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# ADAPTIVE GAMIFICATION FRAMEWORK WITH PROPER PLAYER TYPE CLASSIFICATION AND EFFECTIVENESS EVALUATION

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Abstract. *Previous studies showed evidences that gamification can improve learners' motivation and enjoyment. Improvement of motivation and enjoyment could be influenced by player personality. As there is a variety of personalities, gamification application developers should consider including various gameplay to adapt with each personality type. There is a need for adaptive gamification framework. This paper intends to propose an adaptive gamification framework with proper player classification and effectiveness evaluation method. This paper focuses on introducing gamification framework by combining adaptive gameplay, dynamic difficulty adjustment, Big Five personality model, player performance, and evaluation method to measure player motivation and enjoyment to see the effectiveness of gamification applications such as IMMS and eGameFlow.*
**Keywords:** Gamification framework, Player classification, Dynamic difficulty adjustment, Adaptive gameplay, Effectiveness evaluation

1. **Introduction.** Motivation and enjoyment are important for a successful learning process, as they contribute to learner's good feeling while learning [1]. Some researches reported that by applying game elements in learning could improve learner motivation and enjoyment [2]. The technique to apply game elements into non-game activities is called gamification [3].

Despite its ability, gamification could bring boredom for some players because of lack of variation in contents and difficulties [4-8]. When the player is bored, motivation and enjoyment to learn will be reduced, and the learning process might be disrupted. To solve the problems, the gamification application could use adaptive gameplay based on player characteristics [4,5] and difficulty adjustment based on player performance [6-8].

Some researches have used both methods and made the adaptive gamification frameworks [9,10]. Despite its ability, no proof of its ability is to improve player motivation, enjoyment, and achievement. Those frameworks also classify its users using less-reliable player personality model as player characteristics. This could be a problem for gamification practitioners to give the player tasks to do and evaluate their abilities after finishing the tasks. Therefore, we propose an adaptive gamification framework with more proper personality model as player characteristics and effectiveness evaluation from each aspect of motivation, enjoyment, and achievement.

The subsequent sections will cover as follows. Literature review of theories related to our proposed framework is shown in the next section, followed by the explanation of our proposed framework and its effectiveness evaluation method, and it will be closed by the conclusion.

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## 2. Literature Review.

### 2.1. Gamification.

Gamification is the way to use game elements in non-game activities, either by digital or non-digital media [3]. Game components usually used in gamification are avatar, environment, storytelling, feedback, reputation, rank, level, economy, competition, collaboration, communication and deadline [11]. Gamification has some benefits such as creating interactivity in learning, sustaining learners' motivation in learning activity, giving learners time to think deeper and reflect their action faster, giving positive changes to learners, and simulating the environment related to learning material [12].

### 2.2. Player motivation.

Motivation is defined as a process which involves the biological, emotional, social, and cognitive ability of a person to start and guide its own attitude to achieve its own goal [13]. A person's motivation can be divided into four aspects, which are attention, relevance, confidence, and satisfaction [1]. Attention is related to the concern and curiosity in learning activity. Relevance is related to the understanding of the learning outcomes they will achieve. Confidence is related to the suitability of learning material and the difficulty of learning activity. Satisfaction is related to the expectation of a student's feeling when they can achieve intended learning outcomes.

### 2.3. Player enjoyment.

Enjoyment is defined as a positive feeling when a person does an activity and is eager to repeat it without any boredom or fear [14] because of the flow [15]. Flow will appear when a person's ability is matched with the faced challenge and it makes someone enjoy what they do [16]. Flow has several aspects, such as clear goals, immediate feedback, suitable challenge compared to one's ability, one's awareness blends with an environment, ignoring obstacles in an environment, loss of one's awareness of surrounding and time, and meaningful activity for the subject [15].

### 2.4. Adaptive gameplay.

Gameplay is defined as variants of player interaction with the game world in form of rules implementation to make challenges that can be solved by the player [16]. To reduce player's boredom while playing, a game should be able to adapt its gameplay model with the player [4]. Previous research had developed procedural quest generator to generate variation of quests based on Non Playable Character (NPC) types available in game [4]. Another research had used player type for quest generator in order to reduce the repetitiveness of quest taken [5]. Unfortunately, the procedural quest generator has not been tested properly to see its impact related to player motivation. Also, using previous gaming experience to decide the player type is improper because someone's reason to play a game can be affected by other people [17].

### 2.5. Dynamic difficulty adjustment.

Difficulty adjustment is an in-game feature that helps player to adjust the game's pace to match with the player's [16]. The latest model of difficulty adjustment is called dynamic difficulty adjustment [6]. By using dynamic difficulty adjustment in a game, a player's enjoyment could be increased [10]. Dynamic difficulty adjustment has been used in research of various genres, such as tower defense [6], Multiplayer Online Battle Arena or widely known as MOBA [18], and arcade platformer [8]. Although player enjoyment could be sustained, dynamic difficulty adjustment has not been used to see its impact related to player motivation in playing the game.

### 2.6. Player personality.

Personality can be defined as an emotional and interpersonal style that stayed in oneself for a long time to describe someone's behavior within its action in the various situations [19]. One of the famous personality model is called Big Five personality which is mostly known as OCEAN personality model [20]. This model explained five personality traits inside a person, namely, Openness, Conscientiousness, Extraversion, Agreeableness, and Neuroticism. Openness indicates someone's interest in novel things. Conscientiousness indicates someone's responsibility when facing some tasks. Extraversion indicates someone's approach to their surroundings. Agreeableness indicates

someone's positive orientation to their surrounding. Neuroticism indicates someone's emotional stability.

2.7. **Player performance.** Player performance in a game is related to positive achievement that happened while a player is playing the game [21]. Player with good performance in a game will eagerly want to play a similar game with higher difficulty level because of the willingness to overcome any challenge; meanwhile a player with bad performance tends to play similar games with lower difficulty level because of the player's acceptance to itself when failing to overcome given challenge. Regardless of performance, both players will want to play a game with higher difficulty level because of the curiosity about how difficult it will be [8].

3. **Proposed Gamification Framework.** Several studies have developed the adaptive gamification framework that can adapt to the user [9,10]. [9] used Ferro's classification and [10] used Hexad Personality Type. Ferro's classification was developed based on Big Five personality model but its reliability had not been proven [22]. Meanwhile, Hexad's reliability is still needed to be tested further [23]. As both models were trying to relate with Big Five personality model and their reliability is still needed to be proven further; therefore we used Big Five personality model to classify the player in our framework. Big Five personality model explained that a person has five dominant factors to construct his/her personality, which are Openness, Conscientiousness, Extraversion, Agreeableness, and Neuroticism [20]. Each factor's level will be varied for each person, and the variation will build someone's way to think, feel, and act in his/her daily life.

Based on literature reviews above, we have created an adaptive gamification framework in Figure 1 by combining each explained factor in previous subsection. Every player has personality and performance that will influence the game. Game can be defined as a collection of problems that can be solved by player according to some rules related to the problem. Problem that can be solved by player in game is usually called as quest, which varies in types and difficulty levels [24]. Quest type tells player about objectives, required items, and rewards that a player can gain. On the other hand, quest difficulty level tells player about the amount of required items or enemies that should be defeated in order to finish the quest.

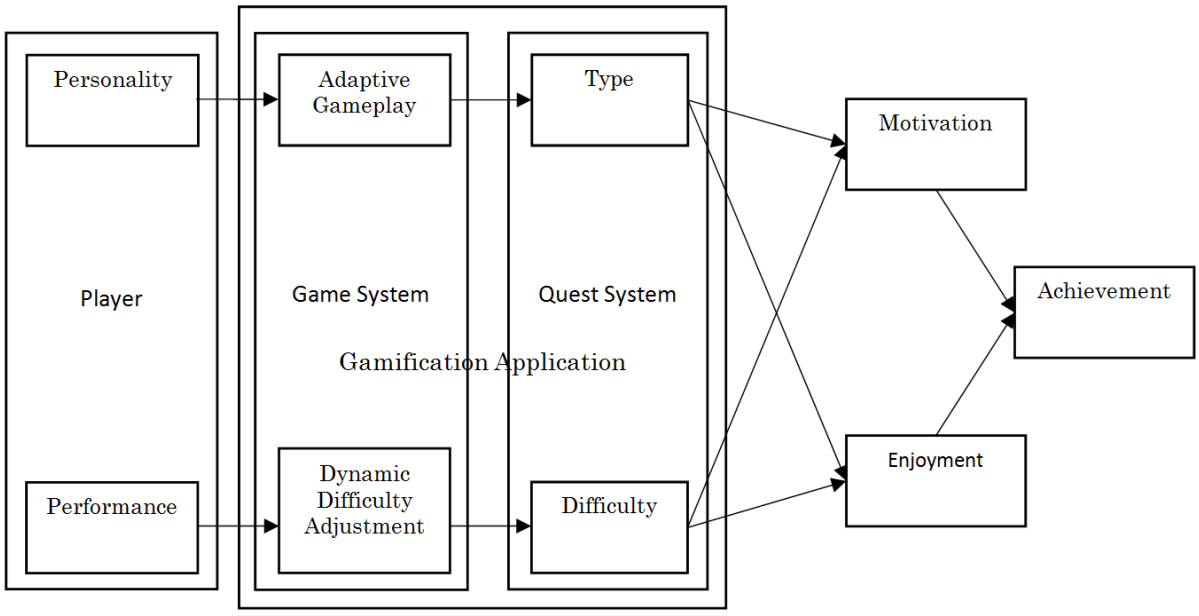


FIGURE 1. Proposed gamification framework

In this framework, there are two components that will work to respond each aspect of the player, which are called game system and quest system. Game system will manage the difficulty level of quests using dynamic difficulty adjustment based on player's performance [6-8] and the variation of quests type using adaptive gameplay based on player's personality [4,5]. Player performance will be measured from several parameters, such as win-lose ratio and finished-taken quest ratio [21]. Player personality will be detected from the answers of BFI-10 questions that player faced when they use the application for the first time [25].

The result from game system will be used by quest system to decide quest type and quest difficulty that will be done by player. When a player clears lots of quest from one quest type, game system will be more likely to recommend the player to do the same quest at the next time. Also, more quest done will make the quest difficulty for the next quests harder. The combination of quest type and quest difficulty that player faced will improve player motivation and enjoyment in playing the game. By improving player motivation and enjoyment, player knowledge related to the content on a game will be improved and it might improve player achievement in a good way.

4. **Effectiveness Evaluation.** The effectiveness of this gamification framework would be measured from three categories: player motivation, player enjoyment, and player achievement. Player achievement relates to player knowledge about the content provided in the game. It will be measured using a short-answer questions test based on in-game contents [2]. A correct answer will give one point, while a wrong answer will give zero point. Those points will be accumulated to find player's level of knowledge.

Player motivation relates to player attitude to participate in activities using the game. It will be measured using Instructional Materials Motivation Survey (IMMS) [26]. IMMS evaluates player motivation from four categories, which are attention, relevance, confidence, and satisfaction.

Player enjoyment relates to player eagerness in doing in-game activities. It will be measured using eGameFlow [27]. EGameFlow evaluates player enjoyment from eight categories, which are concentration, challenge, player control, goal, feedback, immersion, social interaction, and knowledge development.

The final result of IMMS and eGameFlow are average scores for each respective aspect. Average score could be calculated to see the motivation level (from IMMS) and enjoyment

Table 1. Effectiveness evaluation

| Evaluated factor | Evaluation method | Measurement |
|---|---|---|
| Motivation | Instructional Materials Motivation Survey (IMMS) | 44-statements questionnaire to be scored using Likert 5-scale.<br>Higher score means similar to the player, and vice versa.<br>Several statements are using reversed scoring, where higher score means not similar to the player. |
| Enjoyment | eGameFlow | 56-statements questionnaire to be scored using Likert 7-scale.<br>Higher score means player agrees with the statement, and vice versa. |
| Achievement | Quiz | Short-answer questions related to the game content.<br>1 point for right answer, 0 point for wrong answer.<br>Higher score means player knows well about the content, and vice versa. |

level (from eGameFlow). Scores from motivation, enjoyment, and achievement would be correlated, as motivation and enjoyment could improve the successfulness of learning process [1]. Table 1 shows how effectiveness from this framework will be evaluated.

Compared to the previous studies, [16] used SIMS (Situational Motivation Scale) to evaluate motivation value of the users and [17] used session duration time while using the gamification application. SIMS can only measure the motivation of user while doing an activity [28], but not the motivation influenced by learning media used by the user. Meanwhile, using session duration time as motivation level measurement factor is inappropriate because more time spent for an activity could increase boredom level of the user [29].

5. **Conclusions.** The focus of this paper is the development of an adaptive gamification framework with proper player classification using Big Five personality model and evaluates the effectiveness of this framework using IMMS, eGameFlow, and knowledge test. For the future work, this framework will be applied in the development of a gamification application. The application will be used in an experiment to prove the framework's ability to improve player motivation and enjoyment in learning process.

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