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***Research paper***



# A Framework for Integrating Gamification Mechanics and Dynamics to Authentic Learning Environment (Ale) in Non-Game Context

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**Abstract**

One of the most important factors for students' development and achievement is their engagement level with the learning activities. However, some students are lacking in essential 21st century skills that are important for their working life and daily activities. The essential skills are associated with high level thinking skill. Authentic learning environments promote the environment for high-level thinking skills. In order to engage students and confront their motivational problems, gamification approach is integrated into the authentic learning environment. Gamification uses game mechanics and dynamics in a non-game context to motivate, engage and reward user for completing tasks. This paper proposes a conceptual framework and for gamified learning environment according to the guideline and characteristics of authentic learning and integrates it with the relevant gamification mechanics and dynamics embedded into an application prototype. The prototype, named Time+ (Time Plus), is developed with an example topic of Time Management as the non-game context of higher order thinking skills. The aim of this study is to help students improve their engagement positively and enrich the educational experiences for the current millennial students by adapting the gamification concepts in a non-game context. Furthermore, it can also encourage students to learn while engaging with the gamified learning environment and enhance the modern teaching and learning methods.

***Keywords***: *Gamification in Education; Mechanics and Dynamics, Student Motivation; Student Engagement; Authentic Learning Environment*

## 1. Introduction

"Higher-order thinking requires students to manipulate information and ideas in ways that transform their meaning and implications, such as when students combine facts and ideas in order to synthesize, generalize, explain, hypothesize, or arrive at some conclusion or interpretation. Manipulating information and ideas through these processes allows students to solve problems and discover new (for them) meanings and understandings. When students engage in higher order thinking, an element of uncertainty is introduced, and instructional outcomes are not always predictable." [1]. Authentic learning promotes higher-order thinking and the integration of adaptable knowledge. Authentic learning is an approach which students work on realistic problems; gain new knowledge and skills in context. It allows students to construct their own meanings from their work and produce meaningful products and highly skilled performances that are beyond success in school. In response to this, education are now moving towards authentic learning environments which have been shown to enable students to acquire important skills that are critical towards their career [2, 3, 4, 5], as authentic learning emphasizes ill-defined real-world problems and solving these problems [6]. Majority of research calls for changing and transformation in education to meet the needs of millennial students who are always advance and ahead with the information technology. However, the mode of teaching is still conventional pedagogy and students tend to learn passively which lead to reduce in interest and disengagement of the students with the learning activities. Hence, the question is how can we improve students' engagement positively in the learning environment, so that they possessed the essential skills needed?

Different approaches have been developed and evaluated to foster students' engagement. Most ideas and approaches are by blending and integrating the educational environment with technologies. Therefore, this research study focuses on one of the method that was proven to be able to engage and motivate learners to participate, collaborate, share and interact in some activities. This method is known as gamification.

The first section of this article is a general introduction while the second section is background indicating specific information about Gamification and Authentic Learning Environment (ALE). Next section reports the research development and the proposed conceptual framework. The fourth part is system design and prototype development followed by the last section, which is discussion and conclusion.

## 2. Background

This research focuses on gamification in learning, which is different from game-based learning. Gamification in learning is an educational approach that aims at maximizing enjoyment and engagement by capturing the learners' interest and stimulating them to continue learning. The following subsections explain the concept in more details.

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### 2.1. Gamification

Many academics and industry professionals have addressed gamification and have taken a stab at defining it. Many of these definitions, although different in opinions on usefulness, are found to have a unifying theme. For instance, gamification is considered as "The process of game-thinking and game mechanics to engage users and solve problems." [7]. Another researcher defined gamification as "the use of game design elements in non-game contexts" [8]. In a business context, "gamification is the process of integrating game mechanics and dynamics into a website, business service, online community, content portal, marketing campaign or even internal business processes, in order to drive participation and engagement by target audiences." [9]. Generally, gamification is the concept of applying game mechanics and game dynamics in non-game context to drive participation increase engagement and motivate. In this study, gamification of education can be defined as the integration of both gamification mechanics and dynamics to gamify learning activities that intends to encourage desired learning behavior and to engage students in the learning environment. Thus, enable the learner to acquire the essential skills to face real life situations.

### 2.2. Gamification: the Game Mechanics and Dynamics

Gamification has becoming a powerful tool and strategy for engaging, influencing and motivating diverse groups of people [9]. In fact, the concept of gamification has the potential to solve the problems and difficulties in areas such as brand marketing, aerospace training, elementary education, and military strategy. "Game mechanics make the activity challenging, fun, satisfying, or whatever other emotion the game's designers hope to evoke. These emotions, in turn, are the compelling desires and motivations of the experience we call game dynamics." [10]. According to Paharia [9], gamification is built upon 10 primary game mechanics, proven to motivate and engage users, and may use any combination of these techniques to accomplish business goals. Meanwhile, a review article written by Doug Palmer et al., "The engagement economy: how gamification is reshaping businesses", states that "Hundreds of separate game mechanics principles, behavioral economic theories, and current user experience design thinking can be distilled into four overarching elements." Furthermore, a study focused on seven primary elements: points, levels, leaderboards, badges, challenges/quests, onboarding, and engagement loops [7].

On the other hand, gamification dynamics determines the individual's reactions as a response to use the implemented mechanics. Some examples of gamification dynamics are rewards, status, achievement, self-expression, competition and altruism. The power of gamification dynamics requires meeting relatively simple conditions in return for attainable rewards. Then gradually, the tasks become complicated and more challenging for bigger rewards. At the same time, a well-designed game provides an ideal environment and structure that guides players step-by-step towards their goal. This is how gamification dynamics enable and motivate a player to plan and perform simple to complicated tasks towards a goal. Along the way, players exercise a significant level of diligence, creativity, and resourcefulness. Thus, correct combinations of mechanics and dynamics creates a motivating, emotional and entertaining interaction.

### 2.3. Gamification in Education

The most common context for the implementation of gamification is gamification in education. Some examples include Quick Quiz: A Gamified approach for enhancing learning [11], The Effect of Virtual Achievements on Student Engagement [12, 13], Gamifying learning experiences: Practical implications and outcomes [14], Discovery-based games for learning software [15], Orientation passport: using gamification to engage university students [16], Empirical Study on the Effect of Achievement Badges in TRAKLA2 Online Learning Environment [17], High Score!-Motivation Strategies for User Participation in Virtual Human Development [18] and GamiCAD: a gamified tutorial system for first time AutoCAD users [19]. Education researchers have attempted to gamify learning activities that intends to encourage desired learning behavior and to engage students in the learning environment [20]. Intuitively, gamification has great potential to motivate students to learn better and to drive desirable learning behaviors in them. The main aim of the gamification of education is to use the effective game mechanics and dynamics and implement it in the learning activities making the learning experiences more motivating, engaging and importantly enjoyable and fun for the students to keep exploring the subject [21].

Game based learning (GBL) is a teaching approach that is designed to balance subject matter with real life gameplay. An effective GBL environment can lead to active learning and keep students highly engaged in practicing behaviors from the simulated environment to real life. GBL does not necessarily involve the game mechanics to solve problems and engage user. Similarly, GBL refers to serious games such as games used for training, advertising, simulation, or education that are designed to develop new knowledge and skills. Game-based learning and gamification in education refer to the same activities, which are authentic real-world activities. The only differences might be just the implementation of gamification mechanics and dynamics in the gamified education compared to GBL, which does not necessarily use the gamification mechanics and dynamics.

Student engagement is about extending achievement, positive behaviors and a feeling of having a place in the classroom [22]. The millennial students have different goals, needs and learning preferences than students in the past. Student engagement is an important construct for learning and self-improvement. It is important for millennial students to be actively engaged with learning activities in order to acquire the knowledge and skills required [23].

### 2.4. Authentic Learning Environment (ALE)

Education today is turning towards authentic learning environment (ALE) to improve the way learners absorb, retain and transfer knowledge [2]. Several studies have shown that learners prefer active learning rather than traditional lectures [24]. "Authentic learning typically focuses on real-world, complex problems and their solutions, using role-playing exercises, problem-based activities, case studies, and participation in virtual communities of practice" [2]. It is an approach that allows learners to explore and discuss meaningful ideas and concept and relate it in real-world situation [25]. Educational researchers have found that learners who are immersed in the ALE are motivated and encouraged to participate in learning activities through their own willingness [2, 4]. Authentic learning enables learners to develop familiarity with the unfamiliar and discomforting real-world problems and situation and able to provide a meaningful solution to adapt to the situation [25]. It is concluded that authentic learning improves the learners' thinking skills. This type of learning environment if supported by web technology and multimedia brings positive outcomes in engaging students' creative and critical thinking skills [4].

This research study uses the guidelines for designing authentic learning environment based on ten characteristics of authentic learning identified by Reeves, Herrington and Oliver (2002). These characteristics can be used directly to support the design of gamified learning environment.

## 3. Development of Conceptual Framework

In order to improve students' engagement in the authentic learning environment, this study aims to identify the commonly used

gamification mechanics and dynamics that were proven to improve students' engagement positively in the gamified learning environment and to propose a conceptual framework that uses the gamification mechanics and dynamics. Moreover, this research intends to apply the proposed framework of the gamified authentic learning environment in a game system design and develop a prototype. There are some steps to fulfill the objectives of this study as shown in Figure 1.

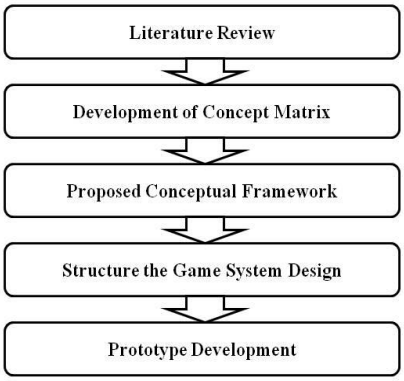


**Fig. 1**: Research steps to achieve the objectives

## 3.1. Literature Review

Literatures were explored from various databases such as Google Scholar, ACM Digital Library, Scopus, Science Direct and IEEE. The research papers, articles and journals were studied and analyzed in order to identify the five commonly used gamification mechanics and dynamics that were conceptually and empirically proven to improve the student's engagement positively in the learning environment. The search keywords include gamification, gamification mechanics, gamification dynamics and gamification in education. A total of 15 papers were studied to identify the type of gamification mechanics and dynamics applied in each of the studies, which were proven to be able to engage student positively in the learning environment. As recommended by [28], each literature should be compiled in a concept-matrix and proper grouping should be developed in order to analyze, categorize and discuss the findings. Therefore, the various types of gamification mechanics and dynamics applied in the 15 literatures were analyzed and categorized in a concept-matrix. Table 1 lists the 15 literature papers used to identify the type of gamification mechanics used in education.

**Table 1:** The list of papers for literature review

| No | *Literature Papers* | *Reference* |
|---|---|---|
| 1 | Raising engagement in e-learning through gamification | [29] |
| 2 | Mobile technology and Gamification: The future is now! | [30] |
| 3 | Gamification for Engaging Computer Science Students in Learning activities: A Case Study. | [20] |
| 4 | Gamification: Using Game Mechanics to Enhance eLearning, | [31] |
| 5 | Gamifying learning experiences: Practical implications and outcomes | [14] |
| 6 | Quick Quiz: A gamified Approach For Enhancing Learning | [11] |
| 7 | GamiCAD: a gamified tutorial system for first time AutoCAD users. | [19] |
| 8 | The effect of virtual achievements on student engagement. | [12] |
| 9 | The Effect of Gamification on Students with Different Achievement Goal Orientations. | [17] |
| 10 | Play as you learn: gamification as a technique for motivating learners. | [32] |
| 11 | Orientation passport: using gamification to engage university students. | [16] |
| 12 | Empirical study on the effect of achievement badges in TRAKLA2 online learning environment. | [33] |
| 13 | Steering user behavior with badges. | [34] |
| 14 | Discovery-based games for learning software. | [15] |
| 15 | Encouraging user behavior with achievements: an empirical study. | [35] |

## 3.2. Development of Concept Matrix

The gamification mechanics that were identified from the literature review are proven to engage students positively in the gamified learning environment. Based on the literature analysis and categorization in the concept-matrix in Table 2, 19 gamification mechanics were identified: that includes points, leaderboards, badges, levels, story/theme, clear goals, feedback, virtual goods, progress, challenges, social, community, fantasy, progressive disclosure, time pressure, stimuli, virtual appointments, guidance and avatar customization. However, due to scope limitation and time constrains, this research study only chooses and discusses five commonly used gamification mechanics in the gamified educational environment which are badges, leaderboards, clear goals, fast feedback and points. "Badges" are the most commonly gamification mechanics found in the literatures. They are "…symbols that indicate mastery of skills and accomplishment" [9]. User enjoys the pleasure to collect unexpected badges in the gamified system in order to rise in status and achievement. It is also used to mark the completion of goals and their progress [7].

The findings of gamification dynamics commonly used in the gamified learning environment are reported in Table 2. There are only three gamification dynamics that can be identified from the literature review which are achievement, rewards and competition. "Achievement" is the most commonly found in the literatures. Many people are motivated by a need to achieve, to accomplish something difficult through prolonged and repeated efforts, to work towards goals, and to win. People are motivated by achievement tend to seek out challenges and set moderately difficult (but achievable) goals. The most satisfying reward is the recognition of achievements [10].

**Table 2:** The concept-matrix to identify the gamification mechanics and dynamic

| Gamification Mechanics | Papers | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| ***Gamification Mechanics*** | | | | | | | | | | | | | | | |
| *Points* | x | x | | | | x | | | x | | | x | | | |
| *Leaderboards* | x | x | x | | x | x | | | | x | | | | | |
| *Badges* | x | x | x | | x | | | x | x | x | | x | x | | |
| *Levels* | x | | | | | | | | | | x | | | x | |
| *Story/Theme* | | | | | | | | | | | | | | x | |
| *Clear Goals* | x | x | | x | | | x | | x | | | | | x | |
| *Feedback* | x | | | x | x | x | x | | | | | | | x | |
| *Virtual Goods* | x | x | | | | | | | | | | | | | |
| *Progress* | x | | | x | | x | | | | x | | | | | |
| *Challenges* | | | | | | | | | | | | | | x | |
| *Social* | x | | | x | | | | | | | | | | | |
| *Community* | x | | | x | | | | | | | | | | | |
| *Fantasy* | | | | | | | x | | | | | | | | |
| *Progressive Disclosure* | | | | | | | x | | | | | | | | |
| *Time Pressure* | | | | | | | x | | | | | | | | |
| *Stimuli* | | | | | | | x | | | | | | | | |
| *Virtual* | x | | | | | | | | | | | | | | |

| Gamification Mechanics | Papers | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| *Appointments* | | | | | | | | | | | | | | | |
| *Guidance* | | | | | | | x | | | | | | | | |
| *Customization (avatar)* | x | | | x | | | | | | x | | | | | |
| ***Gamification Dynamics*** | | | | | | | | | | | | | | | |
| *Achievements* | x | x | x | | x | | | x | x | x | x | x | x | | x |
| *Rewards* | x | x | | x | x | | x | x | | x | x | | | | |
| *Competition* | x | x | | x | x | x | | | | x | | | | | |

### 3.3. Conceptual Framework

One of the objectives of this study is to propose a conceptual framework that uses the gamification mechanics and dynamics to improve students' engagement in the authentic learning environment. The gamification mechanics and dynamics commonly used in the gamified learning environment were identified in the previous section. These gamification mechanics and dynamics that were identified from the literature review are proven to be able to engage students positively in the gamified learning environment. From a total of 19 types of gamification mechanics, five were chosen to be integrated in the authentic learning environment together with three gamification dynamics. The five gamification mechanics identified are badges, leaderboards, clear goals, fast feedback and points. Meanwhile, three gamification dynamics identified are achievement, rewards and competition.

The design and creation of gamified authentic learning environment is not easily accomplished, and it requires a more in-depth thought than the development of content-based learning environment. For instance, the nDiVE used the mechanics and dynamics of gamification, the pedagogical framework of authentic learning and immersive virtual worlds to explore the work related skills in supply chain management [36]. This framework, however, focuses on general authentic learning environment that can be used by educators and learners. This framework is designed according to the ten characteristics and guidelines of authentic learning by Reeves et. al. [6] with the support of commonly used gamification mechanics and dynamics that are identified in this study. It is not necessary to integrate all of the ten characteristics of authentic learning in the gamified authentic learning environment [37]. The proposed framework is divided into five modules based on the five chosen gamification mechanics for this study. The three selected gamification dynamics are added into the last third parts of the framework, which are based on the points, leaderboards and badges. Each module of the proposed framework fulfills some of the characteristics of authentic learning. The five modules of the framework are as follows:

- *Module #1 Based on Clear Goals:* This module of the gamified ALE is based on real-world activities such as *clear goals* or structural learning path as shown in Figure 2. Clear goals are important for the learners to understand the task that needed to be completed. The gamified authentic learning activities allow learners to choose which chapter or modules that they wanted to learn freely rather than in linear manner. This module performed three characteristics of authentic learning including real-world relevance; requiring students to define the tasks and sub tasks needed to complete the activity; and integrating and applying across different subject areas and lead beyond domain-specific outcomes.
- *Module #2 Based on Fast Feedback:* The gamified authentic learning environment provides activities with various level of complexity format. The assessment of activities in this environment is seamlessly integrated with the major task in a manner that reflects real world assessment. Highly structured guided activities are provided for first-time learner (onboarding) and the activities require learners to invest amount of time to successfully complete the activities (time pressure). This environment will auto-evaluate the learner's tasks, progress and provide and *fast feedback* to the learners as shown in Figure 3. Fast feedback is helpful to guide students with right steps when they make mistake or lost with the learning environment.

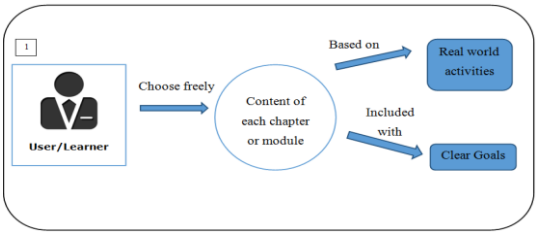


**Fig. 2**: Module #1

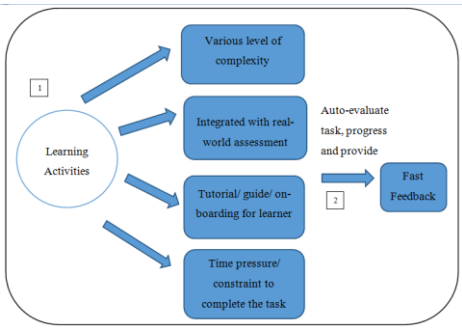


**Fig. 3:** Module #2

- *Module #3 Based on Points & Achievement:* After learners complete the activities, they will accumulate different value of *points* depending on the complexity level of the activities. Points are essential to monitor the learner's *achievements*. Learners are given opportunity to explore the activities in different perspective by using other resources to complete the activities. In this environment, learners are allowed to give multiple solutions rather than a single correct response obtained by the application of rules and procedures as shown in Figure 4.

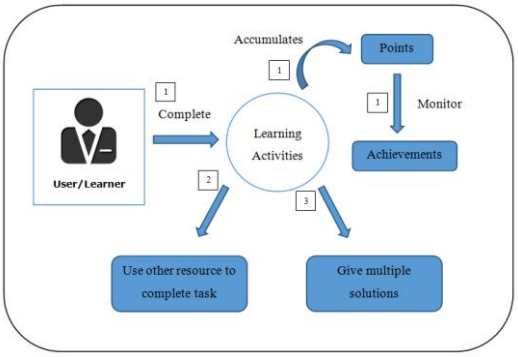


**Fig. 4:** Module #3

- *Module #4 Based on Leaderboards & Competitive:* The points accumulated by the learners will be displayed in the *leaderboards* and they will be able to see their ranking and achievements with other learners. This will motivate the learner to be *competitive*, but this competitiveness can harm the learning and motivation of other learners [39] (Figure 5). Hence, these gamified authentic learning activities give an option for learner to choose either to compete with other learner or to compete against their own achievement and personal best ranking.

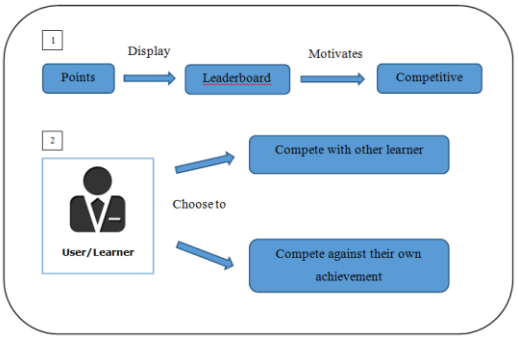


**Fig. 5:** Module #4

- *Module #5 Based on Badges & Reward:* Learners can unlock various types of unique *badges* when they accumulated certain value of points depending on the criteria to unlock the badges. Badges can be used to *reward* learners that return regularly to practice the exercises or task in the gamified learning environment. Besides that, some activities in this gamified learning environment requires learner to collaborate with other learners in order to complete activities that is not achievable only by an individual learner. Learners will be rewarded for this collaboration achievement with badges. Figure 6 shows the last module of the proposed framework.

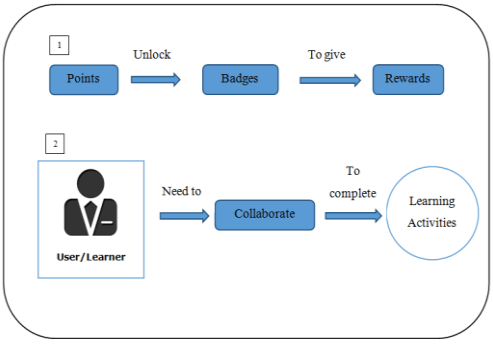


**Fig. 6**: Module #5

### 3.4. Structuring the Game System Design

The essential 21st century skills include communication skills, presentation skills, organization, time management skills, inquiry skills, self-assessment, reflection skills, group participation and leadership skills. These skills are categorized as high order thinking skills that can be learned and practiced in the authentic learning environments. Hence, this study uses time management skills as an example of high order thinking skills of authentic learning environment to structure the game system design of the proposed conceptual framework. The mobile application is name as Time+ (Time Plus). Therefore, the next step after proposing the conceptual framework that integrates gamification mechanics and dynamics in the authentic learning environment is to apply and structure the framework into game system design. The game system design includes an overview of the game design, game description, descriptions of the gamification mechanics and dynamics, gameplay loops/ user flow diagrams and wireframes of the system design.

### 3.5. Prototype Development

This study aims to identify the commonly used gamification mechanics and dynamics that were proven to be able to engage student positively in the learning environment. Then, the identified gamification mechanics and dynamics are integrated in the authentic learning environment to structure and propose a conceptual framework. The framework is then applied into a game system design. The last step to complete this research study is to prototype the proposed conceptual framework. The prototype is developed to realize the system design of the framework. It has no working function close to a real development and is built using "Just in Mind" prototyping tools.

## 4. System Design and Prototype Development

Acquiring good time management skills is not an easy process. The common symptoms for poor time management are procrastination, low work efficiency and disorganization. Different studies offered many effective ways that student can practice to improve their time management skills, such as using time planner, setting goals and datelines, breakdown of task into smaller and manageable parts, prioritizing task and many others. However, the difficult part is to stick with the plan. Students tend to be lacking in motivation to stay persistent and consistent in managing their time in a more efficient manner. Besides that, these essential skills were not being taught and instilled effectively in students by educators.

Time management is important to any person particularly for the student's personal life and career success. However, the design and creation of gamified authentic learning environment is not easily accomplished, and it requires a more in-depth thought than the development of content-based learning environment. Thus, this study only designs the surface content of the gamified authentic learning environment to instill the time management skills in user. The mobile application is name as Time+ (Plus). Time+ is not a game but rather an application that gamify non-game activity to foster user's motivation and engagement to acquire effective time management skill. Time+ (Time Plus) allows students to:

i. Choose the module that they prefer to learn and practice.
ii. Start the learning activities with tutorials and onboarding.
iii. Choose either to compete with other participants or to compete with self-achievements.
iv. Complete the task requirements and assessments with addition of time pressure, giving solutions from other resources, giving multiple solutions and collaborate with others to solve problems or complete task.
v. Gain points from the each of the activities completed.
vi. Get rewards by unlocking unique badges from the activities completed.
vii. Gain achievements and increase in understanding on time management skills.
viii. Display the achievements on leaderboards to constantly improve their performance of learning in a competitive manner.

The gamified authentic learning environment on Time+ (Time Plus): Effective Time Management aims at providing students with an engaging authentic learning experience to enable them to easily understand and apply various simple and effective techniques for managing their time more effectively to achieve their desired goals. In addition to the gamified learning experience, simulation activities and game-based assessments are provided with each module to gauge the learning effectiveness of the participant. The proposed model consists of four main modules: (1) Fundamentals of Time Management, (2) Goal Setting, (3) Planning & Scheduling and (4) Challenges & Ways to Overcome It.

### 4.1. Complete Gameplay Loops

The complete gameplay loops of Time+ are illustrated in Figure 7. The boxes with number from 1 to 4 indicate the primary gameplay loop while the other boxes indicate the secondary gameplay loop. These are the complete gameplay loops that form a cycle of actions that requires the user to perform over and over. From the first primary gameplay loop, which is (1) Choose Module, user is able to choose the modules they preferred. In this case, there are

four modules that can be chosen by the user. Then, after choosing the module, user will (2) start the learning activities. Here, user will undergo tutorials and they will compete with other learners (users) and compete with his/her own self-achievements. During the process to complete the learning activities, user will face time pressure/ time limitation to achieve the mission goals. Some mission goals allows/ promotes the user to find solutions from other resources not only to stick to one solution, multiple solutions are allowed too. Besides that, there will be task that needed the user to collaborate with other users to complete certain complex mission. This will lead to great teamwork effort and healthy competition among them. After completing the mission goals, activities or tasks, user will accumulate points and get rewards for his/her excellent achievements. Badges will be given when the user is able to complete certain complex tasks or when he/she accumulates certain amount of points. The user's achievements will be displayed on the leaderboard. The leaderboard will display user's performances in term of points, badges and ranking and compare them with other users'. User can also view his own achievements based on the modules that he/she has completed.

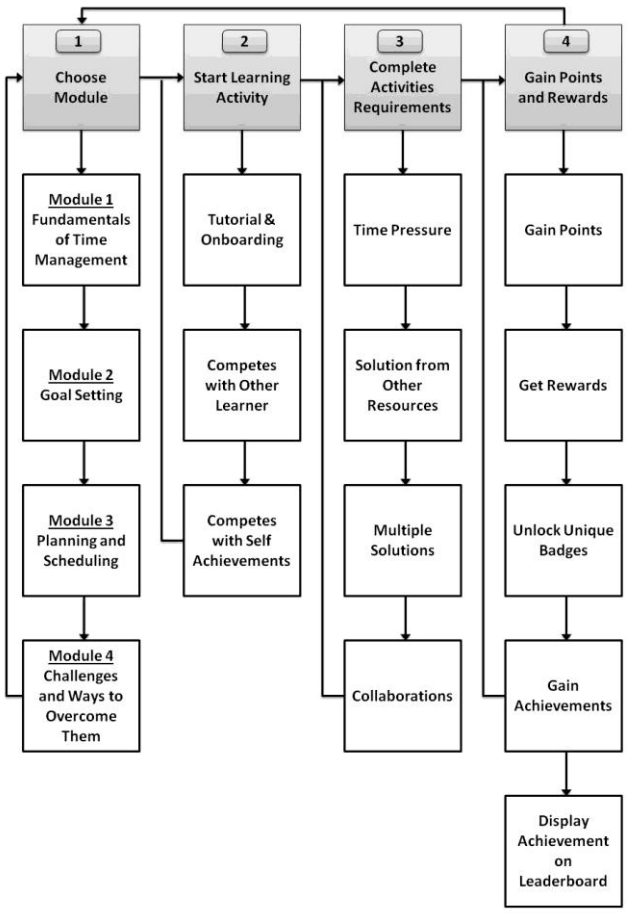


**Fig. 7**: The complete gameplay loops of Time+

## 4.2. Wireframes Screen Design

Figure 8 displays the user flow wireframes of Time+. The user starts from the "Welcome" screen and select "Select Module". This will direct the user to the "Select Module" screen and user will be given options to choose which module to start with. If the user chooses Module 1, then user is directed to "Module 1" screen and given options to choose which sub-modules that user prefers to go with. Then the gameplay starts and ends when the user manages to achieve the mission goals, accumulate points and unlock badges. When the gameplay ends, user will be given options to replay or to choose and proceed with other modules or even exit the gameplay. Other than selecting modules, user can select "Achievements" to view the leaderboard that display his ranking and performances. The "Option" screen is a minor screen that is included in the design. It consists of options to adjust the sound volume, to view the controls and know more about Time+.

There are nine main wireframes screen design of Time+. Generally, wireframe is a skeleton design of an interface, often lacks aesthetic details. These are specifically designed to understand the space and structure of the app, primarily aimed at capturing the usability and functionality. The main wireframe screen designs are "Welcome" (Home) screen design, "Select Module" screen design, "Module 1" screen design, "Mission Goals" screen design, "Gameplay" screen design, "Mission Complete" screen design, "Leaderboard" (Competitors) screen design, "Leaderboard" (Self-achievements) screen design and "Feedback" screen design. "Options" screen design and "Time Out" screen design is two minor wireframe screen design of Time+.

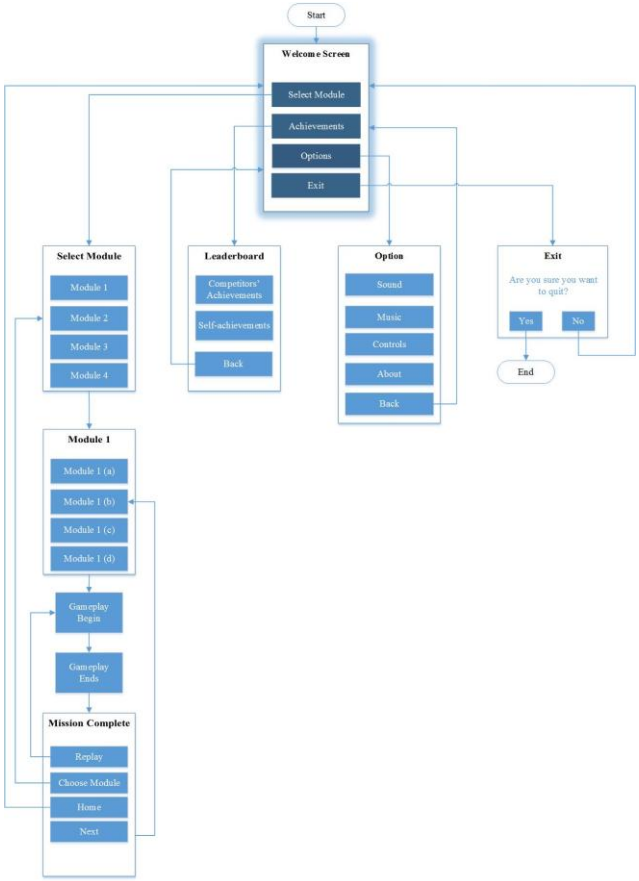


**Fig. 8:** The user flow wireframe of Time+

## 4.3. Prototype Development

Time management skill is used as an example of high order thinking skills of the authentic learning environment to structure the game system design of the proposed conceptual framework. From this, a prototype is developed to show the implementation of the game system design. The prototype had no working functionalities but rather assembles a mock-up that shows the user interface (UI) design of the application. Highlighted in this chapter are the example insight visual of Time+. The screens are organized sequentially following the developed prototype. As mentioned before, the design and creation of gamified authentic learning environment is not easily accomplished, and it requires a more in-depth thought than the development of content-based learning environment. Therefore, the content design for this prototype would only be for module 1(a) as an example. In this module, it consists of two goals, to complete the lesson on convey matrix and to complete the assessment activity on convey matrix. This module aims to teach user about the task prioritization

according to its importance. In the proposed conceptual framework, the learning activities should have sub-task with small accomplishable goals. Also, each of the sub-tasks will have different levels of difficulties and user will gain points and badges based on the complexities of the levels in the sub-tasks/ sub-modules. Figure 9 shows example hierarchy of the modules with its sub-modules. User can choose which ever modules that they prefer as authentic learning allows user to freely choose the lesson and activity that they wanted to learn and practice.

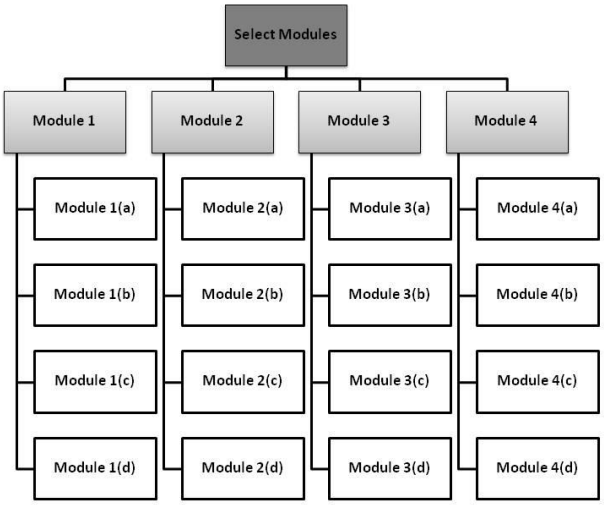


**Fig. 9:** Prototype development hierarchy

In this prototype of Time+, the user starts by selecting the module and sub-module that he preferred. The options of modules in Time+ are just an example of what time management application should have to educate the user in managing their time. After user selects the module, Time+ will show the goals for user to complete the module. Time+ guide and explains the symbols and the next steps to the user. In the module selected by user, he will start will a lesson then end with an assessment activity. The lesson that is used as an example in Time+ Module 1 (a) is the prioritization convey matrix. This lesson teaches the user on prioritization and the convey matrix to classify tasks and activities according to priority. By learning this, user will be able to differentiates and order his task according to their importance. Some examples of each box in the convey matrix is given for user to better understand and apply in real life activities. Then, the user needs to complete the assessment activity, which relates to the lesson learned by the user on convey matrix.

In this activity, Time+ use points and badges system to motivate the user to participate and learn with the application. Also added is the time-based point system, which is also useful to trigger user to complete the activity against time pressure. After user completed the lesson and activity, Time+ will give a feedback on the user's result and achievements. It displays the total points and badges gained by the user after he completed the module.

When user managed to complete the modules, he/she can either retry the module to gain better points or select another module to continue with as authentic learning gave user the freedom to choose the lesson or module that he desires to participate with. On the "welcome" screen of Time+, user can select "Achievements" option to view the leaderboard of his achievements in Time+. The leaderboard displays the user's achievements and performances with other users. It includes the points and badges that he managed to gain after completing the modules in Time+. User is given an option to view his/her own achievements based on the module that he had completed. By doing this, he/she may retry each module that he thinks need to improve and competes against his best achievements. The gamification menus are designed for each module and few of them are shown in Figure 10.

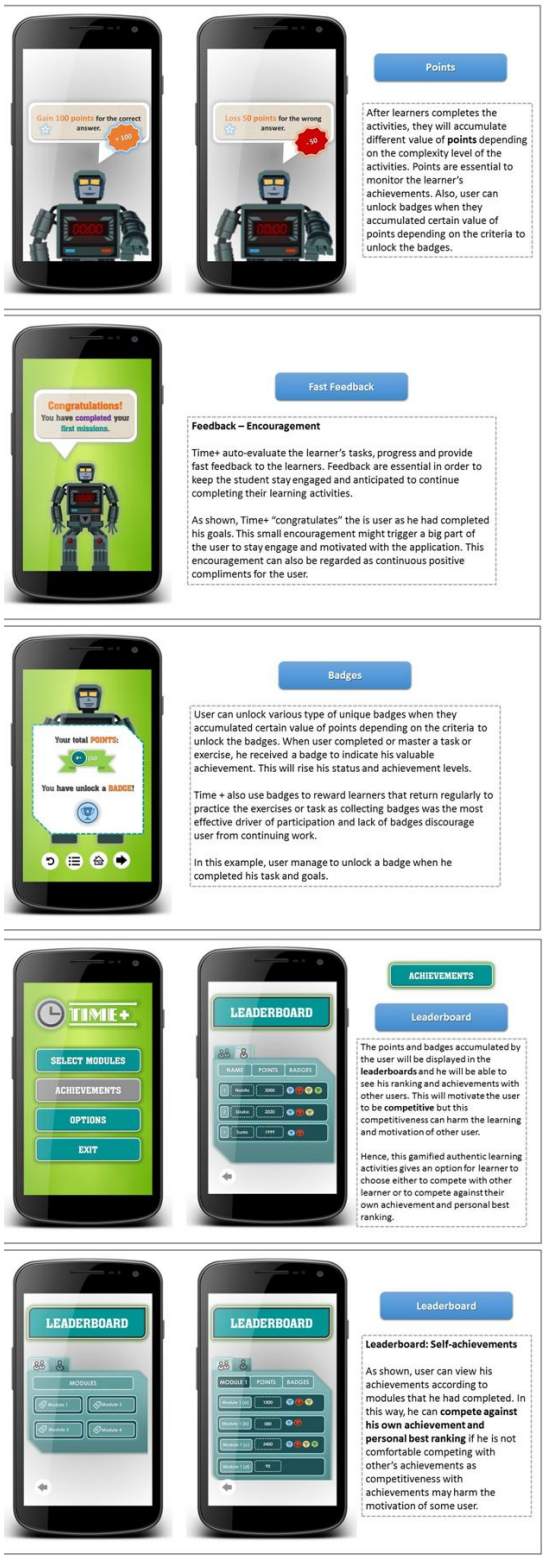


**Fig. 10**: Prototype menus

## 5. Conclusion

In this study, 15 papers are reviewed to identify the commonly used gamification mechanics and dynamics that were proven to improve students' engagement positively in the gamified learning environment. From the reviews, five gamification mechanics were identified which are badges, leaderboards, clear goals, fast feedback and points while gamification dynamics are achievement, rewards and competition. Interestingly, the most commonly used gamification mechanics are badges while the most used

gamification dynamics are achievements.

This study structures and proposes a conceptual framework to design authentic learning environment with support of gamification mechanics and dynamics to increase students' engagement and learning. The design of the framework uses the characteristics of authentic learning as a guideline. The proposed conceptual framework is then applied in a game system design and a prototype named Time+ (Time Plus) is developed for learning time management.

This research contributes to the design of a gamified authentic learning for increasing engagement and learning in non-game learning context where it applies the commonly used gamification mechanics and dynamics that were already proven to improve engagement positively. The gamification mechanics identified are badges, leaderboards, clear goals, fast feedback and points. The gamification dynamics, on the other hand, are achievements, rewards and competitions.

This study also led to a better understanding on the benefits of gamification mechanics and dynamics to improve students' engagement, improve the educational experiences for the current millennial students by adapting the gamification concept, encourage students to learn and engage with the gamified learning environment and also enhance the modern teaching and learning methods.

However, this research has it's own set of limitations. The first limitation is in the number of literature papers used to identify the gamification mechanics and dynamics. This study relies only on 15 relevant literatures in identifying the gamification mechanics and dynamics in the learning environment. There may exist more mechanics and dynamics of gamification that are not covered here. The design and creation of gamified authentic learning environment is also not easily accomplished. It requires a more in-depth thought on the content. This study only manages to design the surface content of the authentic learning environment of time management skills in Time+. It would be better if experts are employed in preparing the content of the time management skills. Finally, it would be best for the future work to develop a working application that can be used to evaluate and proves the effectiveness of the conceptual framework proposed here.

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