Implementation of Gamification Method and Fisher-Yates Shuffle Algorithm for Design and Development Django Learning Application

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Abstract— **The web framework emerges as a solution to enhance web development efficiency. Django, an open-source web framework written in the Python programming language, is one of the popular frameworks. Currently, there are not many programming learning platforms that provide specific programming learning materials for Django, implementing a method to boost user interest in using the platform. This research aims to design and build a web-based Django learning application using gamification methods designed based on the octalysis framework to enhance user learning interest. It also incorporates the Fisher-Yates shuffle algorithm to randomize questions for more variety. The application was tested by several users by filling out a questionnaire prepared using the Hedonic Motivation System Adoption Model (HMSAM). The evaluation results of the application obtained an average percentage of 84,15% in the aspect of behavioral intention to use, which means users strongly agree that the djangoing application generates a desire to use it again in the future. Furthermore, the results in the aspect of immersion were 81,44%, which means users agree that the djangoing application creates an immersive learning experience for the Django framework.**

Index Terms— **Django, Fisher-Yates Shuffle, Gamification, Learning Application, Website**.

I. INTRODUCTION

Technological developments in this digital era have had a big impact in making human life easier. One of the technological developments that we have experienced is in the education sector, where technology has contributed significantly to the teaching and learning process through website development. The use of websites in the teaching and learning process will help speed up access to information, enable interaction between teachers and students, and make it easier to share learning materials. [1].

A website is a page that contains information that can be accessed from all over the world via the internet as long as there is a connection to the internet network. To create a website, several elements such as JavaScript, HTML, and CSS are required. This is very important so that a web address can operate well and display a quality website [2]. However, website development without using a web framework or using vanilla methods has disadvantages, including a lack of efficiency and time effectiveness [3].

With advances in technology, the emergence of web frameworks has become a solution to overcome the weaknesses in vanilla methods. Web frameworks are basically tools that help developers to build websites so that they avoid bugs and can save time in developing websites [4].

Web frameworks come in various types, developers can choose the framework they want to use according to their individual needs [4]. An example of a framework that allows it to be used in website development is Django. Django is a web framework that is open source and written in the Python programming language. Due to its rapid development features, Django is highly sought after by developers today as it takes very little time to build any application [5].

Currently, there are not many programming learning platforms that provide discussions about programming learning materials, especially Django, which implement a method to increase users' interest in learning when using the platform. Increasing user motivation in learning can be done by implementing a method called gamification. This is proven by previous research which discusses the implementation of gamification methods in learning the React Native framework [6]. From this research, results were obtained in the form of implementing gamification

methods in learning which can increase focus and interest in using applications in the future.

During the learning process, quizzes will be provided based on the material that has been studied. The mechanism used in a quiz is randomization of the questions provided, so an algorithm is used to randomize the quizzes irregularly using Fisher-Yates Shuffle on the quizzes provided. There is previous research that discusses the implementation of the Fisher-Yates Shuffle algorithm to randomize exam questions [7]. From this research, results were obtained in the form of applying the Fisher-Yates Shuffle algorithm which can randomize questions optimally and efficiently. There are also previous researchers who discussed the comparison between the performance of the Fisher Yates Shuffle algorithm and the Comparison of Linear [8]. From this research, the results obtained were that the performance of the Fisher Yates Shuffle algorithm was faster than the Comparison of Linear, namely 11.76% of the total of five data tests.

Based on the background of the existing problems and referring to previous research, a django learning platform will be designed and built using website-based gamification methods. It is hoped that by creating this learning application it can attract anyone who has an interest in learning and developing websites using the Django framework through the material provided.

II. THEORY

A. Django

Django is a web framework used to develop a project. Django emphasizes its advantages in fast and practical development, and has a simple design. Django was built by experienced developers to solve many problem in web development. By using HTML, CSS, and JavaScript the frontend appearance of the project is made more user friendly. Meanwhile, the Python programming language is used for the backend [9]. Compared to other web frameworks that use the MVC (Model View Controller) design structure, Django uses another design structure, namely MVT (Model View Template) [10].

B. Gamifikasi

Gamification is the application of game mechanisms and activities to contexts where the primary goal is not gaming [11]. In more detail, gamification can be defined as an idea that combines game-based mechanics, aesthetic elements, and game thinking to engage others, motivate action, encourage learning, and solve problems [12]. Gamification is now increasingly commonly used in non-gaming related applications to improve user experience and engagement [13].

C. Octalysis Framework

Octalysis Framework is the result of research from Yu-Kai Chou in the form of establishing a gamification framework designed using eight core drives that focus on human behavior such as epic meaning, accomplishment, empowerment, ownership, social influence, scarcity, unpredictability, and avoidance [14].
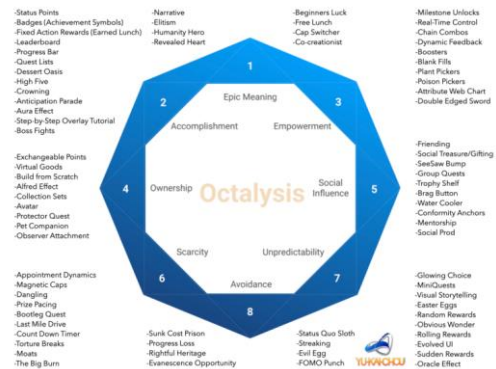

Fig. 1. Core Drive Octalysis Framework

D. Algoritma Fisher-Yates Shuffle

The Fisher-Yates algorithm (taken from the names of Ronal Fisher and Frank Yates) or also known as the Knuth Shuffle (taken from the name of Donald Knuth), is an algorithm that produces random permutations of a finite set, in other words randomizing a finite set. arrange. If implemented correctly, the results of this algorithm will not be biased so that each permutation has the same probability [15]. The way to generate random permutations from questions number 1 to N is as follows [16].

1. Write down all the questions from number 1 to N (total index number).

2. Next, determine non-sequentially a number K (one index) up to the number of numbers that have not been crossed out.

3. After that, look for the question number K that has not been crossed out from the bottom, then write down the number in a different place.

4. Repeat steps 2 and 3 until all question numbers are crossed out.

5. Thus, the sequence of question numbers recorded in step 3 will form a random permutation of the original question number sequence.

E. Blackbox Testing

Black box testing is a software testing technique used to determine the functionality of an application. The main focus of black box testing is the input available to an application and the expected output for each input value. This blackbox testing method is based on software requirements and specifications [17].

F. Hedonic Motivation System Adoption Model (HMSAM)

HMSAM is a model that has been adapted from the Hedonic Motivation System (HMS) as a model that

functions to measure hedonic motivation in a system [18].
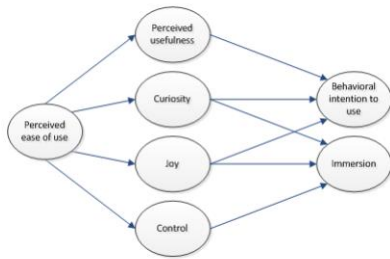

Fig. 2. Model HMSAM.

In Figure 2 there are several factors for measurement in HMSAM, namely as follows.

1. Perceived ease of use is a measure of the ease of using a system.

2. Perceived usefulness is a measure of the usage performance of a system.

3. Curiosity is a measure of the user's level of curiosity about using a system.

4. Joy is a measure of the feeling of pleasure obtained when interacting with the system.

5. Control is a measure of user perception of interaction with the system.

6. Behavioral intention to use is a measure of the user's desire to use the application.

7. Focused immersion is a measure of how focused the user is in using the application.

HMSAM has the final result in the form of behavioral intention to use and also focused immersion. Behavioral intention to use is determined by two aspects, namely perceived usefulness and curiosity. Meanwhile, focused immersion is determined by two other aspects such as joy and control.

G. Likert Scale

The Likert scale is a type of psychometric scale that is often used in questionnaires, and is a common choice in research studies such as surveys [19]. The Likert scale is used to assess the views, opinions and perceptions of individuals or groups regarding social phenomena [20]. The Likert scale consists of five categories with respective points, ranging from strongly agree to strongly disagree.

TABLE 1. LIKERT SCALE CATEGORY INDICATORS

Category	Point
Strongly Agree (SS)	5
Agree (S)	4
Neutral (N)	3
Disagree (TS)	2
Strongly Disagree (STS)	1

When the testing process on respondents is carried out, the HMSAM questionnaire will be used. The results of the questionnaire scores can be calculated to get a percentage using formula 1 for the HMSAM criteria with a positive connotation, while formula 2 is used for the HMSAM criteria with a negative connotation.

$$Percentage = \frac{(SS*5)+(S*4)+(N*3)+(TS*2)+(STS*1)}{5*Total\ Respondent}\ x\ 100\%$$

$$Percentage = \frac{(STS*5)+(TS*4)+(N*3)+(S*2)+(SS*1)}{5*Total\ Respondent}\ x\ 100\%$$

From the results of percentage calculations, the respondents' assessment levels were obtained which were categorized based on the percentage intervals listed in Table 2.

TABLE 2. PERCENTAGE INTERVAL FOR RESPONDENT ASSESSMENT CATEGORIES

Percentage Interval	Category
80% - 100%	Strongly Agree (SS)
60% - 79,99%	Agree (S)
40% - 59,99%	Neutral (N)
20% - 39,99%	Disagree (TS)
0% - 19,99%	Strongly Disagree (STS)

III. METHOD

The methodology that will be used in this research is as follows.

A. Literatur Study

Literature studies are carried out by taking and studying information from various literary sources such as journals, books or other scientific sources to support research according to existing theories. The theories collected in this stage are about Django, Gamification, Octalysis Framework, Fisher-Yates Shuffle algorithm, HMSAM, and Likert scale.

B. Application Design

The application design starts from gamification design using the Octalysis method, followed by designing the application model, flowchart, and designing the interface.

C. Application Programming

Application programming is carried out as a form of implementation of the application design that has been created previously. The technology used is the Next.js framework, React library, and Firebase as a database.

D. Application Testing

Application testing is carried out to ensure that the application created can run well according to the design that has been made. Testing will be carried out using the

Microsoft Edge browser. Next, the application will be distributed to a number of respondents who are interested in learning and developing websites using Django for testing. Users who have tried will answer several questions based on the HMSAM model and Likert scale measurements through the online questionnaire that has been distributed. Questionnaires are used to measure the level of behavioral intention to use and immersion of the applications that have been created.

E. Evaluation

Evaluation is carried out by processing data obtained from the results of answers to online questionnaires that have been filled in by users who have carried out experiments on the applications created. Measurement of the level of behavioral intention to use and immersion was carried out based on Likert scale interpretation of online questionnaire answer data.

F. Documentation

Making a research report is carried out after the evaluation results have been analyzed, with the aim of documenting research activities in writing and then displaying the results and conclusions which can be used as a reference for further research.

IV. RESULTS AND DISCUSSIONS

Application implementation is carried out based on application model design, flowcharts, database design, interface design, and asset selection.
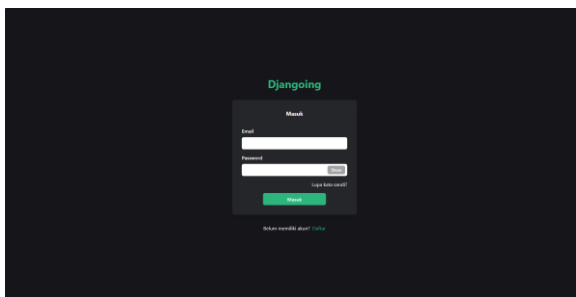
G. Implementation

Fig. 1. Login Page

Figure 3 is the result of the implementation of the login page. On the login page, there are 2 columns that must be filled in, namely email and password. If the user has filled in the required data, the user can press the login button so they can move to the home page if login process is successful. If the user forgets the account password that has been created, the user can press the link. If the user doesn't have an account, there is a registration link that will direct the user to the registration page.
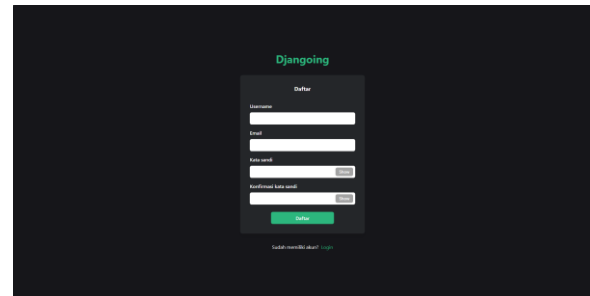

Fig. 1. Halaman Register

Figure 4 is the implementation result of the register page. On the registration page, there are 4 columns that must be filled in, namely username, email, password and also password confirmation. If the user has filled in the required data, the user can press the register button to register a new account if the registration process is successful. If the user already has an account, the user can press the login link and will be directed to the login page.
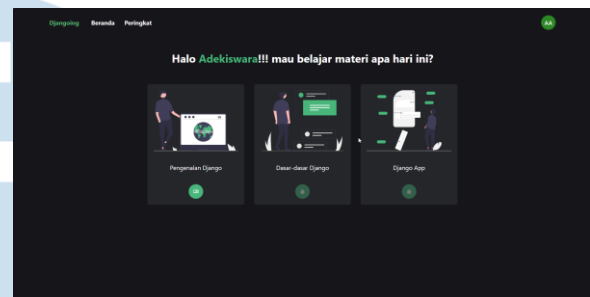

Fig. 2. Home Page

Figure 5 is the implementation result of the home page. On the home page, there is a greeting along with learning modules. Learning modules that are still locked will open if the user has completed or passed the previous module or learning material. If the user presses the button with the book icon, the user will be directed to the material list page.
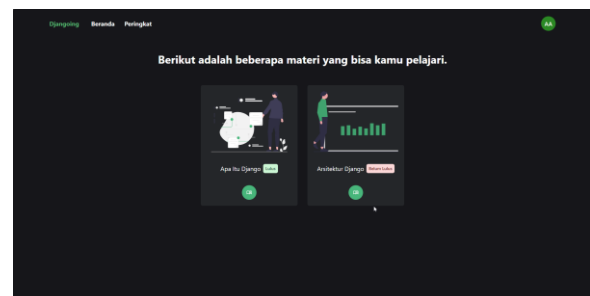

Fig. 3. List Materi Page

Figure 6 is the result of the implementation of the material list page. On the material list page, users can see several materials according to the previously selected module. Learning material will open if the user has completed or passed the previous material. If the user presses the button with the book icon, the user will be directed to the material page.
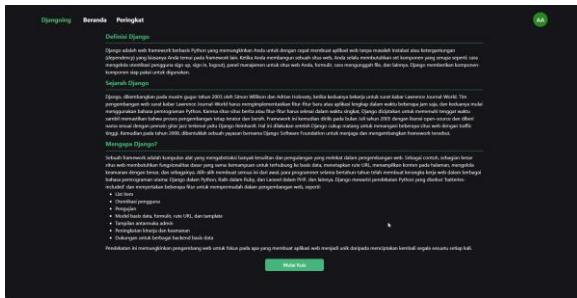
Fig. 4.   Lesson Page

Figure 7 is the result of the implementation of the material page. On the material page, users can view and study the material according to the previously selected material title. If the user has finished understanding the material, the user can press the quiz button to be directed to the quiz page.
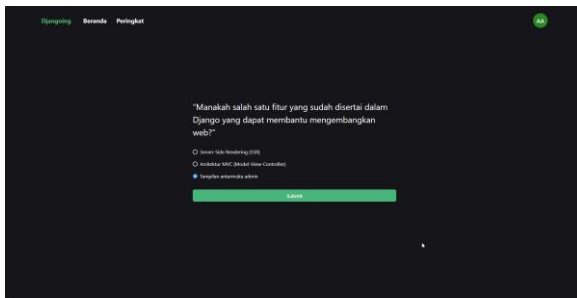

Fig. 5.   Quiz Page

Figure 8 is the implementation result of the quiz page. On the quiz page, users can answer questions according to previously selected material. The quiz only consists of one type of answer, namely a choice answer with the contents of 3 questions which will be displayed randomly in each quiz. Users can press the submit button if they feel they have chosen or answered correctly and will be directed to the next question. After reaching the last question, the correct answer will be counted and returned to the home page.

Fig. 6.   Leaderboard Page

Figure 9 is the implementation result of the ranking page. On the ranking page, users can see a ranking list of other users with only 10 users. Users can choose to display the ranking list globally or friends. If the user presses another user's name, the user will be redirected to the other user's profile page.
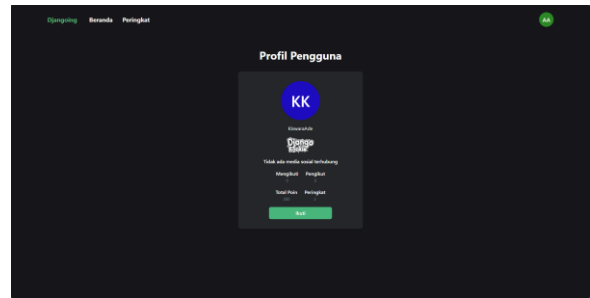

Fig. 7.   Other User Profile Page

Figure 10 is the result of the implementation of another user's profile page which can be accessed via the ranking page. Users can press the follow button to add other users as friends.
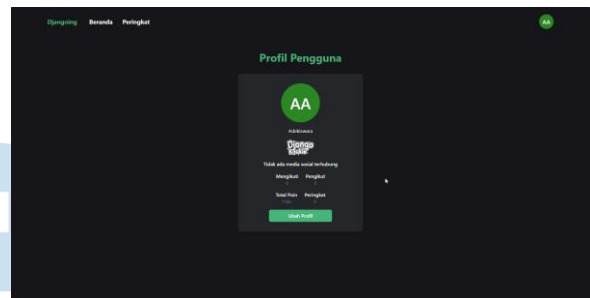

Fig. 9.   User Profile Page

Figure 9 is the result of the implementation of the profile page. On the profile page, users can see the avatar, title, number of followers, number of followers, total points and ranking. If the user presses the change profile button, the user will be directed to the edit profile page.
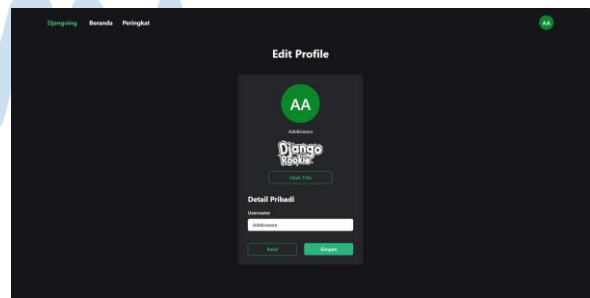

Fig. 10.   Edit Profile Page

Figure 10 is the result of the implementation of the edit profile page, the user can change the title via the change title button, apart from that the user can also change the username and it will be saved to the database after pressing the save button.

H. Evaluation

Application trials are carried out by sharing the access link to the application via social media for testing by a number of users who have the criteria, namely that they are studying or working in the IT field and want to learn or get to know the Django framework in basic terms. Users will be asked to fill out an online questionnaire prepared using the HMSAM model to

measure the level of user acceptance of the application based on the level of application behavioral intention to use and immersion.

From the results of previous application testing, the questionnaire calculation results were obtained using a Likert scale in each aspect of HMSAM which can be seen in Table 3.

TABLE 3. EVALUATION OF TEST RESULTS

HMSAM Aspects	Result
Perceived Ease of Use	88,93%
Perceived Usefulness	87,39%
Curiosity	85,70%
Control	82,76%
Joy	82,19%
Behavioral Intention to Use	84,15%
Immersion	81,44%

Table 3 it can be seen that the highest calculation result is perceived ease of use, namely 88.93%. These results were obtained because users felt that the Djangoing application was easy to use. Apart from that, the immersion aspect has the lowest calculation at 81.44%. These results were obtained because users felt that the Djangoing application did not give them a feeling of being carried away when learning the Django framework. In the results of calculating all aspects of the HMSAM, the final average percentage was obtained at 84.15% which fell into the Strongly Agree (SS) category.

V. CONSLUSION

Based on the results of research that has been carried out, the Django framework learning application using the gamification method and Fisher-Yates Shuffle has been successfully implemented in the form of a website-based application that has been successfully designed and built. The Djangoing application is used using the NextJS framework, React library, Javascript programming language, and Chakra UI. The game techniques in the Octalysis Framework that have been successfully implemented are Easter eggs, leaderboard, milestone unlock, virtual goods, friending, prize pacing, free lunch and progress loss.

The Djangoing application has been tested by 30 users by filling out a questionnaire prepared using the HMSAM model. The evaluation results of the Djangoing application testing were calculated using a Likert scale with results obtained in the behavioral intention to use aspect of 84.15%, which means that users strongly agree that the Djangoing application creates a desire to use it again in the future, apart from that the results in the immersion aspect were 81 .44% which means users agree that the djangoing application creates a feeling of being carried away when learning the django framework

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