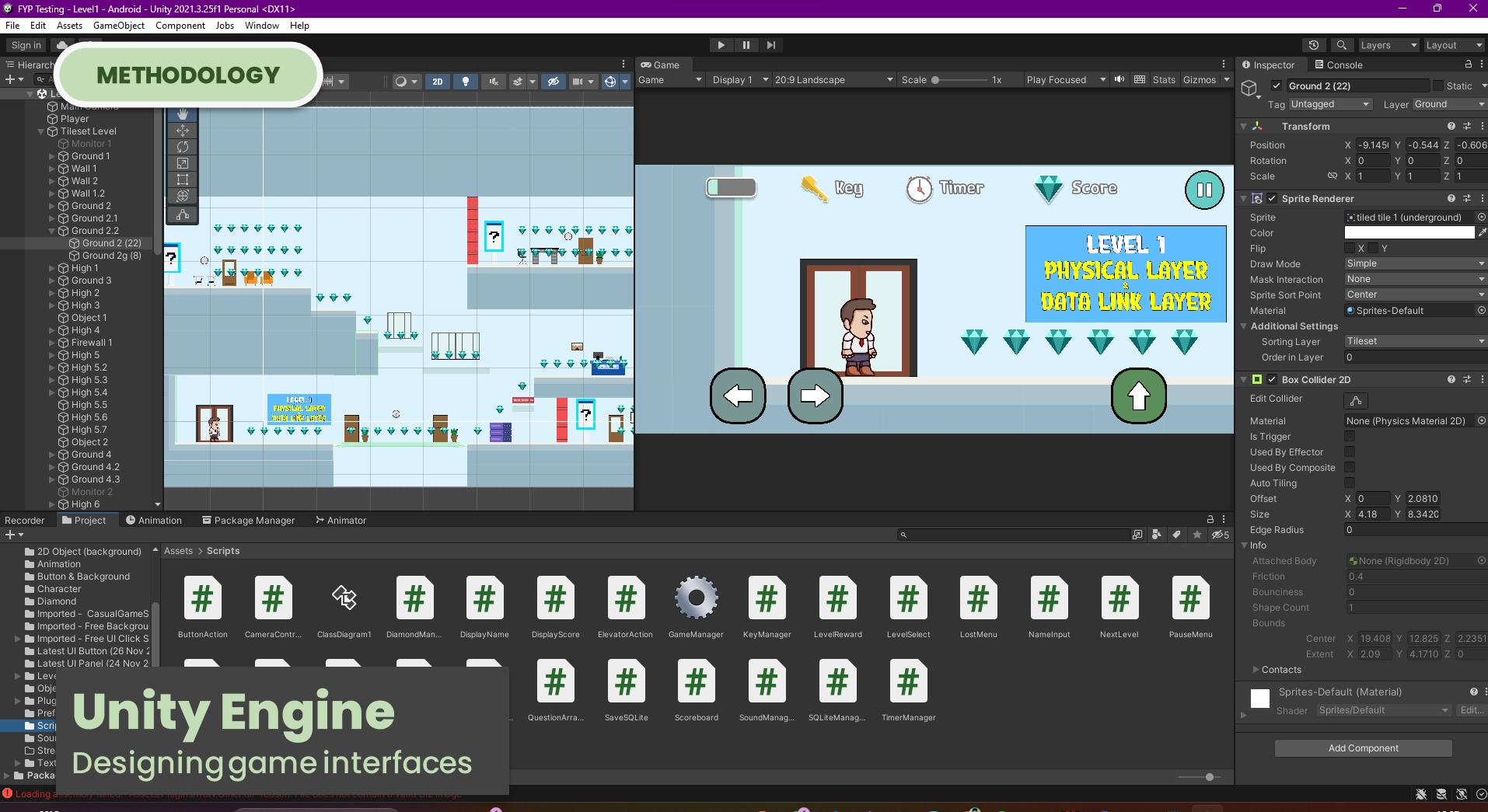
10 min delay
e18 / Lebuhraya...

Search

ENG US

18:51 5/1/2024





METHODOLOGY

```
private float horizontalInput;
public DiamondManager diamondManager;

private bool moveLeft;
private bool moveRight;

[Header("SFX")]
[SerializeField] public AudioClip jumpSound;
[SerializeField] public AudioClip diamondSound;

@UnityMessage | References
private void Awake()
{
    body = GetComponent< Rigidbody2D>();
    anim = GetComponent< Animator>();
    boxCollider = GetComponent< BoxCollider2D>();
    diamondManager = FindObjectOfExactType< DiamondManager>();

    moveLeft = false;
    moveRight = false;
}

References
public void PointerDownLeft()
{
    moveLeft = true;
}

References
public void PointerUpLeft()
{
    moveLeft = false;
}

References
public void PointerDownRight()
{
    moveRight = true;
}

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public void PointerUpRight()
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}

References
public void PointerDownRight()
{
    moveRight = true;
}

References
public void PointerUpRight()
{
    moveRight = false;
}
```

SaveSQLite.cs

```
using System.Collections;
using System.Collections.Generic;
using System;
using System.IO;
using UnityEngine;
using Mono.Data.SQLite;
using System.Globalization;

@Unity Script (2 asset references) | References
public class SaveSQLite : MonoBehaviour
{
    public List<ScoreData> scoreDataList = new List<ScoreData>();
    public int currentID = 0;
    public string databasePath;
    public string filePath;
    private SQLiteConnection connection;

    @Unity Message | References
    void Start()
    {
        LoadJson();
        InitializeDatabase();
    }

    @Unity Message | References
    void OnDestroy()
    {
        if (connection != null)
        {
            connection.Close();
        }
    }

    @reference
    void InitializeDatabase()
    {
        databasePath = Path.Combine(Application.persistentDataPath, "scoredata.db");
        connection = new SQLiteConnection($"URI=file:{databasePath}");
        connection.Open();

        var command = connection.CreateCommand();
        command.CommandText = "CREATE TABLE IF NOT EXISTS ScoreData (ID INTEGER PRIMARY KEY, Name TEXT, Score INT, CurrentID INT)";
        command.ExecuteNonQuery();
    }

    @reference
    public void SaveToJson_SQLite()
    {
        Name = PlayerPrefs.GetString("PlayerName", "Player");
        Count = PlayerPrefs.GetInt("DiamondCount", 0) * 10;

        ScoreData scoreData = new ScoreData();
        scoreData.ID = currentID++;
        scoreData.Name = Name;
        scoreData.Score = Count;
        scoreData.CurrentID = currentID;

        scoreDataList.Add(scoreData);
        connection.Insert(scoreData);
    }
}
```

Solution Explorer

- Solution 'FYP Testing' (1 of 1 project)
 - Assembly-CSharp
 - References
 - Assets
 - Scripts
 - ButtonAction.cs
 - CameraControl.cs
 - ClassDiagram1.cs
 - DiamondManager.cs
 - DisplayName.cs
 - DisplayScore.cs
 - ElevatorAction.cs
 - GameManager.cs
 - KeyManager.cs
 - LevelReward.cs
 - LevelSelect.cs
 - LostMenu.cs
 - Namelput.cs
 - NextLevel.cs
 - PauseMenu.cs
 - PlayerButtonMove.cs
 - PlayerMovement.cs
 - QuestionArray_Level1.cs
 - QuestionArray_Level2.cs
 - QuestionArray_Level3.cs
 - QuestionArray_Level4.cs
 - SaveSQLite.cs
 - Scoreboard.cs
 - SoundManager.cs
 - SQLiteManager.cs
 - TimerManager.cs
 - TextMesh Pro

Microsoft Visual Code 2019

Developing game mechanics using C#

DB Browser for SQLite - C:\Users\Aliff Fikri\AppData\LocalLow\Aliff Fikri\Networked\scoredatab.db

File Edit View Tools Help

New Database Open Project Save Project Attach Database Close Database

METHODOLOGY

Name Type Schema

Name	Type	Schema
Tables (1)		
ScoreData		CREATE TABLE ScoreData (ID INTEGER, Name TEXT, Diamond INTEGER)
ID	INTEGER	"ID" INTEGER
Name	TEXT	"Name" TEXT
Diamond	INTEGER	"Diamond" INTEGER
Indices (0)		
Views (0)		
Triggers (0)		

Type of data currently in cell: Text / Numeric
4 character(s) Apply

Remote

Identity Select an identity to connect DBHub.io Local Current Database

Name

DB Browser for SQLite

Managing SQLite database

UTF-8

1 Tomorrow's high Near record

Search

File Edit View Tools Help

New Database Open Database Write Changes Revert Changes Open Project Save Project Attach Database Close Database

Database Structure Browse Data Edit Pragmas Execute SQL

Table: ScoreData Filter in any column

ID	Name	Diamond
1	boby	43820
2	ahmad	41650
3	hafiz	45180
4	kamarul	40720
5	liza	44790
6	halim	42040
7	vikram	40030
8	abdul	39010
9	faizal	45240
10	nur	40810

Type of data currently in cell: Text / Numeric
4 character(s) Apply

Remote

Identity Select an identity to connect DBHub.io Local Current Database

Name

SQL Log Plot DB Schema Remote

17:44 16/1/2024

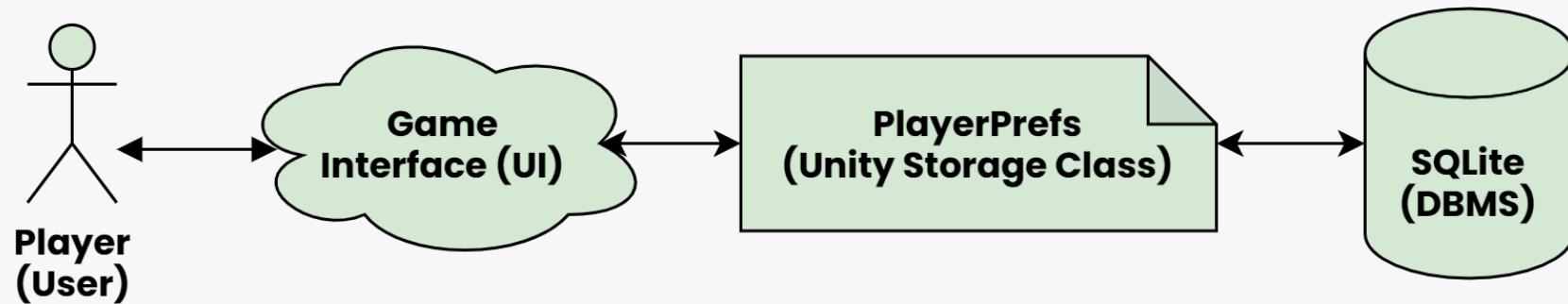
Hardware Requirement

Laptop	
Processor	Intel® Core™ i5-9300H CPU @ 2.40GHz
System Memory	24.00 GB of RAM
Graphic Card	NVIDIA GeForce GTX 1650 with Max-Q Design
Display Memory	4.00 GB of VRAM
Storage	500 GB of SSD storage & 1000 GB of HDD storage
Operating System	Windows 10 Home Single Language

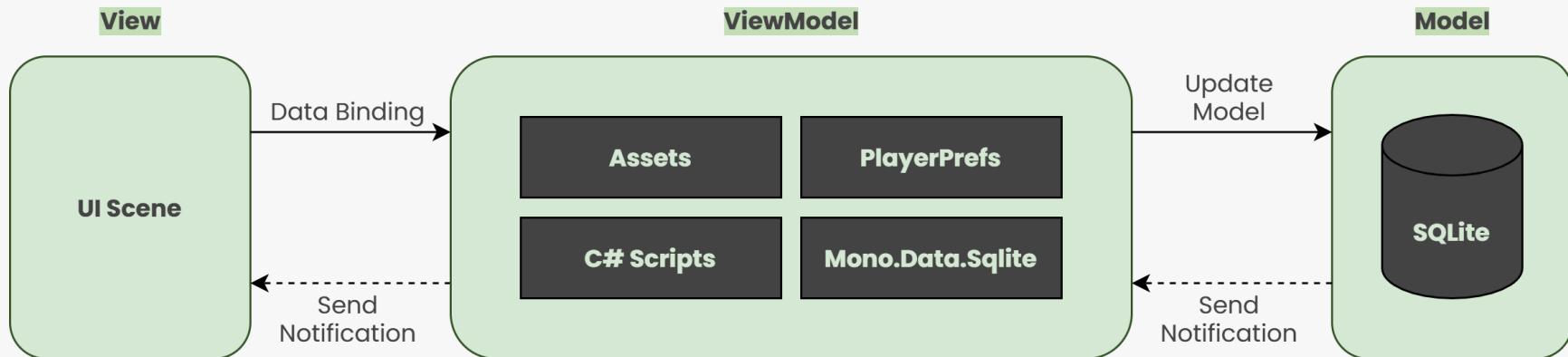
Hardware Requirement

Android Phone	
Minimum Version	Android 5.1 (Lollipop) – API Level 22
API Compatibility	.NET Standard 2.1
GPU	Adreno 506
System Memory	4.00 GB of RAM
Size	33.80 MB

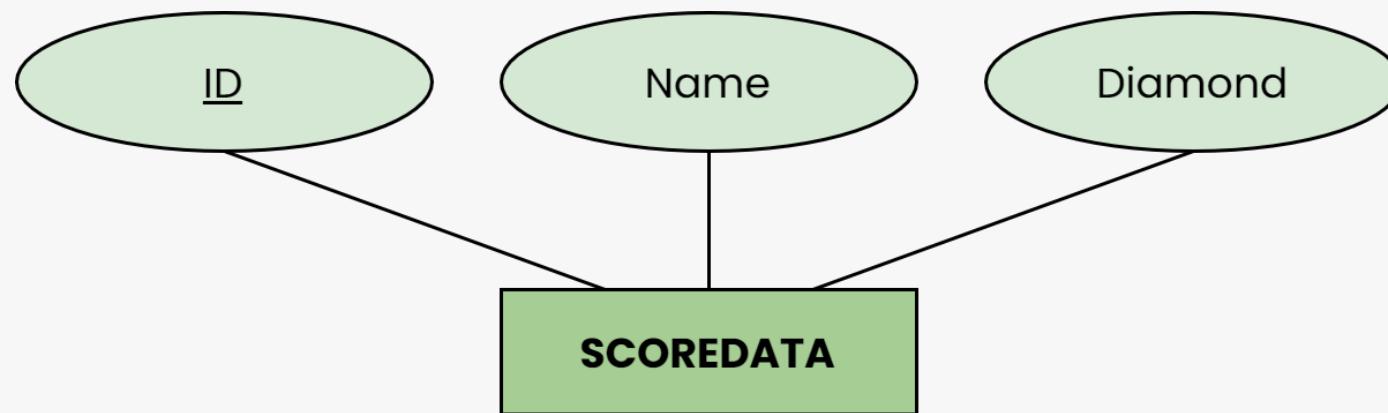
Architecture Design



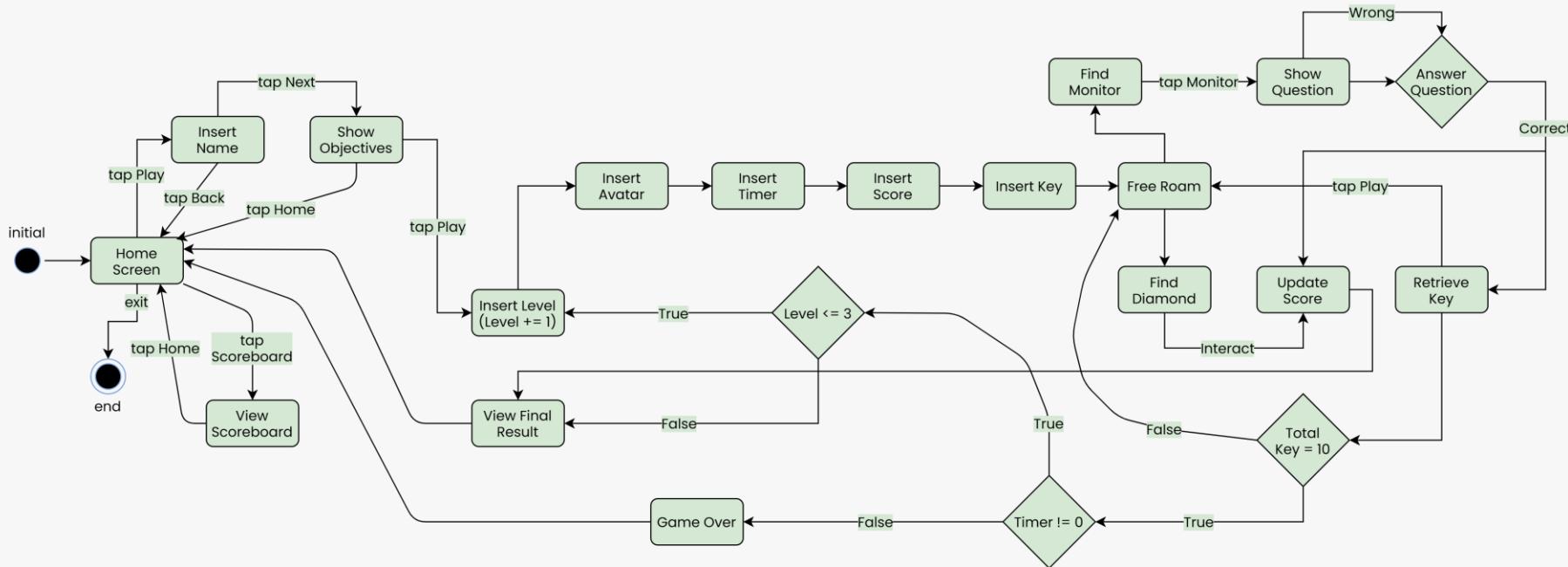
MVVM Architecture Diagram



Entity–Relationship Diagram



State-Transition Diagram



Demonstration

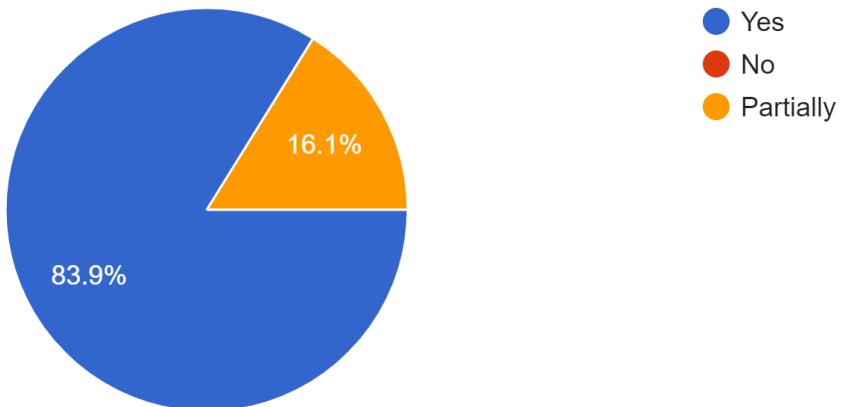
Demonstration



User Acceptance Testing

Did this game application motivates you to learn the layering concept in Internetworking course?

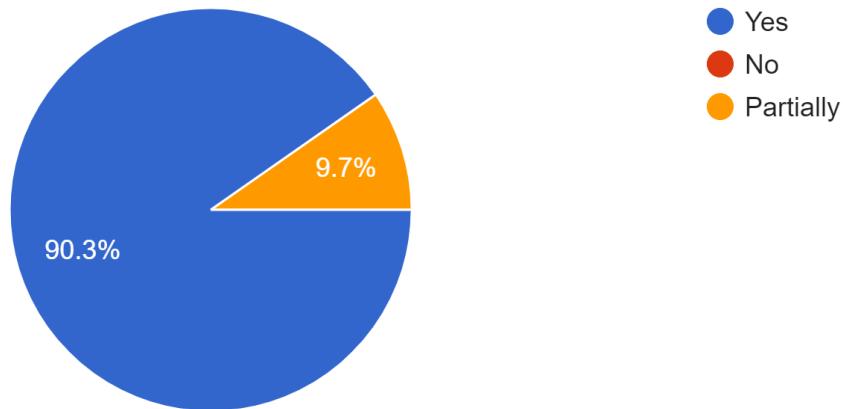
62 responses



User Acceptance Testing

This game helps you to understand the TCP/IP Layer

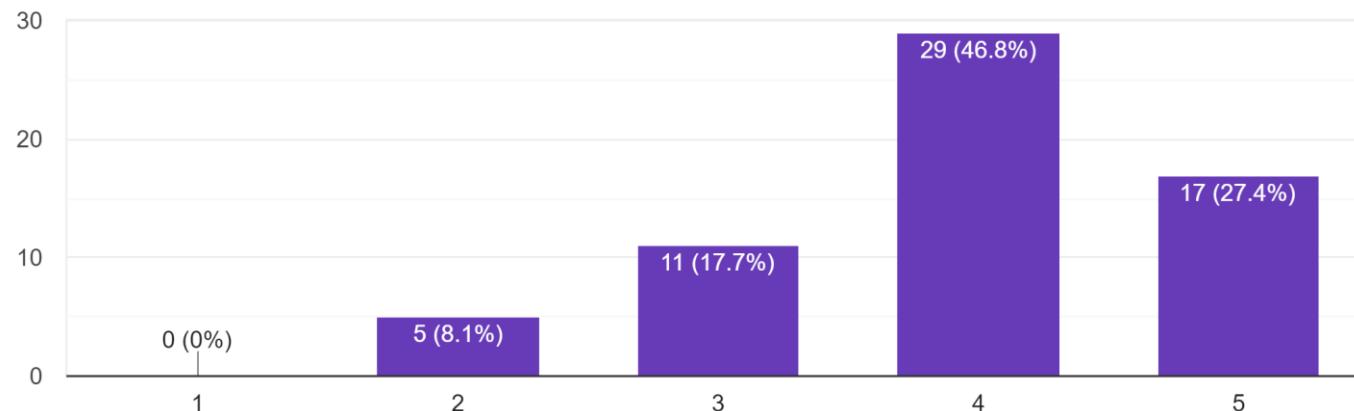
62 responses



User Acceptance Testing

On a scale of 1 to 5, rate your experience using this game application

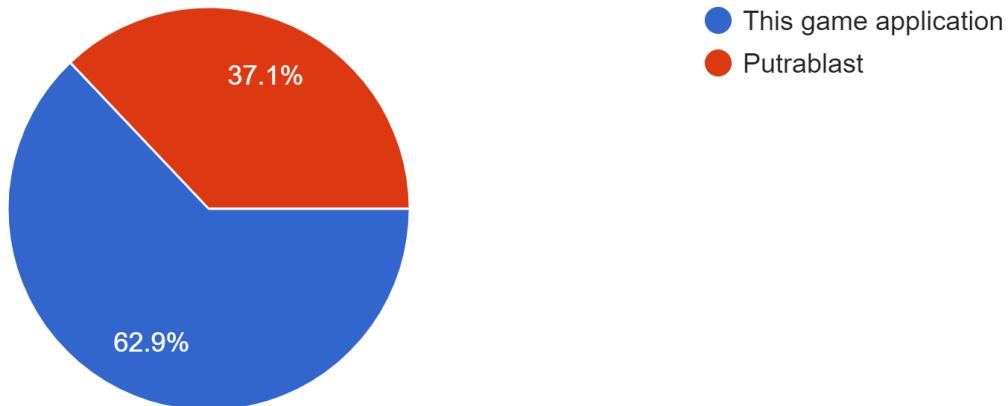
62 responses



User Acceptance Testing

We have the Quizzes in the Putrablast and this game application. Which one is more user-friendly ?

62 responses



Conclusion

- * Implementing **gamification** to **non-game contexts** such as internetworking course can improve player's engagement, motivation as well as **retention** especially for computer network's students.

Future Work

- * Expanding the **study** and **implementation** in the **database** to include **more complex** and **advanced databases** such as MySQL, Firebase Realtime Database and PlayFab.



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1. Alsubhi, M. A., Sahari, N., & Wook, T. S. M. T. (2020). A Conceptual Engagement Framework for Gamified E-Learning Platform Activities. *International Journal of Emerging Technologies in Learning (Ijet)*, 15(22), 4. <https://doi.org/10.3991/ijet.v15i22.15443>
2. Amoros, J. L. (2022, November 14). The Agile Development Process for Mobile Apps | Krasamo. *Krasamo*. Retrieved May 10, 2023, from <https://www.krasamo.com/agile-development-process/>
3. Carrillo, D., García, A. C., Laguna, T., Magán, G. R., & Moreno, J. M. (2019). Using Gamification in a Teaching Innovation Project at the University of Alcalá: A New Approach to Experimental Science Practices. *Electronic Journal of e-Learning*, 17(2). <https://doi.org/10.34190/jel.17.2.03>
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5. Frei, D. (2022, September 7). Saving data in Unity3D using SQLite / MongoDB. Retrieved December 30, 2023, from <https://www.mongodb.com/developer/code-examples/csharp/saving-data-in-unity3d-using-sqlite/>

REFERENCES

6. iiTSysCo. (2022). Computer Networking Offline (Version 6.3.21) [Mobile app]. Google App Store. https://play.google.com/store/apps/details?id=com.iitsysco.networking_concise_notes
7. J, A. (2017). Computer Networking Quiz (Version 3.1) [Mobile app]. APKPure App Store. <https://apkpure.com/computer-networking-quiz/com.alij.cnq>
8. MCQsLearn. (2023). *Computer Networks Quiz – BSCS* (Version 10.1.12) [Mobile app]. Google App Store. <https://play.google.com/store/apps/details?id=quiz.mcqslearn.bscscomputernetworks>
9. NUPUIT. (2022). Computer Network Test Prep (Version 7.0.0) [Mobile app]. Google App Store. <https://play.google.com/store/apps/details?id=com.nupuit.comnet>
10. Saleem, A. M., Noori, N. M., & Ozdamli, F. (2021). Gamification Applications in E-learning: A Literature Review. *Technology, Knowledge, and Learning*, 27(1), 139–159. <https://doi.org/10.1007/s10758-020-09487-x>
11. Yadav, A. K., & Oyelere, S. S. (2021). Contextualized mobile game-based learning application for computing education. *Education and Information Technologies*, 26(3), 2539–2562. <https://doi.org/10.1007/s10639-020-10373-3>



Thank You



Extras

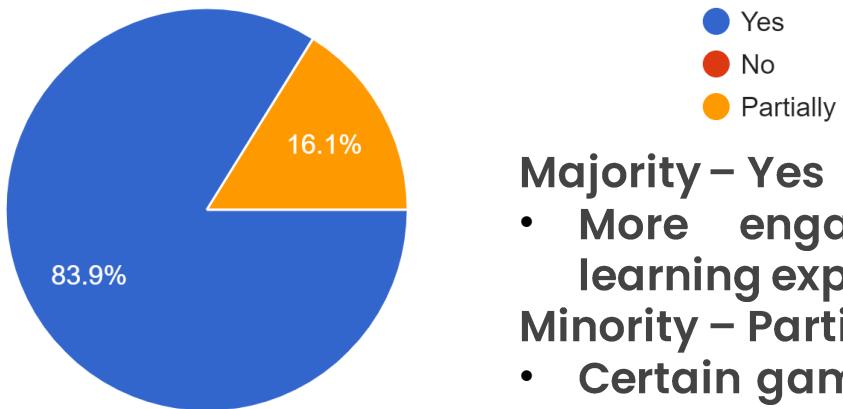
Background

- * Gamification defined as the use of game design elements in non-game context.⁹
- * E-learning platform integrating game features into educational experiences to provide engaging way for students to learn.^{3,10}
- * Gamify an internetworking course for e-learning mobile application by implementing and improving existing learning content.^{1,10}

User Acceptance Testing

Did this game application motivates you to learn the layering concept in Internetworking course?

62 responses



Majority – Yes

- More engaging and leisure learning experience

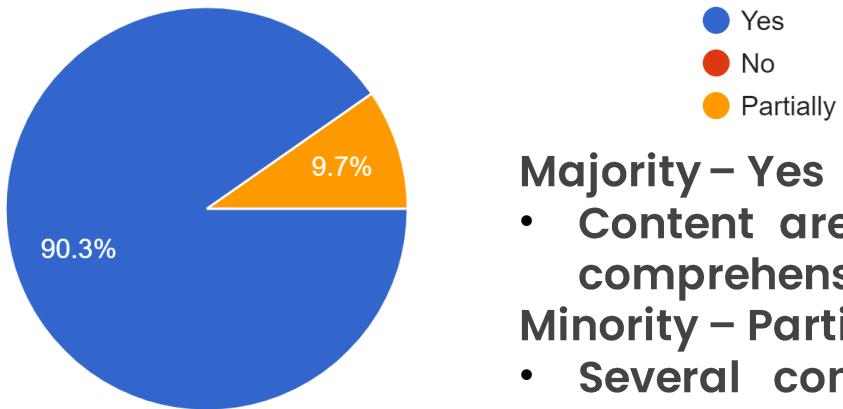
Minority – Partially

- Certain game mechanism have complex and difficulties

User Acceptance Testing

This game helps you to understand the TCP/IP Layer

62 responses



Yes

No

Partially

Majority – Yes

- Content are more related and comprehensible with TCP/IP

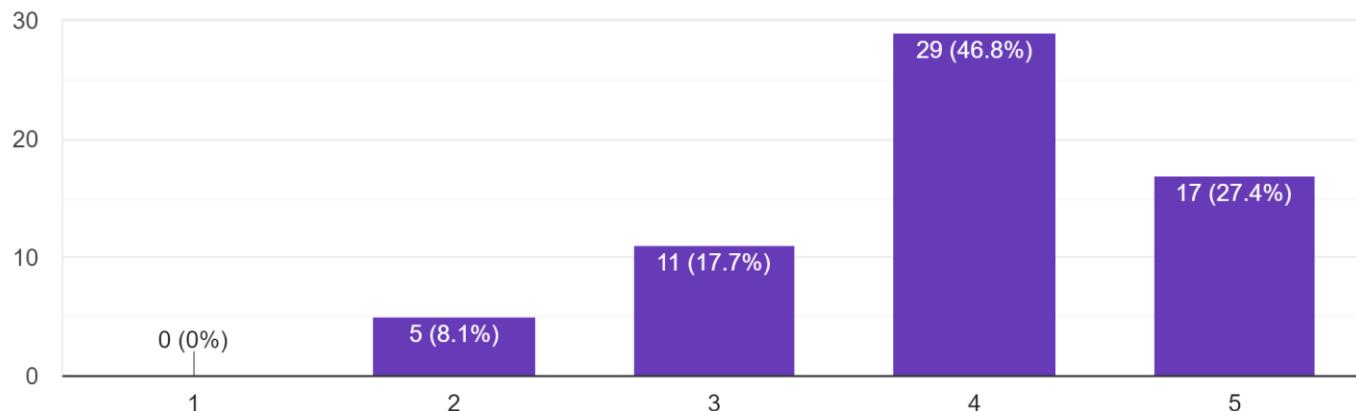
Minority – Partially

- Several content and question are a little bit hard to understand

User Acceptance Testing

On a scale of 1 to 5, rate your experience using this game application

62 responses

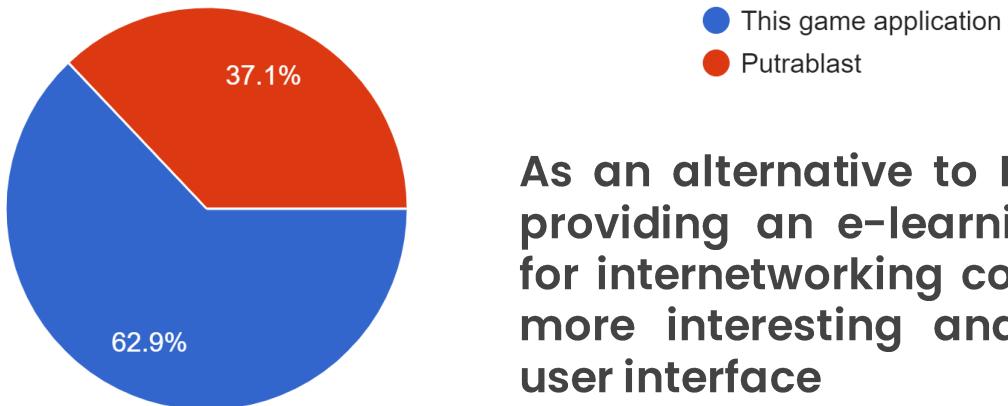


4 & 5 – More engaging and interesting UI, gameplay and game content
2 & 3 – Difficulties in TCP/IP conceptualization and not interactive enough

User Acceptance Testing

We have the Quizzes in the Putrablast and this game application. Which one is more user-friendly ?

62 responses



As an alternative to Putrablast in providing an e-learning platform for internetworking courses with a more interesting and interactive user interface

Extra Question

- * What is the benefit of this game that make it sustain and different from other games?
- * This game has its own benefit that lies in the content of the questions that can be used as a comprehensive study guide and a valuable resource for exam preparation for students.

- * Why choose TCP/IP layer instead of other topic?
- * The TCP/IP layer is the core and most basic topic in understanding the fundamentals of internetworking.

Extra Question

- * Is it possible to increase the number of questions for each level?
- * The number of questions can be increased and varied in each level, but the timer should also be increased to provide more balance and sufficient answering time.

- * Which references have you relied to in order to develop game contents such as questions and answers?
- * Some sources have been selected such as lecture's note from SKR3309 (Network Protocol) and SKR3201 (Internetworking) and have been supervised and verified by the supervisor to ensure that the content is relevant and related with the current course.