Designing Gamified Learning Management Systems for Higher Education

Natalia Limantara*, Meyliana, Ford Lumban Gaol, and Harjanto Prabowo

***Abstract*—Gamification is the application of game elements in non-gaming situations such as education. This technique can be used to improve student learning motivation, engagement, and performance. In practice, this technique is part of the Learning Management System (LMS) that is used during the learning process. Using the prior literature review and observation approach, this research integrates gamification framework, type of player, and six steps of gamification into a gamification model that can be applied in university-level learning. This gamification strategy is expected to boost student learning motivation, engagement, and performance.**

***Index Terms*—Gamification, learning, higher education, LMS.**

I. Introduction

Currently, lecturers are faced with big challenges in the learning process, namely the engagement and motivation of students to learn in the classroom. Lecturers are required to be able to continue to innovate in the way of teaching so that students stay focused on learning and can understand the material given well. How to make the learning atmosphere more fun is also a challenge for lecturers. The main goal is how to create a pleasant learning atmosphere, increase motivation to learn, and increase interaction in the classroom so that it can provide benefits to increased learning performance [1].

Lecturers use various tools to make the learning atmosphere more interactive, such as Kahoot!, Quizziz, Wooclap, and several other tools [2]. These tools can be categorized as a gamification technique. Gamification is the use of game elements in a non-gaming environment [3]. Previous research has indicated that the application of gamification increases engagement, motivation, interest, and accomplishment of learning performance [4]. Gamification can also help students learn more effectively. Lecturers play a critical role in the implementation of this gamification. Lecturers see this technique as beneficial because it helps motivate students by incorporating an element of fun into the game. But on the other hand, lecturers often feel that this concept cannot always be applied to all courses, and they feel that the lack of preparation time can be an obstacle to the implementation of gamification in learning [1]. Gamification produces a different reaction in students. There are students who are overjoyed because they won the game, but there are others who are disappointed with the results. As a result, lecturers' involvement and guidance are critical [5].

Gamification has been applied in several previous studies. The application of gamification in the Computer Information Systems course is carried out using two methods, namely chapter-based scenarios and scenario-based learning. In the first technique, gamification is applied based on the sub-sections of the course material with the aim of training students' understanding based on the textbook. While the second technique is applied by using role play. From the application of gamification, it was found that in chapter based scenarios, the use of points and grades affects student motivation, while in scenario based learning only points motivate students. Students also feel happy because they have the opportunity to choose which material, they want to learn first [6]. While the software testing course, gamification is applied in the form of quizzes and exercises. Lecturers will explain the lecture material first, then continue by giving quizzes and at the final stage students will be given exercises. The result of applying gamification in this course is that it is found that interest and perceived choice are higher than students who study in the traditional way. Students who learn to use the gamification technique also get higher post-test scores even though there is no difference in performance between the two groups of students [7].

Another preliminary research related to the use of gamification in higher education, it was found that leaderboard and points still dominate in the application of gamification followed by badges, levels, rewards, achievements, and quizzes [8]. This study will discuss how the model for learning can be adopted for the learning process especially in the learning management system. This model will consider the gamification framework [9], the type of player [10], and the six steps of gamification [11]. The research aims to provide new techniques for lecturers in carrying out the teaching process that can be more accepted by students.

II. Gamification

Gamification is the application of game aspects in non-gaming environments [12]. Gamification in education refers to the use of game elements in the learning environment. Gamification is used for psychological reasons associated with games, such as enhancing motivation, engagement, and individual performance [1]. Gamification is primarily concerned with the utilization of various element in

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game rather than the development of an entire computer game. Gamification has aesthetics and game dynamics, which are not used for entertainment purposes. There are two types of gamification, namely extrinsic gamification (the most widely used where game elements are added to it) and intrinsic gamification which uses more motivation (RAMP) and behavioral design to engage users.

Currently, extrinsic gamification is widely applied where this gamification system focuses on giving points, levels, leaderboards, achievements, or badges. However, the problem with this strategy is that once the incentive is removed, the behavior tends to stop unless the person finds another motivation to continue the action. To address this, the concept of intrinsic gamification evolved. Performing tasks for intrinsic reasons puts a person in a healthier mental state than performing tasks for extrinsic rewards. In intrinsic gamification, designers can create gamifications that help users to find their own reasons for engaging in certain behaviors. Competence, autonomy, and relatedness are the concepts underlying this gamification. Competent means that participants believe they have mastered; when participants believe there is nothing else to pursue, they will look for different ways to attain new competences. Autonomy is defined as the degree to which a person makes his or her own decisions regarding conduct and when the actions and behaviors that a person does are in accordance with their own sense of who they are [13].

III. Gamification Framework

There are several models of gamification implementation that have been used so far, such as the MDA (mechanic, dynamic, aesthetic) framework [14], [15], MDE (mechanic, dynamic, emotion) framework [9], and Sustainable Gamification Design (SGD) [16]. This study will use the MDE framework as the basic framework for developing a new gamification model. [9]. This framework is a modification of the MDA (Mechanics, Dynamics, and Aesthetic) framework [14]. Within the MDA framework, aesthetics refers to the expected emotional response when a player interacts with a game. Because this aesthetic is more suitable for certain computer games, [9], turning it into an "emotion" which is considered more suitable to describe the engagement results that can be achieved from a gamified environment. The goals, rules, settings, context, types of interactions, and boundaries of the situation to be gamified are the mechanics. Rule mechanics, setup mechanics, and progression mechanisms are the three categories of mechanics. The notion or objective of the gamified experience to be sought is formed by the rule mechanics, which dictate what may be done and its constraints. The experience environment is shaped by setup mechanics (settings, what objects are required, and how objects are distributed). The setup mechanics dictate who players play with: are the opponents known or unknown, internal or external, solo or group? The different types of instruments that designers attach to modify the experience as it occurs are referred to as progression mechanics.

Dynamic is the type of player behavior that appears when the player takes part in the experience. The resulting dynamics depend on how the participant follows the mechanics and the results are difficult to predict. Examples of dynamics are bluffing, abetting, boasting, cooperation, competition, coopetition. Emotions are the mental affective states and emotions that individual players experience as they participate. Emotions emerge from how players obey mechanics and then produce dynamics [17].

IV. Gamification Player's Type

The main idea behind gamification is that it is not a method that is suitable for all participants. This method will be more effective if it can assist users in reaching their goals, is used to learn specific topics, and supports behavior and habit change. Gamification will be more effective if it can adapt to different types of users. Previous research has led to the classification of participants into the Hexad Framework. [10]. Self-Determination Theory (SDT) in particular provides the theoretical foundation for the Hexad Framework on the expression of intrinsic and extrinsic motivation.. Intrinsic motivation means that participants perform an action because they find the activity interesting and enjoyable. Extrinsic motivation means participants take action because there is something they will get [18].

The Hexad Framework proposes six types of participants that differ in the degree to which they can be motivated by intrinsic (eg, self-realized) or extrinsic (eg, reward) motivational factors. This framework uses four types of intrinsic motivation as the basis, namely relatedness, competence, autonomy and purpose. Relatedness means creating a sense of belonging and connectedness with the person, group, or culture who share the goal. Competence means adopting as an extrinsic goal as one's own which requires one to feel effective with respect to it. [10]. In the hexad framework, there are six types of participants, namely disruptor, free spirit, achiever, player, socializer, and philanthropist.

V. Six Steps of Gamification Design

Steps in designing a gamification were required. Werbach and Hunter's Six Steps Gamification is one of the steps that can be taken [11]. The Six Steps are:

Define Business Objective - The first stage is to determine the objectives to be achieved from the gamified system. We can make a list of possible goals that can be achieved, then make a ranking of these goals, review the list that has been made and delete the means, and determine how these goals can provide benefits or value to the organization.

1) Delineate Target Behaviour - Concentrate on what you want your players to do and how you will measure it. This desired behavior must be able to support the end goal that has been determined in the first stage, although the relationship may not be direct. Once there is a list of behaviors, make a measure of their success. This means that this behavior is converted into something that can be calculated.
2) Describe Your Players - There will be people who use the gamification system that has been created. Who are

they? What is their relationship with you? How does the relationship affect the other? What can motivate your players? Identify all possible motivations that could motivate your players. And also determine what can make your players' motivation down.

3) Devise Activity Cycle - The game always has a beginning and sometimes has an end, but along the way the game operates through a series of twists and turns. The most useful way to model actions in gamified systems is through activity cycles, a concept that has gained traction in describing social media services and social networks. There are two types of cycles to develop: engagement loops and progressin stair. Engagement loops explain, on a micro level, what your players do, why they do it, and what the system does in response. Progressin stair provides a macro perspective on the player journey.
4) Don't Forget the Fun - The final question to be answered is is this fun? Ask yourself the following questions: Are players willing to participate voluntarily? If there is no extrinsic reward, will they still want to play? If the answer is no, we have to think about what could make the system more enjoyable. Every player wants to have fun in a different way. So a good gamification system is one that provides fun with a broad perspective.
5) Deploy the Appropriate Tools - Gamification starts with selecting the appropriate mechanics and components and begins coding them into the system. To realize this gamification requires people from several different skills such as people who understand the purpose of the project, understand the target user and basic psychology, game designers, analytical experts, and programmers. Gamification does not always require technology, but it is very good if gamification is realized in an online system.

VI. Proposed Gamification Model

The design of the learning gamification model is divided into input, process, and output. This framework is designed based on [19]. This process is divided into three parts, namely Input, Process, and Output. In addition, the design of this gamification model also pays attention to Werbach and Hunter's Six Steps to Gamification [11].

The first step in designing gamification based on Werbach and Hunter's Six Steps to Gamification is Define business Objective, which is to determine the purpose of gamification. Because this gamification will be applied in the world of education, the main goal is the achievement of learning outcomes. Therefore, the first stage is the achievement of the learning outcomes to be achieved from the entire learning process. This is followed by the selection of topics that support the achievement of the selected learning outcomes.

The second step is DELINEATE the target behavior, which at this stage determines the behavior to be achieved from the use of this gamification. Based on the gamification success factors found, it is determined that student involvement, motivation, and perspective are the measure of success that will be used [20].

The third step is to describe your player, determine who will use gamification and what motivates them to use it. At this stage, the type of player based on the Hexad Framework will be used [10]. The Hexad Framework provides six sorts of users, which differ in their ability to be motivated by intrinsic (e.g., self-realized) or extrinsic (e.g., reward) motivational elements.

Devise the cycle is the fourth stage that will be carried out based on Werbach and Hunter's Six Steps to Gamification. In this stage, the flow of activities from gamification to be carried out is described. At this stage, Instructional Content will be designed based on the SPARC framework [21] and also using the MDE framework [9]. The SPARC Framework is one of the frameworks used to design content and game rules. This framework consists of five components, namely

- Sense - activities must make sense to students and be coherent with the learning process.
- Purpose - the activity should have a clear purpose from the point of view of the instructor. This goal must be in line with the learning objectives.
- Autonomy - activities should be optional and let, even encourage, students to make choices.
- Relatedness - each action must have a positive impact on other students or the material itself.
- Competency - the activity should ensure that the student will be able to master the chosen rules and tools.

The next step is to design the gamification that will be used based on the MDE framework. The mechanics used in this study are points, badges, leaderboard, collectible items, xp, levels, and progress bars. These elements were chosen because based on preliminary research, these elements are the most widely used elements in gamification for learning [20], [22]. While the selected dynamics are constraints (time limit), completion, continuation, and competition. When students use ArkaLearning, it is hoped that it will bring up from the emotional side, namely challenge, competition, and enjoyment.

The fifth stage is DON'T forget the fun, where it must be ensured that the gamification is fun to follow. This stage needs to be evaluated when gamification has been carried out and continuous improvements are made. The elements of the game used must also always be changed so that it always creates feelings of interest in students.

The last stage is DEPLOY the appropriate tools. At this stage, selected tools that can support the application of this learning gamification. In this study, gamification of learning was applied using the Moodle LMS (Learning Management System). Where learning materials and all game elements can be centralized in one application that is easily accessible by students and lecturers. The use of LMS allows communication between users and also better content management [23].

The final stage is that after students have completed all the learning activities carried out, an evaluation of the achievement of learning outcomes will be carried out, by doing a post test. The outputs that are expected to be achieved by students are the achievement of better learning outcomes, increased student motivation, increased student engagement, and also positive feedback from students regarding the use of these tools. This achievement can be measured by distributing questionnaires to students. Fig. 1 shows the gamification model for learning proposed in this study.

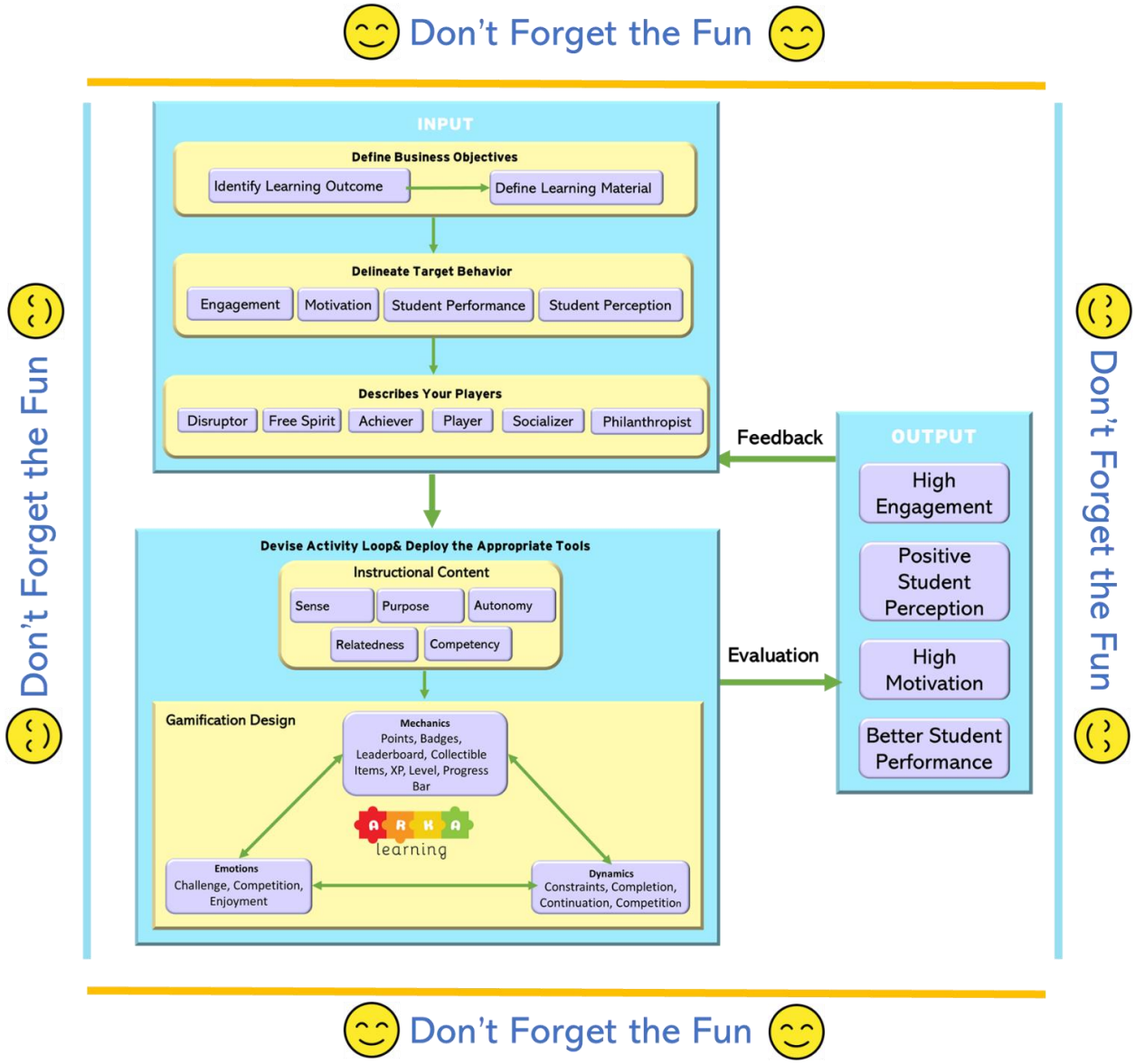


Fig. 1. Proposed gamification model.

VII. Proposed Gamified Learning Management System

ArkaLearning is built as a gamification tool that adopts a gamification model that has been designed by researchers. In ArkaLearning, students can learn certain materials and get rewards based on the activities they have done. The first stage is to determine the learning outcomes that will be targeted in learning using this gamification. In this research, This study uses the User Experience (UX) course as the research subject. This course will be studied by first year students majoring in Information Systems at universities in Indonesia. This course was chosen because working as a UX designer or UX researcher is one of today's most in-demand jobs. . In the United States, career in UX field is one of the top 50 jobs. In 2021, 405,000 new UX designers emerged from Google's UXD Certificate [24] and in 2020, interest in UX roles increased by 289%. There are 8,000 – 24,000 UX-related job openings worldwide and are expected to grow by 22% over the next decade as technology advances [25]. Under these conditions, students' interest in studying this field needs to be maintained or improved by providing new ways of learning.

Based on the Information Systems curriculum from ACM (The Join ACM/AIS IS 2020 Task Force, 2020), User Experience course has 5 (five) learning outcomes which can be seen in Table I. Based on this learning outcome, players will go through 5 levels of the game. The player's journey can be seen in Fig. 2. Lecturers in class will use ArkaLearning in the learning process by providing materials, quizzes and assignments through ArkaLearning. Each level will contain material related to certain learning outcomes. Assignment can be done individually or in groups. Every time, students complete the given quiz or assignment, they will get collectible items that can be used to advance to the next level.

TABLE I: User Experience Learning Outcomes

User Experience Learning Outcome
Apply principles of user-Centered design (UCD)
Apply user-system interaction principles
Design and create effective user-centered user interaction with an application
Identify and evaluate attributes of effective UX
Evaluate the influence user centered design has on user experience (UX)

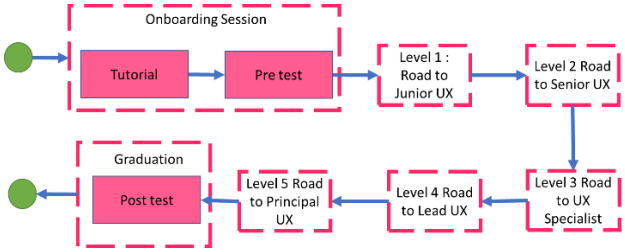


Fig. 2. Player's journey.

At each level, students will work on several activities such as accessing study materials, doing quizzes, and submit assignments. From each activity carried out, students will get collectible items and points which can be used to advance to the next level.. To make ArkaLearning simpler, there is only one collectible item that is used, namely Diamond. Students will get diamonds every time they successfully carry out an activity. To provide opportunities for students, opportunities are also given for students who get bad score or are late in submitting assignments to repeat the activity by reducing the collectible items that have been collected. Table II shows an illustration of the collectible items that can be collected at each level. To increase learning motivation, collectible items collected can be exchanged for certain rewards such as additional grades for assignments or exams.

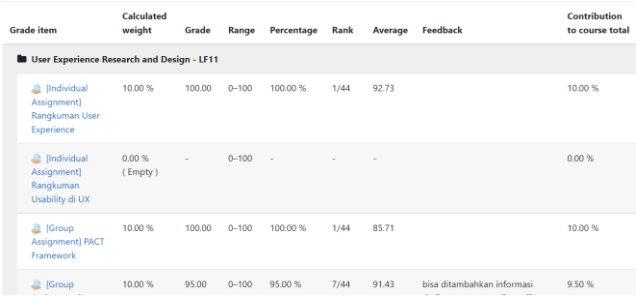
TABLE II: COLLECTIBLE ITEMS COLLECTION

	# of Collectible Items	#Items for next level
Onboarding	5	-
Level 1	4	5
Level 2	5	9
Level 3	13	14
Level 4	5	27
Level 5	3	32
Graduation	10	35
Optional Level	8	-
Total	**53**	-

In addition to collectible items, students will also get badges if they have successfully passed a level. These badges provide information about which level of the game the participant has successfully completed all the given activities. There are a total of 6 badges given in ArkaLearning, of which one badge each if you successfully pass a level and one additional badge if the student manages to collect five badges from each existing level (Fig. 3).

In ArkaLearning, participants have two types of leaderboards. The first leaderboard (Fig. 4) is based on the achievement of the value of the activities carried out by the participants. The second leaderboard (Fig. 5) is based on the experience points collected by each participant. Experience Points can be collected by participants if participants carry out an activity in ArkaLearning or in other terms, these Experience Points can describe student activity in using ArkaLearning. There are 6 levels that can be achieved by students, namely Freshman, Sophomore, Junior, Senior, Gradute, and Master. Display of Experience Points achievement can be seen in Fig. 6.

Fig. 3. Badges.



Grade item	Calculated weight	Grade	Range	Percentage	Rank	Average	Feedback	Contribution to course total
User Experience Research and Design - LF11								
[Individual Assignment] Rangkuman User Experience	10.00 %	100.00	0–100	100.00 %	1/44	92.73		10.00 %
[Individual Assignment] Rangkuman Usability di UX	0.00 % (Empty)	-	0–100	-	-	-		0.00 %
[Group Assignment] PACT Framework	10.00 %	100.00	0–100	100.00 %	1/44	85.71		10.00 %
[Group	10.00 %	95.00	0–100	95.00 %	7/44	91.43	bisa ditambahkan informasi	9.50 %

Fig. 4. First leadeboard.

Rank	Level	Participant	Total	Progress
1	6	LOUIS IGNATIUS	201xp	0xp to go
2	5	ROBERTUS ASIKIN	180xp	20xp to go
3	5	RYAN FEBRIAN	163xp	37xp to go

Fig. 5. Second leadeboard.

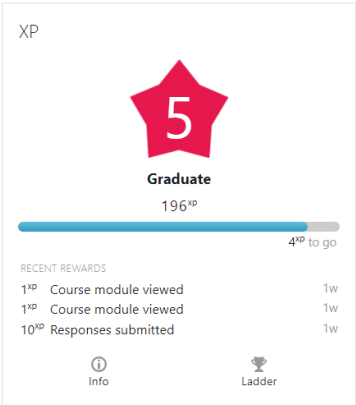


Fig. 6. Experience points achievement.

To make it easier for students to see the progress of work, students can see the progress of each activity through the Completion Progress (Fig. 7). The achievements of each activity can also be seen in this section. There are four colors in this completion progress, namely blue depicting activities that have not been carried out, green representing activities that have been completed and achieving the expected targets, red depicting activities that have been completed but failed to reach the target, and yellow depicts activities that are in progress.

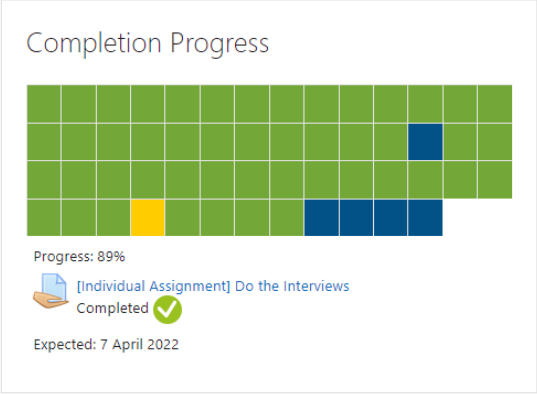


Fig. 7. Completion progress.

Fig. 8 describes the features that can be used by students in this ArkaLearning system. In general, participants in ArkaLearning can carry out several activities such as view dashboard, accessing learning materials, taking quizzes, collecting assignments, viewing progress, viewing XP scores, viewing scores and rankings, and viewing badges.

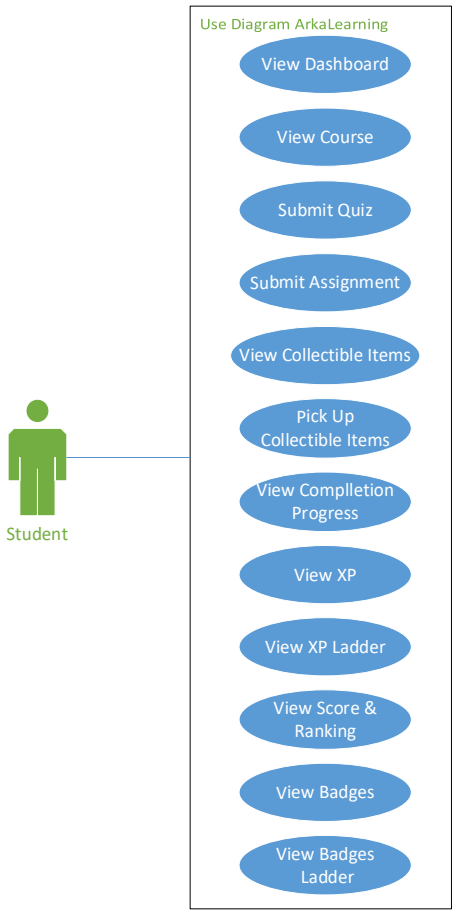


Fig. 8. ArkaLearning's use case diagram.

Dynamic is the type of player behavior that appears when the player takes part in the experience. The resulting dynamics depend on how the participant follows the mechanics and the results are difficult to predict. Examples of dynamics are constraints (time limit), completion, continuation, and competition. In ArkaLearning, dynamics are formed from rewards given to participants. Every time they complete an activity and reach a certain value, participants will get rewards in the form of items. If the participant fails to do a task, then the participant can work on additional tasks to get the required item.

To provide recognition for the understanding that has been achieved by students, students will get badges.. In addition to providing challenges for participants, each activity has a time limit and a maximum limit of experiments. With a feature where students can repeat the activity several times, ArkaLearning gives students the opportunity to learn and not be afraid to make mistakes.

Emotions are the mental affective states and emotions that individual players experience as they participate. Emotions emerge from how players obey mechanics and then produce dynamics. In ArkaLearning the emotion that is expected to emerge from the participants is a feeling of challenge because participants are asked to complete an activity to get a certain reward. In addition, participants can also see their ranking position among other participants which will create a feeling of competition. It is also hoped that participants will feel motivated to continue using ArkaLearning because they are curious about what the participants will find if they succeed in raising their game level. In addition, the story or narrative that is built in ArkaLearning makes participants feel that they are included in the story as one of the roles in the story that is built.

VIII. Conclusion

The learning gamification model proposed in this study uses the MDE Framework, HEXAD Framework, and Werbach and Hunter's Six Steps to gamification as a reference for the formation of the gamification model. The proposed learning gamification model is applied to learning management systems (LMS). The application of LMS was chosen because it will make it easier for lecturers and students to carry out the learning process and access all data related to gamification. By using LMS with gamification, it is hoped that students can be more motivated in learning process and there is an increase in engagement in the classroom. This research produces new learning methods that can increase student motivation so that it can increase the potential for successful student studies.

For further research, it will be continued by evaluating the gamified environment that has been proposed. The research will use experimental research by dividing students into control groups and experimental groups. Lecturers in the experimental group will use ArkaLearning in the learning process while lecturers in the control class will teach in the usual way. The results of this study aim to see whether ArkaLearning can have an impact on increasing learning performance, motivation, engagement, and provide a positive perspective when compared to the control group.

Conflict of Interest

The authors declare no conflict of interest.

Author Contributions

Natalia conducted data collection and article writing. Professor Meyliana, Dr. Ford, and Professor Harjanto give reviews and comments for the article. All authors had

approved the final version.

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