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IMPROVING USABILITY THROUGH A GAMIFICATION-BASED E-LEARNING SYSTEM WITH MDA FRAMEWORK

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ABSTRACT

This research aims to develop a gamified e-learning platform of PT. Adhi Karya, a construction engineering company in Indonesia, using the mechanics, dynamics, and aesthetics (MDA) framework. The effect of gamification on the e-learning system was examined using a questionnaire that measured usability, which consisted of efficiency, errors, learnability, memorability, and satisfaction. Purposive sampling technique was employed to recruit the participants, and validity and reliability tests were conducted before the questionnaire was distributed to the participants. Our results show the successful implementation of gamification into PT Adhi Karya's e-learning system, where the majority of the respondents considered that the system had good usability, demonstrating the suitability of the framework for gamification-based e-learning system.

Keywords: *E-Learning System, Gamification, MDA Framework, Usability*

1. INTRODUCTION

The e-learning system is a learning system that utilises information and communication technology (ICT) to support the teaching and learning process. The e-learning system has various advantages, such as being accessible anytime and anywhere and providing users with a more interactive and interesting learning experience. E-learning is currently attracting the attention of many stakeholders, such as academics, professionals, companies, and industry. This learning system utilises electronic media (audio and/or visual) via the Internet [1]. E-learning combines processes, materials, and infrastructure using computers and networks to significantly improve the quality of learning, including aspects of management and distribution of learning materials [2].

However, e-learning systems also have several challenges, one of which is usability problems. Usability in the context of a website is usability that can be tested by evaluating the extent of the website's usefulness for users by paying attention to effectiveness, convenience, satisfaction, and efficiency. Daumas and Redish (1999) stated that usability is used to measure the level of user experience when interacting with system products, such as mobile phones, websites, and software. In broader perspective, usability refers to how users can study and use a product to achieve their objectives and how satisfied they are with its use [3]. Based on ISO 9241-11, usability has three important measurements, namely effective, efficient and satisfactory. In other words, usability is the level of ease, efficiency, and user satisfaction in using a system. Poor usability can cause users to have difficulty using the e-learning system, which can reduce user satisfaction. Factors that can influence the usability of e-learning systems are game-based learning or gamification design.

Gamification is the process of using game mechanisms or rules in non-game activities with the goal of increasing user interactivity [4]. Octafiani et al. [5] stated that gamification is the use of game design techniques, game mechanics, and game thinking to improve non-game contexts. Gamification works by creating more engaging technology, encouraging users to engage in desired behaviours, helping solve problems, and exploiting humans' psychological tendencies to engage in games. This technique can encourage a person to perform work that is usually boring and make it more enjoyable. Thus, the use of game elements in learning motivates users in the learning process and maximises feelings of enjoyment and involvement in

the learning process [6]. Apart from that, this media can be used to capture aspects that interest users and inspire them to continue learning [7]. Unfortunately, not all gamification can improve the usability of e-learning systems. Gamification that is not well designed can make e-learning systems more complicated and difficult to use. Therefore, an appropriate framework is needed to design gamification in e-learning systems.

The mechanics, dynamics, and aesthetics (MDA) framework is a framework that can be used to design gamification in e-learning system. It is one of several types of gamification method frameworks that have been widely applied to particularly e-learning systems. As the name implies, MDA has three main components, *i.e.*, mechanics, dynamics, and aesthetics [8]. Mechanics refers to the rules that govern how gamification works, while dynamics refers to how gamification influences user behaviour. Aesthetics is how gamification is perceived by users [9]. The MDA framework can help gamification designers to create gamification that suits user needs and can increase the usability of e-learning systems. The MDA framework is also crucial for e-learning system developers in establishing a more user-friendly system since it provides a model that can be utilised to describe e-learning systems conceptually and independently for a particular platform. This benefit allows e-learning system developers to focus on user-friendly system design without having to worry about the technical implementation details [10].

Based on the Corporate E-Learning – Global Market Outlook (2017-2026) report, e-learning has been adopted by 90 companies in the world as a training tool [11]. Zapier reported a 67% increase in productivity after implementing gamification in their internal training system [12]. This adoption of e-learning occurs because e-learning provide many advantages, such as wide geographical coverage, comfort and ease in accessing information, cost-effectiveness, and efficiency as supporting technology [13].

E-learning has also been implemented by one of the leading construction companies in Indonesia, namely PT. Adhi Karya. The e-learning system owned by PT. Adhi Karya is called *Ilmu Adhi*. The system contains learning material consisting of several topics available as e-learning modules suitable for the needs of the human resources at PT. Adhi Karya. The modules in *Ilmu Adhi* consist of learning videos, learning PPTs, forums, quiz questions, and training history. However, the use of e-learning at PT. Adhi Karya has not been fully optimised as the e-learning is only utilised when the company carries out orientation of new human resources. Several employees who have used *Ilmu Adhi* complained that the way the e-learning works is too plain, so it does not attract the interest of the users. They also reported a lack of user engagement, further highlighting dissatisfaction of the e-learning users.

This research aimed to develop PT Adhi Karya's e-learning system based on gamification using the MDA framework in order to increase the usability. This research is expected to provide recommendations for e-learning system developers to establish e-learning systems that are more user-friendly and have an excellent user satisfaction rating..

2. LITERATURE REVIEW

2.1 Gamification In E-Learning System

A large body of evidence has shown the increased use of gamification in e-learning systems due to its ability to enhance the motivation, engagement, and experience of the users [14]; [15]; [16]. Gamification represents the utilisation of game mechanics, elements, and thinking in a non-game environment [15]. It has been widely applied in various domains in the past years [17] as a way to promote employee outcomes in terms of their responsibility and targets [18]. Furthermore, according to Gartner Group, by 2015, over 50% of companies would have gamified their innovation processes. This prediction was made as gamification offers clear objectives, quick feedback, and difficult tasks [19].

Gamification incentivises the users by incorporating game aspects and tactics such as leaderboards and instant feedback. These factors give users a sense of empowerment and participation in how they undergo the procedures and complete tasks. Further, Ding (2019) [20] explained that the gamification elements stimulate users to become more goal-oriented through repetitive learning, patience, teamwork, and health competition with others. The use of gamification can also enhance essential soft skills like cooperation, communication, and decision-making [21]. Understanding the basic ideas of games is vital when describing and using gamification as a strategy [22].

Gamification applies game elements, which are regular patterns used to design games. Each gamified design element has its own function, which can be applied to almost any working environment, from corporate to education environment. The elements that are suitable for e-learning include points, reward systems, badges, leaderboards,

progression, progress bars, quests, levels, avatars, and social elements.

Points have been used in education for many years. They are accumulated after the completion of a certain activity and are an absolute must in a gamified system. Points may also indicate progress on the course and are used to gain status or open some awards or contents [15].

The majority of gamified systems correlate rewards to trophies or badges, which are seen as achievements. Reward system itself is a system used to reward players who complete missions. Obtaining a badge or trophy is insufficient; the learners should also able to display their accomplishments. If the e-learning system employs achievements as rewards, it must have a profile page where badges or trophies can be acquired and made public. There are different reasons as to why people want to collect badges and prizes. Some people collect them as a powerful drive, while others enjoy surprises and the joy that comes with finding an unexpected reward. Rewards should be designed in an attractive, interesting, and useful way. Likewise, they should be made as a designer's creation, and at the same time, they should be made enjoyable and challenging to obtain in order for them to accomplish their goals [15].

Leaderboards are used as a means of encouraging learners who are competitive. Nevertheless, as nobody enjoys being at the bottom of the scoreboard, distinctive strategies can be employed. For example, we can design leaderboards for every task as well as an overall total leaderboard [23]. Another example is to employ a no disincentive leaderboard, which is usually used in social networks and suitable for less competitive environments. In a no disincentive leaderboard, the learner is always placed in the middle despite the points that the learner has, as there will always be a few others that score lower or higher. Then, to motivate the learner, the other learners will be placed at bottom or top relative to his position [24]

Progression displays player status while progress bar displays player performance. Progress bars are linked to levels and provide learners with a percentage-based reference. In gamified e-learning systems, progress tracking is an essential component, which gives learners immediate feedback on their progress and encourages them to keep going, especially as the course approaches to the end. Instead of just allowing learners to browse the materials, an e-learning system should allow them to finish the levels. Nonetheless, levels can be used to manage content access, and naturally, it should begin with easier contents to draw learners to study [23].

Level refers to a sector or segment of a game. However, in the e-learning system, lessons and topics are considered as levels. Levels must be logically constructed so that the learner can grasp them with ease. They ought to be extendable since we may decide to expand the materials later on [15]

Quests are tasks that need to be completed by learners. They are usually designed as a big problem in which the learners need to complete challenges, levels, and earn badges and points, as well as learn as much as they can in the given time [15]

The last two game elements that are typically used in a gamified of e-learning system is avatar and social elements. Avatar is a visual depiction of a player or alter ego, while social elements refer to relationships formed between players through the game [25]. In this study, some of these elements were employed as a gamification system built into an e-learning system.

2.2 MDA Framework

The MDA framework is a framework employed to analyse aspects of a game. This framework was initially developed by game designers Mark LeBlanc, Robert Zubek, and Robin Hunicke [8]. This framework is one of the most frequently used in developing games since it has more details on the game design processes, particularly in the pre-production and production stages [26]. It also enables game researchers to comprehend and bridge the gap between game development and design aspects. Mechanics, dynamics, and aesthetics are the three main components of the MDA framework (Figure 1). Mechanics relates to the primary function of a game that regulates the rules of the game. These mechanisms assist gamification designers in determining how to advance the action and entice players to engage with the game [27]. Game mechanics offer a variety of actions, control systems, and behaviors within a game, as well as promote game dynamics and give players thrill and enjoyment. [27] Some of the mechanics elements are points, levels, leaderboards, badges, quests, and storytelling. When a game is created, there will be interactions between players and the rules of the game, in which the dynamics component plays a vital role. Dynamics depicts how to regulate the reactions of players to the rules of the game and also between one player and another player. They are considered as “run-time behavior of the mechanics acting on player inputs and each other’s outputs over

time" [8]. The dynamic elements in a game include progression, creativity, productivity, and scarcity. Lastly, aesthetics relates to how the player feels when playing the game. It is part of the interaction results between mechanics and dynamics that can invoke emotions. It also depicts "Fun" concept in a distinct way, where it emphasises the vocabulary associated with "Fun". Examples of aesthetics elements are discovery, challenges, narrative, expression, submission, fellowship, sensation, and fantasy [27]

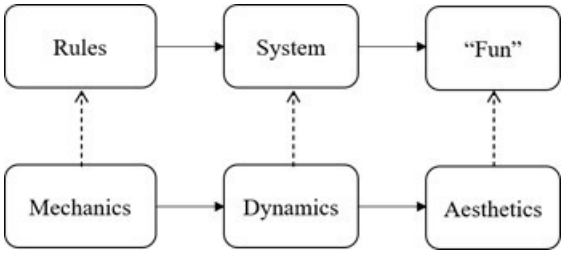

Figure 1. MDA Framework

2.3 Usability

Usability is defined as a quality attribute that explains or measures how easy it is to use an interface. Usability is one of the critical factors in developing an application [28]. In his modeling, Nielsen describes a scheme for the successful acceptance of a system by user, where the acceptance of the system is influenced by five factors, namely:

1) Learnability: measures the level of ease in performing simple tasks when first encountering a design. The indicators or criteria that show whether an application has met the learnability factor or are ease of understanding, looking for specific information, and identifying the navigational mechanism. Applications are considered easy to learn if the systems are able to present an interface that allows users to learn knowledge without extra effort in using the application as well as build knowledge about interaction patterns that have been learned through the use of the existing applications [29].

2) Efficiency: measures the speed of completing a specific task after studying the design. The indicators used to show that an application has met the efficiency factor are ease of reaching and navigating. Achieving efficiency indicators can be done by measuring the number of stages carried out in completing a task and the time spent in completing a given task [29].

3) Memorability: refers to how quickly users regain skills in using the design when they return after some time. The parameters that indicate whether an application has met the memorability factor are ease of remembering and reestablishing [29].

4) Few error detections: relates to observing how many errors users make, how severe the errors are, and how easy it is for them to find the solutions. The indicators of few error detections are the number of errors detected and ease of fixing [29]

5) User satisfaction: measures the level of satisfaction in using the design. The success of this factor can be reflected from two indicators, namely pleasant and comfort to use [29].

3. METHODOLOGY

Based on the explanation above, this research was conducted to address two research questions (RQs), namely:

RQ1: What are the results of the prototype design using the MDA framework in gamification-based e-learning at PT. Adhi Karya?

RQ2: How does the addition of gamification features to *ilmu Adhi* influence the user satisfaction?

This research was conducted using quantitative methods with a descriptive approach. The research was conducted at PT Adhi Karya, Jakarta, Indonesia. Data collection was carried out through literature studies, observations, interviews, and questionnaires. Literature studies were carried out through books, journals, and publications related to theory and previous research regarding gamification-based e-learning design using the MDA framework. Observations were carried out at PT. Adhi Karya to identify the process of how employees use the e-learning system. Meanwhile, interviews were conducted to obtain information and data needed to implement a gamification-based e-learning learning system. The interview in this research was done at PT Adhi Karya by interacting with the Human resource department, the person in charge of *Ilmu Adhi*, and those that are relevant in the study.

Next, conjoint analysis was applied to identify the attributes and preferences of PT Adhi Karya's e-learning users. After that, the gamification design was carried out using the MDA framework carried out by Putra and Yasin [29] as depicted in Figure 1. In the mechanics stage, points, leaderboards, and quizzes were added to support the point's activeness

of the users, display the rank based on the collected points, and provide challenges to the users, respectively. Further, the mechanics consisted of mechanics for admin and employees (learners). The admin's mechanics would manage the learning materials, challenges, reviews, rewards, and point redemptions. Meanwhile, learners' mechanics were devised to view learning materials, provide material reviews, complete challenges, exchange points, and view leaderboards. The dynamics explained the user interface and the flow from entering the e-learning system to obtaining the achievement. The dynamics of the gamification-based e-learning learning system were designed to help players gain the aesthetic element of discovery. Learners could seek factors that enable them to obtain rewards by exchanging points when they are using the e-learning system. Lastly, in the aesthetic stage, challenge and discovery were employed. There were eight points that could be gained by the learners when they played games in the system. In the challenge, the learners needed to play strategically in completing missions, allowing them to study the learning materials to get points. On the other hand, in the discovery, the learners would exchange the collected points with the available rewards.

Based on this framework, *Ilmu Adhi* users would obtain a badge and could create an Avatar if they have completed the questions' mission. Users would also earn progress notes, badges, prizes, and additional quests if they completed the quizzes. When answering the quizzes, users would also face challenges in the form of a time limit. When users have enrolled in a particular quiz, they would also have access to learning videos and PPTs on *Ilmu Adhi*. Users would be awarded points, badges, trophies, and employee benefits as a result of completing challenges, which would encourage the users to continue to explore *Ilmu Adhi*.

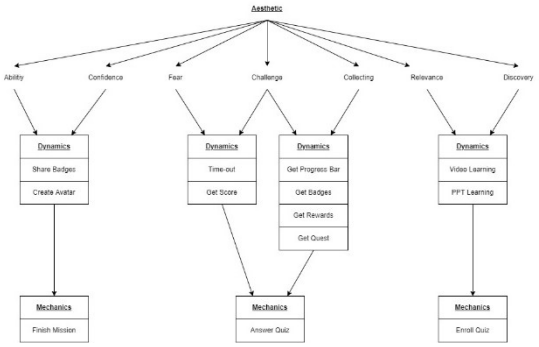

Figure 2. *Gamification design based on the MDA Framework*

User satisfaction with the gamified-based e-learning was also evaluated based on Nielsen's five usability criteria: learning ability, memory, efficiency, errors, and satisfaction. Evaluation was carried out by distributing questionnaires via WhatsApp using the Google Forms feature. The questionnaire consisted of 22 questions plus 1 optional suggestion for respondents to provide suggestions and inputs. The questionnaire employed a Likert scale with 1-5 points. The number of respondents in this study was calculated using Slovin's equation, which was 80 employees. Purposive sampling technique was used to ensure that the respondents met the criteria desired by researchers [30], *i.e.*, employees of PT Adhi Karya and have used *Ilmu Adhi*. The questionnaire has been tested for validity and reliability before being distributed to respondents.

Data analysis was carried out using SPSS V.26. To examine the validity and reliability of the questionnare, the validity test and reliability test were conducted. According to Sugiyono (2013), the validity test was considered valid if the sig r value was > 0.05 and invalid if the sig r value was < 0.05. If the Cronbach alpha (α) value was <0.60, then the questionnaire would be considered as unreliable. If the α value was between 0.61 – 0.81, then the questionnaire was reliable. Further, if the α value was between 0.81 – 1.0, the questionnaire was considered very reliable [31]. The data was also analysed using smart PLS to ensure that the measurement instrument measured what it was supposed to measure and produced consistent results [32].

3. Result and Discussion

3.1 The developed E-learning system operation

Gamification-based e-learning of PT. Adhi Karya was designed based on the MDA framework where input from the users were incorporated. To operate the application, the user must first open the ADHI Integrated Information System via https://sinta.adhi.co.id/ until the login display is displayed. Next, the user should enter his/her company email and password correctly.

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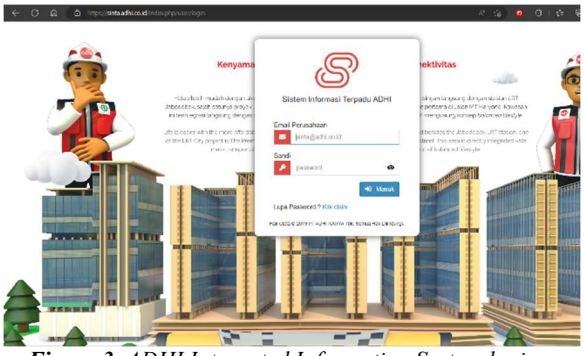

Figure 3. *ADHI Integrated Information System login display*

After that, the ADHI Integrated Information System would direct the user to a display shown in Figure 3. Users could select the SCIENCE menu in the application list (Figure 4), which would display the main menu of *Ilmu Adhi* (Figure 5).

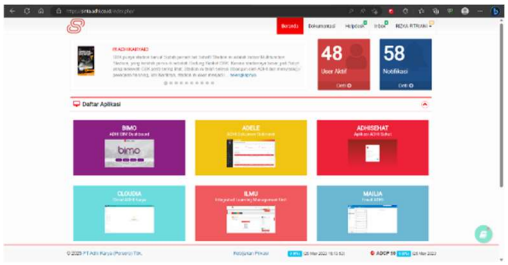

Figure 4. *Main display of ADHI Integrated Information System*

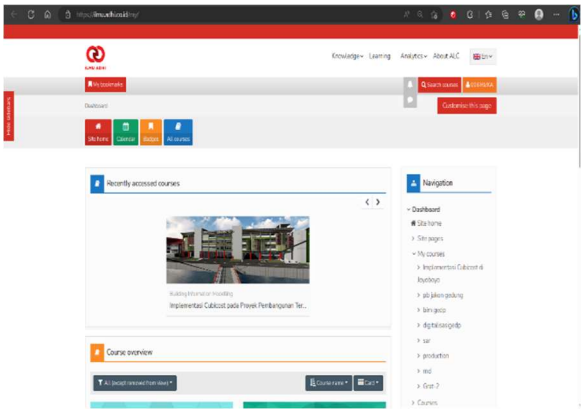

Figure 5. *Main menu of Ilmu Adhi*

In the navigation menu, user could select a course in which the sample course developed was "pb jakon Gedung" (Figure 6). Once the user entered the "pb jakon Gedung", pre-test, business manual (the learning material), and post-test menu would be displayed.

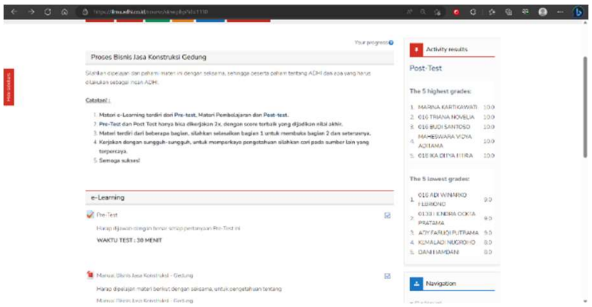

Figure 6. *Menu Course display of "pb jakon Gedung"*

In the pre-test section, the user would need to complete 10 questions before entering the Business Manual (Figure 7). After completing the pre-test, the user could learn from the material provided in the "Manual Bisnis" (Business Manual). The user would then be asked to complete post-test consisting of 10 questions after the user confirmed that he/she have completed the learning in the Business Manual. Comparison of the pre-test and post-test results can illustrate the progress of the user's level of understanding and learning as previously reported [33] [34]. In the post-test display, the user could select re-attempt quiz to redo the quiz. This feature provides continuous learning opportunities with feedback, enabling the users to improve their understanding of the materials [16]

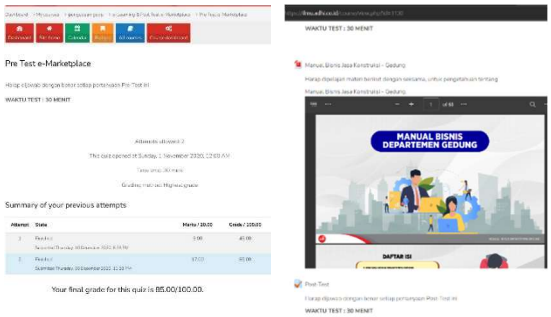

Figure 7. *Pre-test (left) and Manual Bisnis (right) displays*

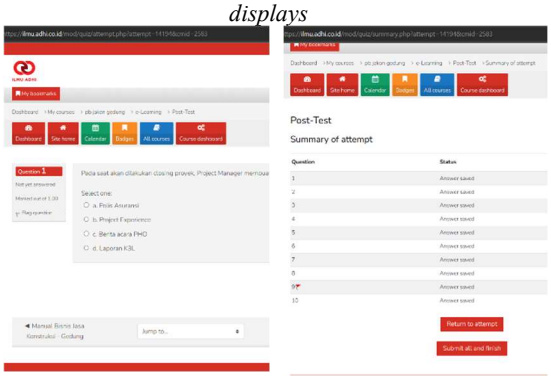

Figure 8. *Post-test question display (left) and its confirmation (right)*

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In the post-test section, the user would need to answer 10 questions, which were displayed individually (Figure 8). Users can mark a question by pressing the "Flag question" button. User could confirm the answers before submitting the response to the system (Figure 8). The user would return to the post-test menu, with the system adding the results of the previously completed quiz answers to the score table (Figure 9).

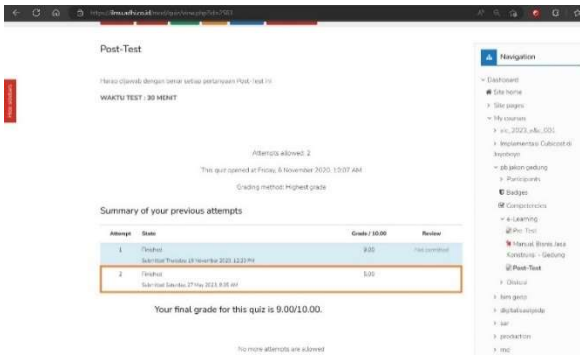

Figure 9. Post-test results

3.2 Gamification features

a. Mechanics

The mechanics used in the e-learning were finish mission and answer and enroll quiz. This gamification model was designed to direct users to know what they can do when accessing *Ilmu Adhi*. If the user completed the daily mission, the progress would be visible from the contents of the *Ilmu* progress bars (Figure 10).

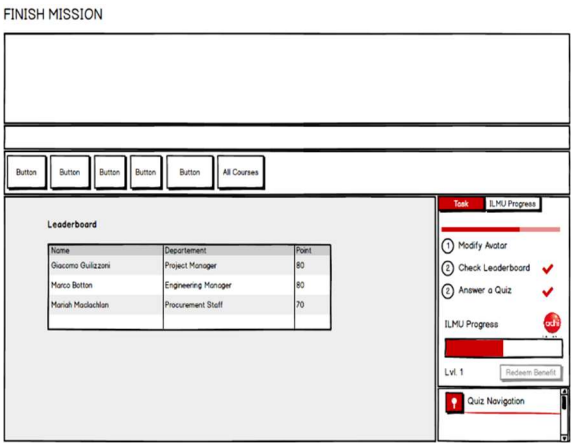

Figure 10. Finish mission display with progress bars

b. Dynamics

The dynamics elements included in the learning management system were completion, progression, constraints, competition, and continuation which were made in the form of share badges, create avatars, collect badges, and leaderboards (Figure 11). Quest, video, and PPT learnings were also included as the dynamics.

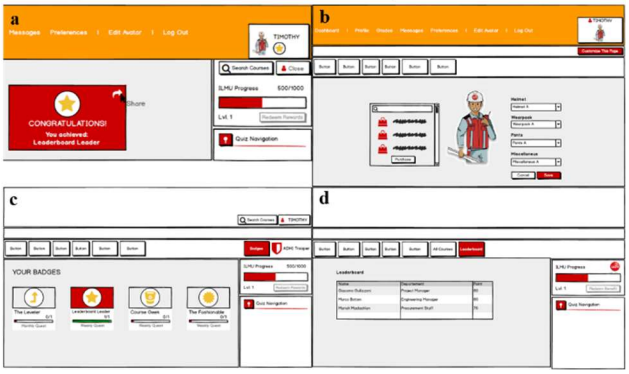

Figure 11. Dynamics elements of the e-learning. Share badge (a), create avatar (b), collect badges (c), and (d) leaderboard features are developed as part of the elements.

c. Aesthetics

The aesthetic elements, the emotions that arose from using the system, conveyed in this application consisted of abilities, confidence, fear, challenge, collecting, relevance, and discovery. These elements were depicted through features on the display that attracted users and entered the display created. The elements were formed due to the interaction between mechanics and dynamics, which were built into the e-learning.

Overall, the use of the MDA framework in this research allows for a structured approach to implementing gamification in e-learning systems, enabling e-learning that is developed to meet gamification implementation indicators measured by checking the availability of gamification elements, the quality of gamification elements, and the implementation of gamification elements. The MDA framework has been widely used in developing gamification in e-learning systems on various teaching materials in academic environments and in acquiring work skills. Previous research reported that the system developed resulted in increased learning, ease of using the system, increased interest in e-learning as well as increased motivation, engagement, and achievement [35]; [4]; [26]; [29]).

3.3 User satisfaction

Before disseminating the questionnaire, the questionnaire was first tested for its validity and reliability. A summary of the validity test results is presented on Table 1. Overall, the 22 questions showed validity as the calculated r value was all greater than the r table value with n = 80 (0.22). Meanwhile, the calculated α values using Cronbach's were all above 0.5, indicating its good reliability (Figure 12). These two parameters demonstrated that the questionnaire could be used as a data collection tool.

Table 1. Recapitulation of validity testing results

Questions	R value	R value table 5% (n = 80)	Sig.	Result
1	0.691	0.220	0.000	Valid
2	0.644	0.220	0.000	Valid
3	0.639	0.220	0.000	Valid
4	0.640	0.220	0.000	Valid
5	0.597	0.220	0.000	Valid
6	0.587	0.220	0.000	Valid
7	0.580	0.220	0.000	Valid
8	0.448	0.220	0.000	Valid
9	0.610	0.220	0.000	Valid
10	0.299	0.220	0.000	Valid
11	0.692	0.220	0.000	Valid
12	0.667	0.220	0.000	Valid
13	0.445	0.220	0.000	Valid
14	0.735	0.220	0.000	Valid
15	0.514	0.220	0.000	Valid
16	0.564	0.220	0.000	Valid
17	0.645	0.220	0.000	Valid
18	0.556	0.220	0.000	Valid
19	0.600	0.220	0.000	Valid
20	0.486	0.220	0.000	Valid
21	0.480	0.220	0.000	Valid
22	0.458	0.220	0.000	Valid

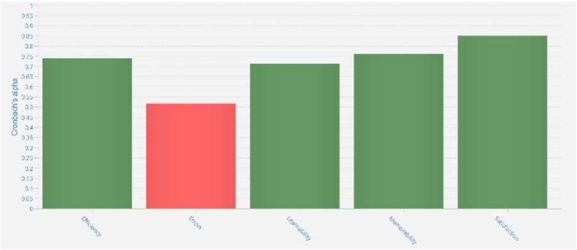

Figure 12. Cronbach's alpha value for each variable

PLS test was carried out to assess model testing as well as structural model testing. The outer loading values reflect how well an indicator able to explain a latent construct. The higher the outer loading value, the better the ability to explain the construct [36]. Table 2 presents the relationship magnitude between indicators and variables by observing their outer loading value.

Table 2. Outer loading result

Variable	Indicator	Outer Loading
Efficiency	EF1	0.844
	EF2	0.878
	EF3	0.803
Errors	ER1	0.432
	ER2	0.901
	ER3	0.902
Learnability	L1	0.902
	L2	0.439
	L3	0.562
	L4	0.888
Satisfaction	S1	0.942
	S2	0.668
	S3	0.776
	S4	0.055
	S5	0.898
	S6	0.435
	S7	0.475
Usability	US1	0.921
	US2	0.704

Next, the discriminant validity is reflected by the cross-loading value of the variable that must be greater than the correlation with other variables in the model, as presented in Table 3. All variables had a good discriminant validity, suggesting that these indicators can explain the variables well and these indicators do not measure other variables that are not correlated with these indicators.

Table 3. *Discriminant Validity Results*

Variable	*Efficiency*	*Errors*	*Learnability*	*Memorability*	*Satisfaction*	*Usability*
Efficiency						
Errors	*0.677*					
Learnability	*1.006*	*0.601*				
Memorability	*0.677*	*0.703*	*0.631*			
Satisfaction	*1.006*	*0.685*	*0.910*	*0.704*		
Usability	*1.106*	*0.682*	*0.764*	*0.629*	*1.086*	

The inner model was evaluated using R-square, where R-square measure how far a model can

explain the variation of dependant variables. The R-square and R-square adjusted values of satisfaction were 0.784 and 0.768, respectively. These values were larger than 0.75, demonstrating its strong model. The value reflected that variables efficiency, errors, learnability, memorability, and satisfaction affected Ilmu Adhi's user satisfaction with a combined percentage of 78.4%. This percentage indicates the need to identify other variables that influence e-learning user satisfaction in future studies. Further the R-square calculation for each variable is shown in Table 4. Efficiency had the highest impact on the user satisfaction, followed by learnability, errors, and memorability.

Table 4. R-Square Variables Calculation Result

Variable	Efficiency	Errors	Learnability	Memorability	Satisfaction
Efficiency					0.531
Errors					0.207
Learnability				0.351	
Memorability					0.124
Satisfaction					

There were 53.1% of the participants who agreed and strongly agreed that gamification improved e-learning's usability (efficiency, errors, learnability, memorability, and satisfaction; Table 5). Meanwhile, 34.71% of the participants neither disagreed nor agreed, and the remaining participants either disagreed and strongly disagreed that the e-learning gamification improved the usability. Increased usability of gamified e-learning has also been reported elsewhere. Specifically, gamification enhances learning, engagement, and motivation of its users as well as ease of use [35]; [4]; [26]; [29]. Unfortunately, almost one-third of the participants were neutral about the effect of gamification on e-learning's usability, and there was a number of participants that were not convinced with the gamification, suggesting more research should be conducted to effectively design and select the suitable gamification elements.

Table 5. Questionnaire result

Interval	*Category*	*Percentage (%)*
1.00 – 1.79	*Strongly disagree*	*1.24*
1.80 – 2.59	*Disagree*	*10.95*
2.60 – 3.39	*Neither disagree nor agree*	*34.71*
3.40 – 4.19	*Agree*	*42.56*
4.20 – 5.00	*Strongly agree*	*10.54*

Our results demonstrate the successful implementation of gamification into PT Adhi Karya's e-learning system through the MDA framework. The R-square value of the questionnaire has a combined percentage of 78.4% for efficiency, errors, learnability, memorability, and satisfaction, further validating that these variables primarily affect *Ilmu Adhi*'s usability. The majority of the respondents acknowledged that the gamification design using the MDA framework had good usability, showing the suitability of the framework for gamification-based e-learning systems. Furthermore, the results of the current study reinforce the effectiveness of gamification for increasing user satisfaction in e-learning systems, highlighting that gamification can indeed make the learning experience more interesting and enjoyable, thereby increasing user motivation and engagement

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