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Need Analysis of Gamification-Based E-Learning Development with ADDIE Method for Student Learning Using Moodle Platform

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Abstract

A significant challenge in e-learning is maintaining student motivation and engagement in the learning process. Gamification has been proven effective in increasing student motivation by adding game elements into the learning experience. This research aims to analyze the need for gamification-based e-learning development for student learning using the ADDIE (Analysis, Design, Development, Implementation and Evaluation) method on the Moodle platform. Moodle was chosen because it supports various gamification plugins, such as Level Up XP, Block Game, Ludic, Quizventure, Game, and Badge Ladder. Through a comprehensive needs analysis, this research produces an appropriate design to improve learning engagement and effectiveness. The results of this research are expected to guide the development of gamification-based e-learning that is optimal for student learning.

Keywords: E-learning; Gamification; ADDIE method; Moodle; Student learning; Gamification plugin

Abstrak

Tantangan utama dalam e-learning adalah mempertahankan motivasi dan keterlibatan mahasiswa dalam proses pembelajaran. Gamifikasi telah terbukti menadi pendekatan yang efektif dalam meningkatkan motivasi mahasiswa dengan menambahkan elemen permainan ke dalam pengalaman belajar. Penelitian ini bertujuan untuk menganalisis kebutuhan pengembangan e-learning berbasis gamifikasi untuk pembelajaran mahasiswa menggunakan metode ADDIE (Analysis, Design, Development, Implementation dan Evaluation) pada platform Moodle. Moodle dipillih karena mendukung berbagai plugin gamifikasi, seperti Level Up XP, Block Game, Ludic, Quizventure, Game dan Badge Ladder. Melalui analisis kebutuhan yang komprehensif, penelitian ini menghasilkan desain yang tepat untuk meningkatkan keterlibatan dan efektivitas pembelajran. Hasil penelitian ini diharapkan memberikan panduan bagi pengembangan e-learning berbasis gamifikasi yang optimal untuk pembelajaran mahasiswa.

***Kata-kata kunci**: E-learning; Gamifikasi; Metode ADDIE; Moodle; Pembelajaran mahasiswa; Plugin gamifikasi*

1. Introduction

The increasing use of e-learning in higher education settings has significantly impacted the accessibility of learning. However, student motivation and engagement in e-learning is often lower than in traditional learning methods. Many students feel less motivated in online learning environments than traditional face-to-face learning methods [1].

One way to increase student motivation and engagement in e-learning is to implement gamification. Gamification is the use of game elements, such as points, levels, and challenges, in a non-game context to increase student motivation, engagement, and experience in achieving certain goals, including learning. Gamification increases student engagement by presenting entertaining and competitive elements [2]. With gamification elements, the learning experience can be more interactive and interesting, thus encouraging students to be more active in the learning process.

As a flexible and open-source e-learning platform, Moodle provides various gamification plugins that enable a more interactive learning experience [3]. Moodle allows developers to integrate game elements that can improve interaction between students and the learning process. Some gamification plugins available in Moodle include Level Up XP, Block Game, Ludic, Quizventure, Game and Badge Ladder, which allow for achievement mechanisms, point systems and challenges that make learning more engaging.

A structured approach is needed to develop gamification-based e-learning that meets students' needs. This research uses the ADDIE method to design and develop such e-learning. ADDIE consists of five structured stages: Analysis, Design, Development, Implementation, and Evaluation, which sequentially help developers produce effective learning products [4].

This research aims to conduct a needs analysis in developing gamification-based e-learning with the ADDIE method using the Moodle platform. With this structured approach, the gamification-based e-learning system developed is expected to increase

student motivation and involvement in the learning process, thus achieving more optimal learning outcomes [5].

2. Method

This research uses a development approach by applying the ADDIE model as a framework to develop gamification-based e-learning on the Moodle platform. In Figure 1, the ADDIE model consists of five main stages: Analysis, Design, Development, Implementation, and Evaluation, which are applied systematically to ensure e-learning development is in line with student needs [6]. Through the application of the ADDIE model, the development of gamification-based e-learning is expected to meet students' learning needs and increase engagement motivation in the learning process.

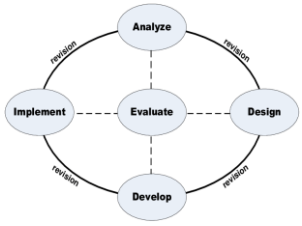

Figure 1. ADDIE Method

2.1 Analysis

The analysis stage is a very important first step in the ADDIE model, where the main focus is identifying student needs and preferences in gamification-based e-learning. At this stage, surveys and interviews were conducted to identify students' needs and preferences for the desired gamification elements in e-learning. Elements such as points, challenges and badges are proven effective in increasing student engagement in online learning. Gamification elements such as points and badges increase users' intrinsic motivation in e-learning systems [7]. The results of this analysis become the basis for designing more effective gamification features to be implemented in the Moodle platform.

2.2 Design

The design stage in the ADDIE method aims to develop concepts and implementation strategies for gamification elements based on the results of the analysis that has been carried out. At this stage, a gamification element scheme uses plugins such

as Level Up XP - Gamification, Block Game, Ludic, Level Up XP Availability, Quizventure, Game, and Badge Ladder. The gamification element design is implemented on the Moodle platform to increase student interaction and engagement in the learning process [8]. The design will map a learning journey that can motivate students to reach higher levels as their learning material progresses.

2.3 Development

The development phase is where the prototype of gamification-based e-learning system is built on Moodle platform. Various pre-designed plugins are installed and configured to enhance the learning experience. The use of gamification elements such as the Badge Ladder system and rewards, which have been proven effective in improving student motivation and learning outcomes, were implemented in the system [9]. This development process involved several iterations to test the system's functionality and fix bugs, to ensure that the system runs smoothly and provides an optimal learning experience.

2.4 Implementation

After the development stage, the gamification-based e-learning prototype is implemented to a group of students as a trial stage. Implementation is done on a limited basis to validate the system's effectiveness in increasing student engagement and motivation to learn. Testing at the implementation stage is important to ensure the gamification system meets the objectives of increasing user engagement and motivation [2]. In addition, feedback from students is also collected to evaluate the gamification features that are most effective and preferred by them.

2.5 Evaluation

The evaluation stage is conducted through analyzing the data collected during the implementation stage. This assessment uses survey methods or statistical analysis to determine how much gamification elements have successfully increased student motivation and engagement in the learning process. Evaluation is conducted to measure the success of gamification implementation in e-learning and its effectiveness in increasing student engagement. One important aspect of evaluation is user interaction

analysis, which can provide insight into how gamification elements affect student behavior and participation in learning [10]. In addition, an evaluation of the gamification-based e-learning system using the Heuristic Evaluation (HE) method was also conducted.

3. Results and Discussion

Using gamification elements such as points, levels, and badges in e-learning has proven effective in increasing student motivation and engagement [11]. Leveling systems encourage students to continue participating and reach higher levels as a form of appreciation for their achievements. In addition, game features such as Quizventure and Games help reduce boredom by creating a more interactive and competitive learning experience. Positive responses to rewards such as badges strengthen students' intrinsic motivation, contributing to improved learning outcomes. Overall, gamification in e-learning can create a more engaging learning environment and significantly increase student engagement [12].

3.1 Analysis Stage

The analysis stage begins with the identification of a thorough need to determine the requirements and objectives of gamification-based e-learning [13]. This involves user identification, student learning preferences, motivation, and interest in gamification. Based on the analysis results, some required gamification features were formulated, as presented in **Table 1**.

Table 1. The results of the Gamification-Based E-Learning Needs Analysis

Features	Sub-features	Needs and Implementation	Implementation Type	Plugins Used
Social	Social Utility	Online chat	Function	Chat
	Leaderboard	Leaderboard, badges	Function	Badge Ladder
	Support Network	Forum, wall	Function	Forum, Wall
Reward	General Reward	XP, HP	Function	Level Up XP
	Meta-game Reward	GP, status indicator	Function	Level Up XP
	Intermittent Reward	Enhanced experience of fun and excitement	Function	Ludic
Punishment	Punishment	Deduction of points after certain events	Rules	Badge Ladder
	Negative reward	Use of points owned after experiencing punishment	Rules	Badge Ladder
	Event duration	Duration assignment for activities	Rules	Badge Ladder
Game-based Learning	Quiz Game	Game-based quiz	Function	Quizventure, Game
	Level Progression	Student level up based on XP	Function	Block Game

3.2 Design Stage

The design stage in the development of gamification-based e-learning focuses on meeting student needs. Therefore, some plugin usage is expected to fulfill those needs. Based on the analysis, the system feature needs are divided into several categories, namely social, reward, punishment, and game-based learning.

Some plugins are used to fulfill the needs of social features. Social features are divided into three sub-features with different functions. The Social Utility sub-feature is designed to provide online chat to communicate between students. The implementation of this sub-feature is done by using the Chat plugin, as shown in **Figure 2**. The Leaderboard sub-feature aims to provide rankings and badges to show student achievement which is implemented through the Badge Ladder plugin in **Figure 3**. The Support Network sub-feature is used to encourage interaction between students in the form of a forum or wall, to support this sub-feature, a forum or wall plugin is used as shown in **Figure 4**.

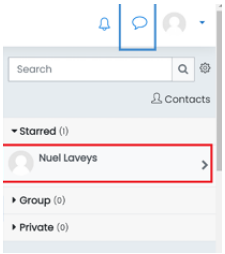

Figure 2. Chat

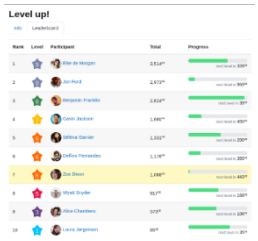

Figure 3. Badge Ladder

Figure 4. Forum

The second need in this e-learning system is the reward feature, which consists of several sub-features: General Reward, Meta-Game Reward, and Intermittent Reward. The General Reward sub-feature awards XP (experience points) and HP (health points) to students as a form of appreciation for completing certain tasks. The implementation of this sub-feature uses the Level Up XP plugin, as shown in **Figure 5.** Furthermore, the Meta-Game Reward sub-feature rewards GP (gold points) and status indicators to show students' progress in learning. This sub-feature is implemented similarly to the General Reward sub-feature using the Level Up XP plugin. The last sub-feature is Intermittent Reward, where this sub-feature focuses on interesting experiences that students feel

while using e-learning. Using the Ludic plugin as an implementation medium, shown in **Figure 6**.

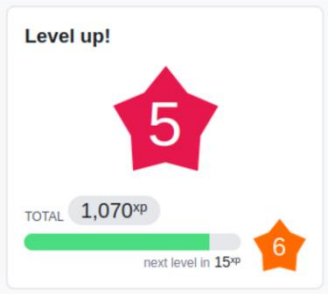

Figure 5. Level UP XP

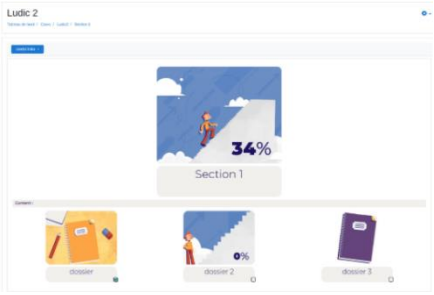

Figure 6. Ludic

The third need is the punishment feature, ensuring students stay on the right learning pattern by applying certain sanctions. The punishment feature is divided into several main sub-features: Punishment, Negative Reward, and Event Duration. The Punishment sub-feature reduces the points that students have earned after doing activities that violate the rules. The Negative Reward sub-feature is used to regulate the use of points owned by students as a consequence of certain violations. The Event Duration sub-feature will determine the duration of certain activities to provide healthy time limits and set the task completion duration. All sub-features in the punishment feature are implemented using the Badge Ladder plugin as shown in Figure 3.

As part of the gamification-based e-learning system development, the Game-based Learning feature must be an important component to increase student engagement through game-based learning. This feature must have two sub-features: Quiz Game and Level Progression. The Quiz Game sub-feature is designed to provide an interactive quiz experience packaged in a game concept. Using the game plugin in Figure 7, students are invited to complete a game-based quiz combining education with entertainment to increase student motivation **[14]**. The Level Progression sub-feature shows students the level obtained based on XP. The implementation of this sub-feature uses the Block Game plugin in **Figure 8**, which supports the progressivity of learning and student performance.

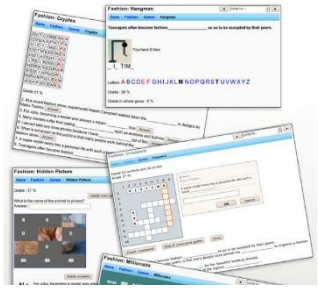

Figure 7. Game

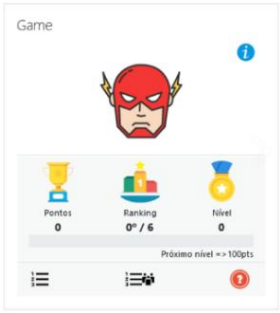

Figure 8. Block Game

3.3 Development and Implementation Stage

The development stage continues the design stage, where several previously designed plugins are installed on the e-learning page. At this stage, gamification components such as points, badges, games, leaderboards, and other interactive elements are added to create an interesting gamification experience that can increase student motivation and interest in e-learning [15].

Figure 9 shows a page that provides structured learning materials for students. Students can easily access the materials. Moreover, a student learning progress display can increase students' desire to access learning with the Ludic plugin. In addition, using the Block Game plugin can make it easier for students to track their points and rank in a particular course.

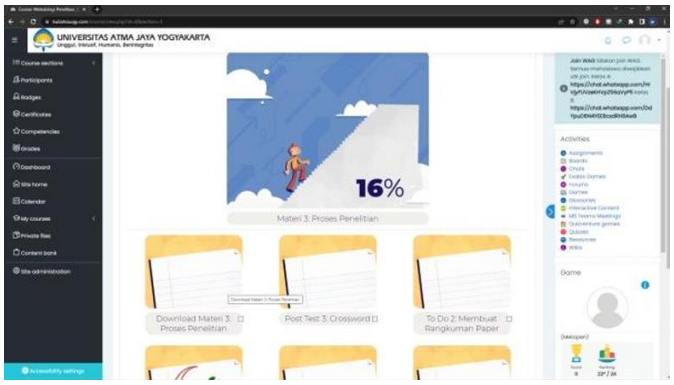

Figure 9. Display the E-Learning Page Using a Combination of Ludic and Block Game Plugins

The page contains the ranking of all students in a course using the Badge Ladder plugin, as shown in Figure 10. Each student's points are different. More active students will get the top rank, according to the rewards obtained through e-learning.

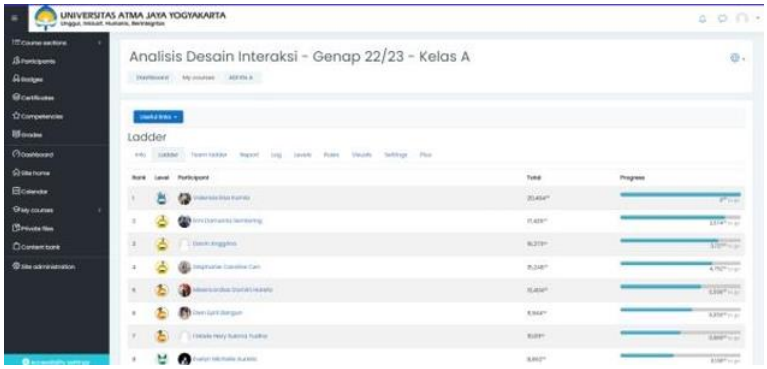

Figure 10. Display the E-Learning Page Using Badge Ladder plugin

The use of game plugins in e-learning increases the variety of student learning. One example is in Figure 11, a cryptex game-based quiz is presented. With the variety of quizzes like this, students are expected to not feel bored doing it and will be more provoked and motivated in learning through e-learning.

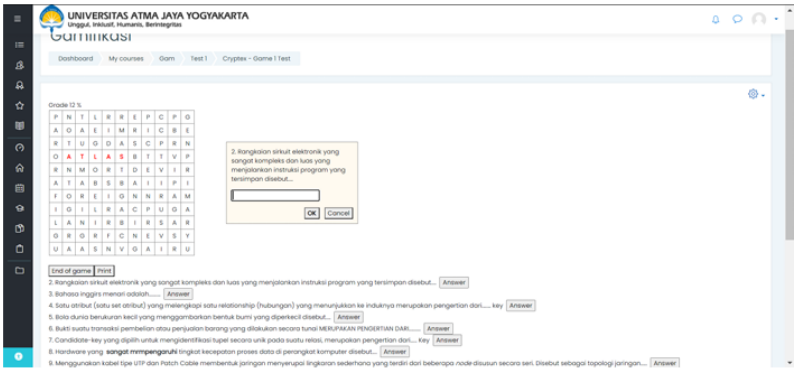

Figure 11. Display the E-Learning Page Using Game Plugin – Cryptex

After the development stage is complete, this gamification-based e-learning system is implemented directly to students in a real learning environment. The implementation is used in the Analisis dan Desain Interaksi course in 1 semester with 120 students from the Department of Information Systems Atma Jaya University Yogyakarta and 1 lecturer who actively uses e-learning. Students used it to evaluate the effectiveness of features such as Reward, Punishment, and Game-based Learning. In addition, the interaction that occurs through social features is expected to create a positive competitive learning atmosphere. The results of this implementation are also the basis for evaluation.

3.4 Evaluation Stage

Based on the evaluation results at the end of the semester of the Analisis dan Desain Interaksi course, most students (85%) gave feedback that gamification increased their

interest in using e-learning. In addition, lecturers observed increased student participation in discussions and the learning process. This can be seen from students' high achievement points (XP) during gamification-based e-learning. This research shows that e-learning with gamification plugins can increase student engagement and motivation [16].

In addition, an evaluation of the gamification-based e-learning system using the Heuristic Evaluation (HE) method was also conducted. HE involves expert evaluators who will assess the e-learning. The evaluation uses Nielsen's heuristic interactive design principles. This method identifies usability problems by having experts perform certain tasks while researchers observe and analyze their findings [17]. The evaluators are 3 lecturers from the Informatics Department of Atma Jaya University Yogyakarta.

Table 2 presents the recapitulated severity rating values collected during the Heuristic Evaluation process.

Table 2. Recapitulation of Severity Rating Value

No	Prinsip Heuristic Evaluation	SR 1	SR 2	SR 3	SR 4	Total	Nilai SR
1	Visibility of System Status	1	5	0	0	6	2,2
2	Match Beetween and the Real World	1	2	1	0	4	1,6
3	User Control and Freedom	1	3	1	0	7	3
4	Cosistency and Standard	1	2	0	0	3	1,25
5	Error prevention	0	0	0	0	0	0
6	Recognition Rather Than Recall	1	2	0	0	3	1
7	Flexibility and Efficiency of Use	1	1	0	0	2	1,5
8	Aesthetic and Minimalist Design	1	1	1	0	3	1,5
9	Help Users Recognize, Diagnoze and Recovers from Error	1	1	0	0	2	0,6
10	Help and Documentation	1	8	2	0	11	3,83
			Rata-rata				1,648 = 2

Based on the final results of the severity rating value recapitulation in Table 2, it can be seen that the average severity value is 1.648, which if rounded to 2 [18]. The 2 scale

shows that this gamification-based e-learning system is included in the minor usability problem category **[19]**. In this category, the usability problems found are relatively small. Each problem that arises contributes to the student experience, but does not directly cause failure in completing tasks. Nevertheless, improvements are still needed because they can affect the effectiveness, efficiency, and level of student satisfaction. These improvements can be given a low priority.

Based on the comparison between the frequency of problem findings and severity rating for each heuristic principle, the analysis shows that heuristic principle H3 (User Control and Freedom) has a severity rating of 3, which is categorized as a major usability problem [20]. In addition, heuristic principle H10 (Help and Documentation) also has a severity rating value of 3.83 (rounded to 4). It is classified as a usability catastrophe, meaning improvements must be made immediately before launching the product. One solution that can be done is to make a manual book to make it easier for users to use gamification-based e-learning.

4. Conclusion

This research shows that the development of gamification-based e-learning using the Moodle platform can increase student engagement and motivation in the learning process. Using the ADDIE method, each stage of development is structured and by user needs. Gamification plugins such as Level Up XP - Gamification, Block Game, Ludic, Level Up XP Availability, Quizventure, Game, and Badge Ladder increase student interest and participation. The results of this study support the development of gamification-based e-learning for higher education, with the hope that the integration of gamification will create a more dynamic and interactive learning environment.

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