

Gamification To Study Machine Learning Using Octalysis Framework

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Abstract— Machine learning is an area of study that enables computers to learn and improve their performance without explicit programming. Its primary application is assisting humans in processing vast amounts of data. Machine learning is a crucial area of study, and to assist students in learning about it, a gamification application has been developed using the Android platform. The aim of this research is to not only provide knowledge to students but also make the application interesting by using the Octalysis Framework. The application's level of acceptance will be tested on students at Multimedia Nusantara University who are taking machine learning courses. The Unified Theory of Acceptance and Use of Technology Model (UTAUT) method will be used to evaluate the application, which received an average score of 86.77%. This score indicates that students strongly agreed that the gamification approach using the Octalysis Framework and Android platform for machine learning was well-received.

Index Terms— android application; gamification; machine learning; octalysis framework.

I. INTRODUCTION

Machine learning is a field of study that enables computers to learn without being explicitly programmed, where the computer can then work according to what it has learned. [1]. Machine learning is can be used to process vast quantities of data, often in diverse formats, that are beyond human ability to process quickly. Because of that, machine learning is needed to help humans in processing data. Machine learning is commonly used to teach machines how to process data efficiently so that large amounts of data can be processed and become valuable information. Machine learning has several different algorithms for solving problems with data [2]. Machine learning can also be used to make forecasts with the available data. With the various benefits of machine learning that are useful today, machine learning is a subject that should be passed down to the current generation, as it enables them to make good use of future data and extract valuable insights from it.

Gamification is a way to hand down knowledge using an element from the game, such as challenge and feedback to help the learning process. Gamification is a

method for using in-game mechanisms for non-game environments [3]. Gamification takes several in-game elements such as badges, rankings, rankings, etc., and uses them to transform non-game environments into game environments. One of the uses of this gamification is to assist in the field of learning.

The gamification method has been proven to be able to meet its target in channeling machine learning knowledge. A study showed that there were workshops teaching machine learning to junior high school students using the gamification method which was carried out in Thailand [4]. In this study, it was explained that junior high school students were given an explanation about machine learning and were given the challenge to classify sweet mangoes by looking at the physical shape of the mangoes, such as the color of the mangoes, the hardness of the fruit, and so on. The students then entered the mango data into an application called Rapid Miner, which is a UI-based application for machine learning for classification. In the end the students succeeded in classifying the mangoes, and based on observations, the students looked happy and the model built by the students proved to be successful.

Research [5] concludes that some of the studies that have been reviewed have weaknesses, such as the absence of an appropriate framework to use. Researchers are too focused on making basic programming studies so they don't pay attention to the fun factor to encourage users to complete games. So, this research will use the Octalysis Framework in designing machine learning gamification applications. Octalysis framework is an approach to creating a gamification system that was introduced by Yu-Kai Chou [6]. The Octalysis framework assumes that in gamification there must be encouragement so that users want to interact and interact in the game. The driving factors are divided into eight in the Octalysis Framework, including epic meaning, development and accomplishment, empowerment of creativity and feedback, ownership and possession, social influence and relatedness, scarcity and impatience, unpredictability and curiosity, and loss and avoidance [7]. By using the Octalysis Framework approach, users get encouragement so that users want to interact in the

game. Gamification with Octalysis Framework has also been proven to transmit knowledge, such as the Java programming language [8], and machine learning. The gamification technique built using the Octalysis Framework method is not only aimed at young people, but has also been tried on elder people [9]. By focusing on the 8 core drivers of the Octalysis Framework, the application of gamification techniques in education has the opportunity to create experiential independent learning, for all ages, and can be expanded exponentially [10].

This research using RAD (Rapid Application Development) method to develop the mobile gamification application. The RAD system development method was chosen because it allows researchers to be able to change the design of the application during the application development process [11]. In addition, the application development process can be revised repeatedly on the prototype that has been made, so that the developer does not need a long time in the prototyping process.

With the gamification method using the Octalysis Framework that has the potential to help the teaching process of machine learning knowledge, this research will design a mobile gamification application using Octalysis Framework for Android platform. Then at the end of this research, to evaluate the resulting application this research will use the UTAUT model, which has proven in evaluating a new information technology [12]. This application is expected to help students who are studying machine learning to gain knowledge and can also increase student interest in learning machine learning.

II. METHODOLOGY

A. Object of Research

The object of this research is to design and build a mobile machine learning gamification application for students at Multimedia Nusantara University, department of Information Systems study program who are studying machine learning. The mobile machine learning gamification application that has been created will later be tested for user acceptance using the UTAUT (Unified Theory of Acceptance and Use of Technology) model to be able to measure the acceptance rate of Multimedia Nusantara University student's batch 2019 Information Systems study program who are studying machine learning. The applications that have been built from this research will be distributed to students, then those who are needed and available to try the application will be provided with the UTAUT model. In this study there were as many as 13 students who were available to be respondents of this research and had the necessary requirements, namely having an Android phone. Then the results of the entire research will be analyzed and will be a suggestion for future research.

B. Research Method

RAD (Rapid Applications Development) is a method for system development. RAD itself makes it possible to build an application quickly and is suitable for use if you don't have a large number of teams. In the RAD method, developers can create an application by prioritizing feedback from users, so that the prototype that has been made can be revised repeatedly so as to get optimal application results. Figure 1 explaining about the steps available on RAD [13]. In the RAD method, the application development process can be revised repeatedly on the prototype that has been made, so that the developer does not need a long time in the prototyping process.[11].

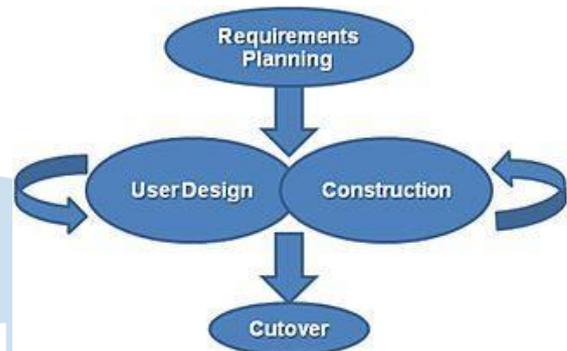


Fig. 1. Steps Available on RAD

1) Requirements Planning

In this research, the goal is to help students who are studying about machine learning in a more engaging way. Therefore, in this research, we built a mobile machine learning gamification using the Octalysis Framework. Observations are made by analyzing material about machine learning that needs to be learned, then studying techniques for making gamification according to the Octalysis Framework.

2) User Design

In this step, researchers plan the application to be built according to the Octalysis Framework. Therefore, the researcher ensures that all eight cores contained in the Octalysis Framework are contained in machine learning gamification applications. The following is a user design of each core in the Octalysis Framework which will be implemented on the construction site.

- **Epic Meaning and Calling**
This core is about driving people to believe that they are chosen to do something. This core will be implemented when the user plays for the first time, there will be words indicating that the user is the chosen one to be able to finish this game.
- **Development and Accomplishment**
This core is about driving people to always make development to accomplish some goals. This core will be implemented when the user clicks

the right answer, and the user will get additional levels and scores.

- **Empowerment of Creativity and Feedback**

This core focuses on empowering the user's creativity and giving the user's feedback right after they use their creativity. This core will be implemented in giving users creativity to create their own in-game name, and the name will be displayed on the leaderboard.

- **Ownership and Possession**

This core is about giving user the feel that they own something and triggering the user to improve it. This core will be implemented with the user's score and level. Every user in this game has their own level and score and every user wants to improve their level and score.

- **Social Influence and Relatedness**

This core is about all social aspects that can motivate people. This core will be implemented with a leaderboard that can display the rank of each player that plays the game.

- **Scarcity and Impatience**

People tend to want something that is rare and not immediately attainable. This core will be implemented with each stage in this game and cannot be passed without completing the previous stage.

- **Unpredictability and Curiosity**

This core is about driving people to be curious about something because of the unpredictability. This core will be implemented with different questions at each stage.

- **Loss and Avoidance**

This core is about driving people to avoid them from losing something. This score will be implemented when the user clicks the wrong button or input the wrong answer, then the user's score will be reduced by 25 points.

3) Construction

In this step, researcher will build the application using C# and the PHP programming language. The implementation of this research resulted in a machine learning gamification application.

4) Cutover

The cutover phase is carried out to measure the level of student acceptance in machine learning gamification applications that have been designed by distributing machine learning gamification applications on the Android platform. Researchers distributed Google Drive links to students who were taking machine learning courses, then distributed questionnaires in the form of google forms to fill out. The questions in the questionnaire distributed are based on the unified theory of acceptance and use of technology (UTAUT)

model which can measure the level of acceptance of new technologies in students [14] [15].

TABLE I. ACCEPTANCE LEVEL CATEGORY INTERVAL

Percentage Interval	Acceptance Level Category
0% - 20%	Strongly Disagree
20.01% - 40%	Disagree
40.01% - 60%	Uncertain
60.01% - 80%	Agree
80.01% - 100%	Strongly Agree

III. RESULTS AND DISCUSSION

A. Octalysis Framework Implementation

The following is a user design plan for each core in the Octalysis Framework that will be implemented in the construction phase.

1) *Epic Meaning and Calling*

When the user first enters the system, there are words to indicate that the user is the chosen person who can complete all the existing stages.

2) *Development and Accomplishment*

If the user has completed the existing stage, then the user will get an additional level and also an additional score.

3) *Empowerment of Creativity and Feedback*

Users get the freedom to write the desired name so that it can appear on the leaderboard.

4) *Ownership and Possession*

In the first step, open the Kali Linux command terminal.

5) *Social Influence and Relatedness*

There is a leaderboard that displays the rank of each user so that it can encourage users to compete between friends to get the most scores.

6) *Scarcity and Impatience*

Every stage in this game cannot be skipped. The user must complete the previous stage in order to advance to the next stage.

7) *Unpredictability and Curiosity*

There are several different questions at each existing stage that increase user interest in advancing to the next stage.

8) *Loss and Avoidance*

If the user presses or enters the wrong answer, then the user's score will be reduced by 25 points.

The following is a flowchart to help understand the application to be built.

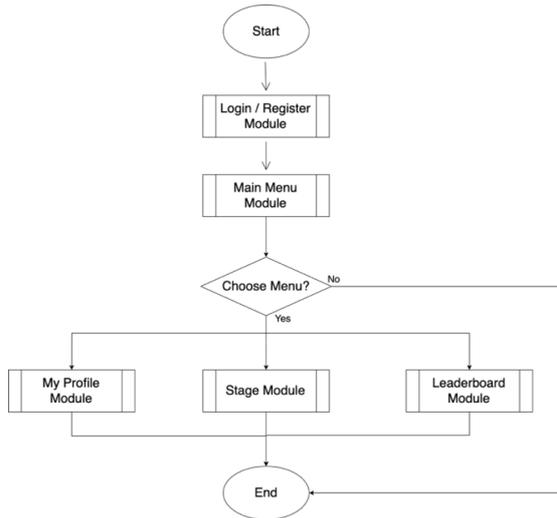


Fig. 2. Main Flowchart

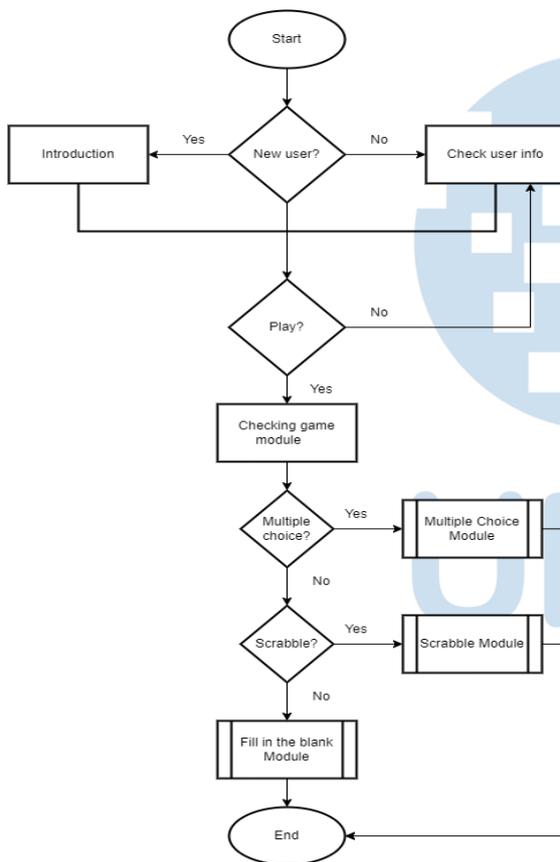


Fig. 3. Stage Module Flowchart

Figure 3 above is the flow of the stage module. If the user presses the play button on the main menu page, the user will be taken to the stage module. For users who have just registered their account, an introduction will appear which contains words that make the user feel special or selected. This is in accordance with the Octalysis Framework factor, epic meaning and calling. Then if the user has played this game before, the level information will be checked and adjusted to the stage button that can be accessed. Then when the user presses

the stage button, the system will see the game module at that stage, whether it is a multiple choice, scrabble, or fill the blank type stage.

B. Construction

The application was built using C# and PHP programming language, and uses MySQL to store user data so the leaderboard can display all the player's rank. To use this application, a new user has to register their account so they can log in into the game.

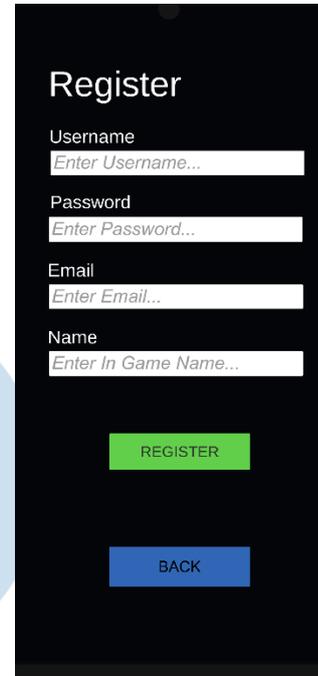


Fig. 4. Register Page

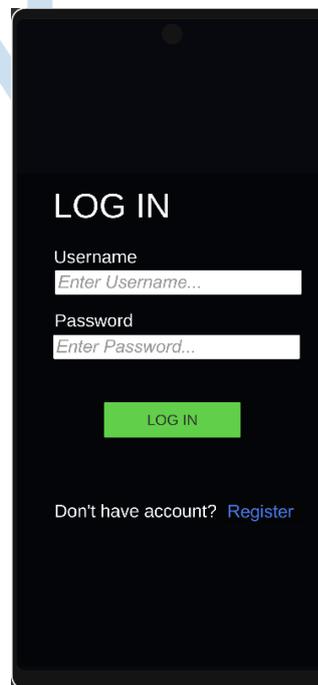


Fig. 5. Login Page

After the user has successfully logged in, the user will see the main menu module as shown in the Figure 6.



Fig. 6. Main Menu Page

Figure 6 is the page that users see when they have successfully logged into the game. On the main menu page, users can choose 4 menus, namely Play, Leaderboard, My Profile, and Quit. If the user presses the Play button, then the user can play the game. Then if the user presses the Leaderboard button, the user will go to the Leaderboard page which contains the ranking of each user who plays this game. If the user presses the My Profile button, the user will go to a page that displays information about the user's account. Finally, if the user presses the Quit button, the user will exit my Machine Learning application.

On the Leaderboard page, users can see the rank that the user has or see the rank that is owned by the user's friends or other users. The rank that appears on the leaderboard adjusts to the number of scores owned by the user. This score is one of the elements used in the Octalysis Framework, ownership and possession which means the user has something, in this case the user has a score that will be obtained when the user answers the question correctly. Then there are also elements of social influence and relatedness that are applied in the form of a leaderboard, which can challenge users to compete with other users.

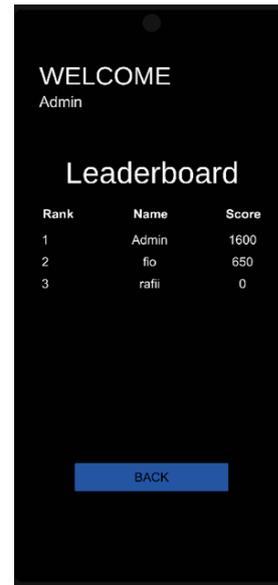


Fig. 7. Leaderboard Page



Fig. 8. Introduction Page

Figure 8 is the user introduction page. Users who play my Machine Learning application for the first time will see this page when they tap the Play button. This page displays making the user believe that the user is the chosen person who can complete all the stages in this game. This is an example of the application of the Octalysis Framework, epic meaning and calling, which makes players believe there is something greater than themselves or the player is someone who is chosen.

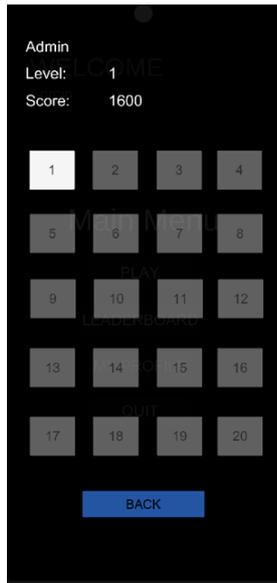


Fig. 9. 20 Stages of the Game

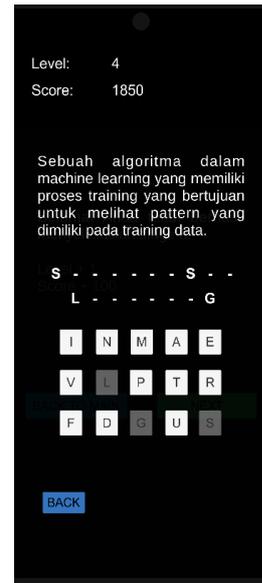


Fig. 11. Scrabble Page

After tap Next button, user can see the stage list that is available at this game. This game has 20 stages, and users have to clear each stage in order to proceed to the next stage. In each stage, there will be a different machine learning question. From the 20 stages, there are 3 types of game. The first is multiple choice, the second is scrabble, and the last is fill the blank. An example of multiple choice shown in Figure 10, scrabble stage in Figure 11, and Fill in the Blank Stage in Figure 12.



Fig. 10. Multiple Choice Stage

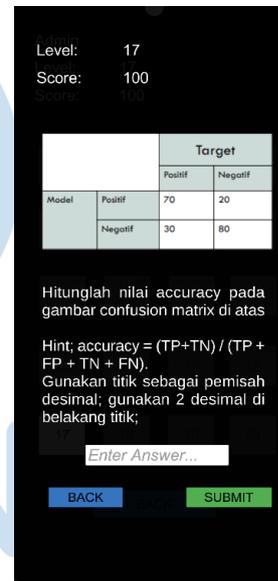


Fig. 12. Fill in the Blank Stage

The stage with the fill the blank type is one of the implementations of the Octalysis Framework at the point of unpredictability and curiosity, which makes this application unpredictable because there is an unexpected type of stage that suddenly appears in the final stage.

For each question, if the user successfully answers the question, a successful answer page will appear as shown in Figure 13 and get 100 points. But if the user presses the wrong button, then the user will lose the 25 score points they have. This is in accordance with one of the points in the Octalysis Framework, namely loss and avoidance. With the reduction of the user's score points, the user will try to answer questions in a stage correctly and will avoid the risk of losing the score points they have.



Fig. 13. Interface if User Answer Correctly

C. Cutover

The cutover stage is carried out to measure the level of student acceptance of the machine learning gamification application that has been designed by sharing the machine learning gamification application on the Android platform. Measurements were made by distributing questionnaires to students who were testing the application. The questions on the questionnaire distributed were made based on the unified theory of acceptance and use of technology (UTAUT) model which can measure the level of acceptance of new technology in students. Then from all the list of questions, will use a Likert scale to calculate the level of acceptance of student information. Each of the questionnaire questions was answered using a scale of one to five, where one means strongly disagrees and five indicates strongly agree. The results of the questionnaire that has been calculated using the UTAUT method are fully discussed in the next chapter.

IV. TESTING AND IMPLEMENTATION

The completed application will be tested using the UTAUT model. The UTAUT model has five indicators to measure the level of acceptance of new information technology. The indicators consist of performance expectancy, effort expectancy, social influence, facilitating conditions, and behavioral intentions. The data obtained for this test was obtained from a questionnaire distributed to the sixth semester students who are studying machine learning. In this study, there were 13 students who were willing to become respondents and had the requirement to have an Android phone. Then to be able to measure indicators in the UTAUT model, this study uses a Likert [16] scale. Table II show the results of each indicator in the UTAUT model.

TABLE II. ACCEPTANCE LEVEL CATEGORY INTERVAL

No.	UTAUT Model Indicator	Average of Acceptance	Acceptance Rate Category
1	Effort Expectancy	89.23%	Strongly Agree
2	Performance Expectancy	88.46%	Strongly Agree
3	Social Influence	84.61%	Strongly Agree
4	Facilitating Condition	87.69%	Strongly Agree
5	Behavioral Intention	83.84%	Strongly Agree
Average total acceptance percentage		86.77%	Strongly Agree

Table II is the calculation result of each UTAUT model indicator. It can be seen that the average percentage of acceptance on the effort expectancy indicator is 88.46%. Then on the UTAUT performance expectancy indicator, there is an average acceptance percentage of 88.46%. Then on the UTAUT social influence model indicator, the average percentage of acceptance is 84.61%. Then on the UTAUT facilitating condition indicator, the average percentage of acceptance is 87.69%. And finally on the UTAUT behavioral intention indicator, the average percentage of acceptance is 83.84. Then from all the indicators of the UTAUT model, the average percentage of acceptance is 86.77%. Based on the Table 2, it can be concluded that the respondents strongly agree that this machine learning gamification application can be accepted by students who are studying machine learning. The lowest score is on behavioral intention, which is triggered by a display that is still simple so that it is less attractive to users to use the application. Therefore, changes to the appearance are made to increase user interest as shown in Figure 14 below.

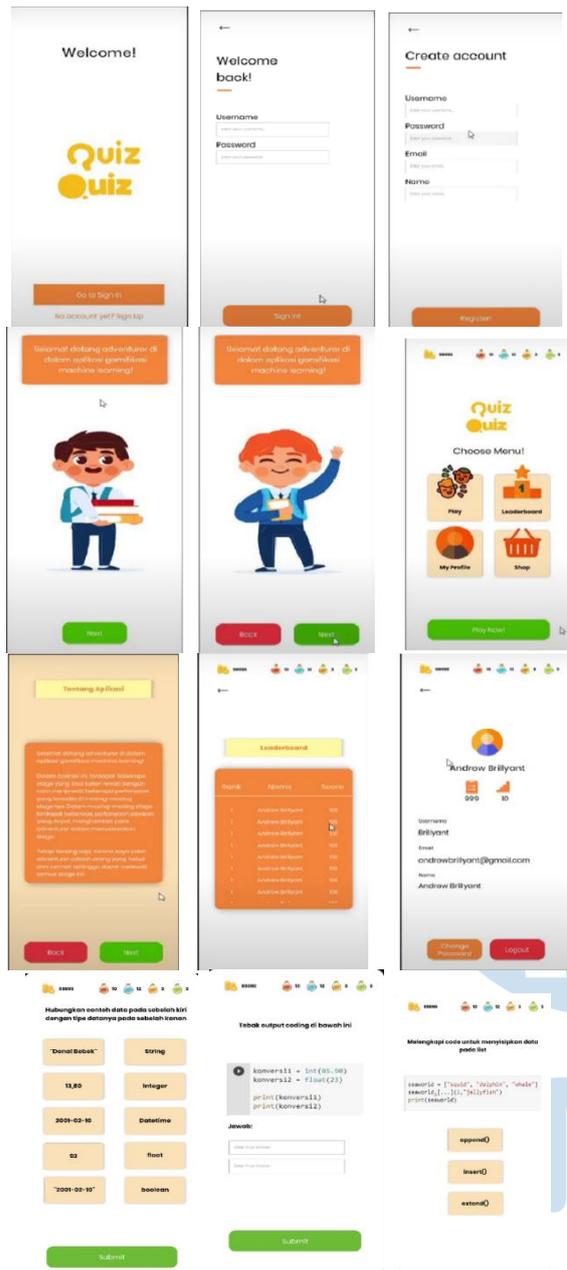


Fig. 14. Interface if User Answer Correctly

V. CONCLUSION AND SUGGESTION

A. Conclusion

In this study, the machine learning gamification application using the Octalysis Framework gamification method has been designed using the C# programming language and using the UNITY game engine platform. This gamification application has also been connected to the MySQL database with PHP to connect the front end with the C# programming language. Then to support the live leaderboard feature, this research uses hosting so that users can access this application online. This machine learning gamification application can already be installed and used by downloading the apk file that can be found on the

researcher's google drive. Then the machine learning gamification application as a result of this research has been evaluated by 13 respondents using the UTAUT model to see the percentage of acceptance by students who are taking machine learning courses. From the distributed questionnaires, the average percentage figure for all UTAUT factors is 86.77%, which can be concluded that the respondents strongly agree that this machine learning gamification application can be accepted by students who are studying machine learning.

B. Suggestions

In this study, there are several suggestions that can be given that can be used for the development of machine learning gamification applications in the future such as, added a friend list feature to the application and created a leaderboard that can be filtered based on friends, as well as several categories so that users get an incentive to get number one ranking, and it is also possible to monitor student progress, then added a database for questions for each stage so that it is possible to create new stages in machine learning gamification applications more practically, so that users can learn more about machine learning, and lastly adding a type of stage that allows the user to fill in more complicated coding, so that it will add variety to the questions contained in each stage.

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