

# Fun with Tribology: a gamified educational application

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**Abstract**—Fun with Tribology (FwT) is an educational application designed and developed for the sole purpose of enhancing educational experience of students of Tribology at Universiti Kebangsaan Malaysia (UKM). Tribology can be defined as the science and technology of interacting surfaces in relative motion, and includes the study of friction, wear, and lubrication. Currently, this course is being taught through traditional teaching methods which includes but are not limited to asynchronous and synchronous learning. Fun with Tribology is an educational application that the students can use to play games and learn this course. This application has in no way replace the teaching methods but instead enhance the student's engagement with the course. This application is built using the waterfall-agile development method. The entire application has been developed using flutter. The game has two sections Fun Puzzle and Fun Hangman. Fun Puzzle can divide any image into parts and make a puzzle out of it. Then the students can solve the tribology related puzzle to pass to the next segment where the student can answer the questions related to tribology. Fun hangman is a fun childhood game that can be used to incorporate the questions of tribology to make a fun learning experience for the students of tribology. This application is an example of an attempt to gamified the tribology teaching and learning.

**Keywords**—gamification; learning; tribology; mobile;

## I. INTRODUCTION

Today's students are digital natives with a distinct personality. They have different learning styles, a fresh attitude toward the learning process, and higher expectations for teaching and learning because they grew up with digital tools. Teachers are confronted with new obstacles and must address critical concerns connected to the customization of the learning process to the needs, preferences, and requirements of students. One of these developments is gamification in education [1]. Gamification is to engage people, encourage action, promote learning, motivation, and solve issues utilizing game-based mechanics, aesthetics, and game thinking [2].

Tribology is the engineering and science of interacting surfaces in motion [3]. The Industrial Tribology program at Universiti Kebangsaan Malaysia (UKM) has five learning objectives. The nature and intricacy of the course material make tribology courses challenging for mechanical engineering students to comprehend. Currently, the lecturers teach this course using the andragogy, pedagogy, and heutagogy traditional teaching and learning methods. Even though including gamification elements in academic learning activities has several advantages for students, most setup and preparation tasks are still done by lecturers or professors manually. Creating quizzes with questions and answers, separating students into equal teams for competitions, and setting up physical equipment to carry out teaching and learning exercises in a gaming format were some of the duties. Because these procedures require too much time and effort from lecturers or teachers, they are frequently rejected by lecturers or teachers, or the effects of interactive learning activities are not conveyed to students or audiences. As a result, lecturers or professors frequently decide against integrating gamification components into their lecture classes, or they fail to communicate the benefits of interactive learning activities to audiences or students. Using current manual procedures, it is very challenging for lecturers or teachers to track and assess their students' performance in interactive learning activities.

The intention of gamification techniques in academic content is to boost students' academic achievement, yet this circumstance undercuts that intention. This is owing to a dearth of records and sources regarding students' academic progress during learning activities. Even if there are many advantages to various types of gamifications, solving puzzles stimulates the brain in a remarkable way. The purpose of employing puzzles in the classroom is to encourage students' emotions, creativity, and curiosities as well as to improve their general thinking abilities and lateral thinking. Through the use of brief questionnaires, the attitudes of two groups of university students enrolled in a second-year engineering mathematics course are assessed.

According to the research, puzzles can be more enjoyable to play than traditional multiple-choice-based games. Using the Fun with Tribology (FwT) application, students will be able to enjoy learning, be motivated for the course and have a more engaging experience. Lecturers will be able to utilize digital tools that the students are already familiar with to help the students learn with excitement.

## II. BACKGROUND AND RELATED WORK

### A. Current Teaching and Learning of Tribology

The course Industrial tribology is taught to final year students of mechanical engineering. Each section consists of less than 30 students. The classes are 2 hours long each week and the course consist of labs, lectures, tests, quizzes, and mini project. To keep the class interesting and engaging, the lecturers mostly use the available application from the Internet; Kahoot! and Quizizz. The As-Is teaching method is illustrated in Fig. 1.

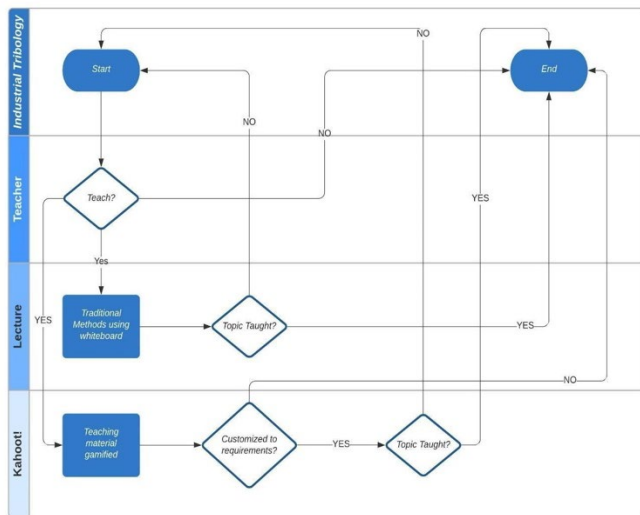


Figure 1. Swimlane diagram for the As-Is Teaching Method

### B. Comparison of Similar Applications

Kahoot! and Quizizz are basically the same technology from different manufacturers and teachers tend to use both of them in class. While gamification of the course material can be achieved through a generic website it is in no way a replacement for the traditional teaching and learning which utilizes the lectures and explanations.

Kahoot! enables students to learn through games and trivia quizzes. It is easy to make games and invite learners to the games [4]. The quiz can be taken on any device with a web browser, such as an iPad, Android device, or Chromebook, and students do not need a Kahoot! account to take it [5]. Teachers can create their own Kahoot! in minutes by searching through millions of ready-to-play Kahoot! on any topic, and by combining multiple question kinds to boost participation. They can also host Kahoot! live in class or online for distance learning, assign student-paced material review challenges, and, evaluate learning outcomes using reports.

Meanwhile, Quizizz is an educational application used by teachers in class to perform fun and engaging multiplayer class

activities. Students reported to have had a better class learning experience and were more satisfied after using Quizizz. Quizizz incorporates game elements such as avatars, themes, memes, and music into the learning process, making it more enjoyable [6].

Table 1 compares the current teaching systems. Industrial Tribology requires the proposed gamified educational application as this course aims to have a personalized application to better enhance the student’s motivation and engagement with the course.

TABLE I. COMPARISON OF EXISTING AND PROPOSED SYSTEM

Criteria / Name	Kahoot!	Quizizz	Traditional teaching and learning	Proposed Project (FwT)
Format of questions	multiple choices, true/false	multiple choices, true/false	Open to all questions	Multiple choice, Puzzle, Hangman
Automatic Data recording	Yes	Yes	No	yes
Digitized process of academic content setting by providing template	Yes but without template	Yes but without template	Depends on topics	Yes
Time and Energy required to operate	Varies on usage	Varies on usage	Higher relative to digital methods	Lower compared To Kahoot! and Quizizz
Automatic verification of student answers	Yes	Yes	No	Yes

## III. METHODOLOGY

This project employed the combination of agile and waterfall, where the best of waterfall and agile features are being applied. The waterfall’s strong features suited well in the first phase of the project, where it sequentially supported the requirements gathering and analysis, followed by the system design. The ‘agility’ came in throughout the implementation phase as well as the testing phase. It supports the iterative and rapid development as the application was being developed and tested.

### A. Requirements Phase

After eliciting the requirements from the stakeholders and current applications, eight use cases are identified and proposed. This is illustrated in Fig. 2. In this Use Case diagram, the actors are Students and Teachers where the students have access to registration, login, edit profile, access game which includes Fun with puzzle and Fun with Hangman and the progress and achievement check extends the games. The teacher on the other hand has access to maintain applications and check progress and achievements. The maintain application includes upload questions and updating the game rules.

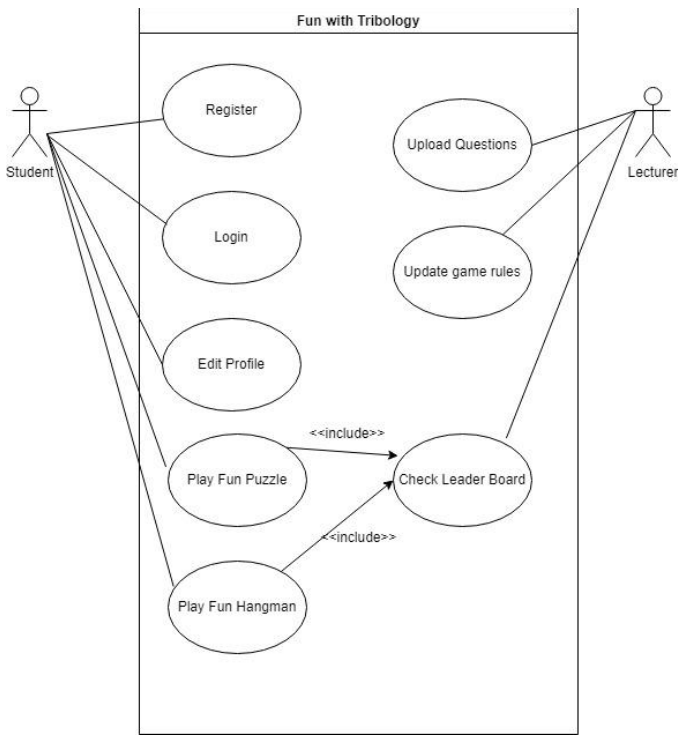


Figure 2. Use cases for Fun with Tribology

### B. System Design Phase

A database holds information on certain objects, and they can be fetched to and from the application. Firebase acts as a codeless backend for storing user data. Entity Relationship Diagram (ERD) which is the design of the database used for Fun with Tribology. Firebase has collections that are both named values and generated values. Fig. 3 shows the database design.

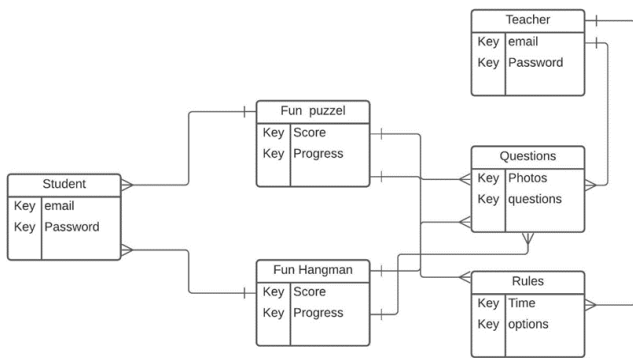


Figure 3. Entity relationship diagram for Fun with Tribology

The architecture of this project applies MVVM framework, where it stands for Model-view-viewmodel. In the MVVM framework, databinding is a new mechanism. It enables the view to be linked directly to the View-properties Model's and activities. With databinding, the View-Model component does not need to tell the view of changes via code, and the view recognizes that data has been loaded and displays it. Fig. 4 shows that the application consists of four subsystems, and they work together to show the view layer. In this architecture the Models are the player database and Game database objects that

come Login and registration page. The individual components in the subsystems are the views that has act as the interface. The subsystems act as the view models that interact with the vie

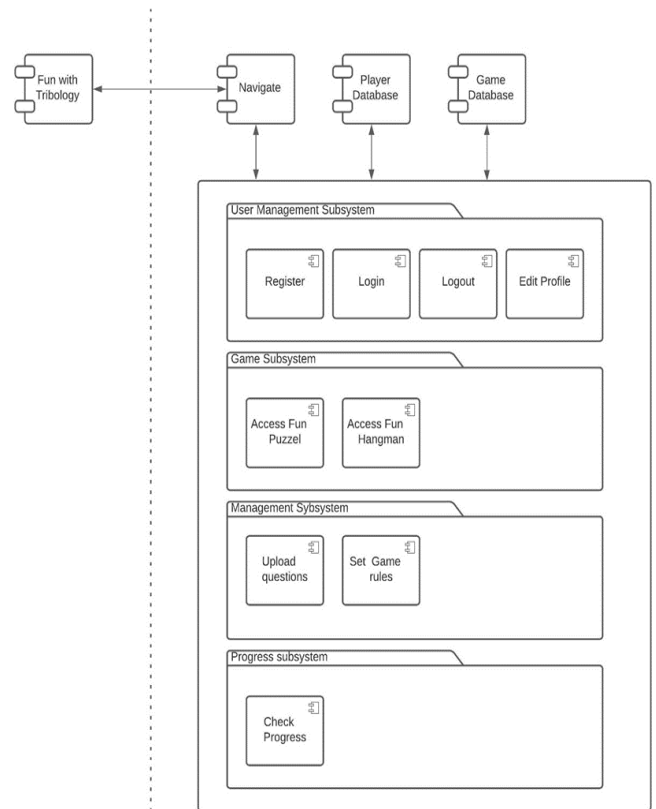


Figure 4. System architecture for Fun with Tribology

## IV. IMPLEMENTATION

The development or implementation of FwT can be broken down into two parts: user interface and game, and back-end.

### A. User Interface and Game Development

To develop Fun Puzzle high level logic was used to make sure each picture is broken down and made into puzzle. The objects of this class are manipulated to create the slide game. Fun hangman uses no packages display the game but rather. Fun hangman determines if the player selecting the letter matches with the letters coming from the database and starts drawing using images if there is no match. The interfaces are as shown in Fig. 5 and Fig. 6.

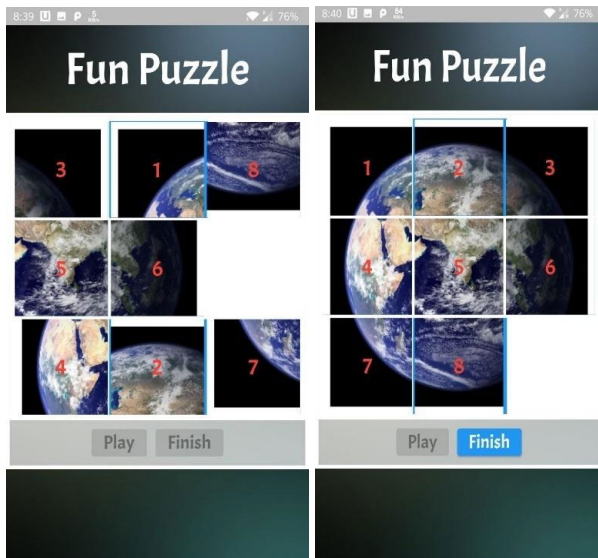


Figure 5. Fun puzzle game

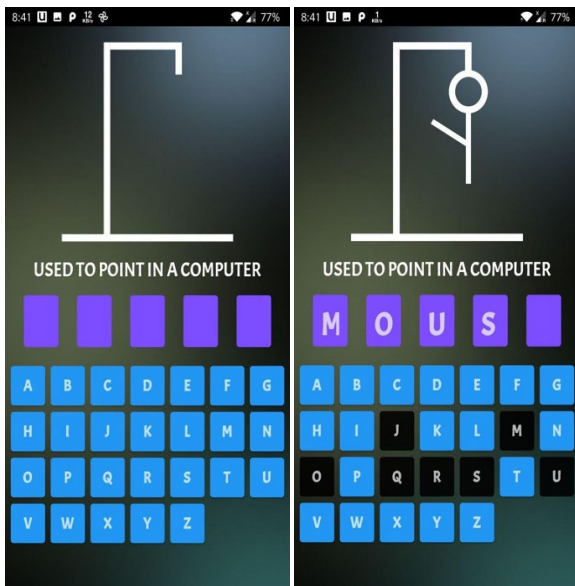


Figure 6. Fun hangman game

### B. Back-end Web Services Development

The backend was implemented using Firebase and all the data from the admin user interface and player score data is stored there. Meanwhile, all the logic is implemented in by Flutter.

### V. SYSTEM TESTING

The testing conducted for the Fun with Tribology is black box testing, via functional testing, followed by user acceptance test (UAT). The fundamental goal of system testing is to validate and verify the system in order to endure quality and scalability, as well as the user's satisfaction.

The functional test achieved 100% coverage where all test case designs for each functionality was successfully executed. In addition, every single one of the test cases is passed. In addition, the stakeholder had the chances to participate in testing the application via the UAT, where all functionality featured in the application was successfully executed as planned.

### VI. CONCLUSION

The implementation of the mobile application Fun with Tribology (FwT) has met the goal which is to facilitate and enhance the experience of learning of tribology with gamification. With the flexible way to manage learning material into the application by the lecturers, the players can engage with the course in a playful and exciting manner.

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