

DESIGN AND IMPLEMENTATION OF A GAMIFIED MOODLE SYSTEM

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Abstract

Nowadays many academic institutions are moving to e-Learning and most of them have adopted Moodle as the Learning Management System (LMS). Moodle provides numerous tools for learning management and assessment. However, such tools present some limitations that prevent students from getting some benefits such as engagement and motivation which are very important for the improvement of student performance.

This study proposes a Moodle system that uses gamification techniques to increase student engagement and enhance students' learning. The system uses the concept of experience points as a key factor to increase motivation and engagement. It provides experience points when the student interacts with course activities. The study results showed that, 85% of 65 respondents participated in using the designed Gamified Moodle System, pointed out that the system increased their motivation and engagement. The results indicates that the Gamified Moodle System could be suitable e-learning software prototype for increasing motivation, and engagements.

Key words: Gamification, e-learning, Motivation, Engagement

1. Introduction

In many countries, education has the first role for the development process while Learning Management Systems (LMSs) act as catalysts to influence and speed-up a learning process (Shrivastava et al.,2013; Wongso et al., 2014). The development of ICT has a strong impact in education (Prestridge, (2012), especially with the advent of e-learning that is becoming more important. Nowadays, many academic institutions are moving to e-Learning of which most of them are using Moodle as one of the most popular Learning Management System (LMS) (Shrivastava et al.,2013). New e-learning support techniques using Moodle software are developed every now and then in many schools, academic institutions and universities. Uses of LMS as a medium of transferring knowledge through online communities face some challenges which include lack of motivation and engagements. Some motivation tools should be implemented in the learning system so as to increase students willing of using and participating in the learning activities

Moodle is an open-source Learning Management System developed by an Australian teacher Martin Dougiamas based on constructivism educational theory (Xiang-Feng, 2014). Constructivism is a

theory of knowledge and skill acquisition based on learners' interactions, experiences, and ideas. It emphasizes social activities such as forum discussion, course dialogue, collaboration and interaction between instructors and students. Moodle as a well-known and most popular Learning Management System provides a lot of tools which support teaching and e-learning process. The word "Moodle" stands for "Modular Object-Oriented Dynamic Learning Environment": it provides all functionalities and other system features in the form of Modules. It gives great opportunities for distant learning – providing teaching resource material, knowledge tests, and controlling study progress (Krouk et al., 2020). It also provides numerous tools for learning management and assessment. However, such tools present some limitations that prevent students from getting some benefits such as engagement and motivation which are very important for the improvement of student performance.

The student performance is a key indicator for knowing students' progress, knowledge, skills and learning behaviors. Student learning needs good methods of teaching and learning environment which could keep students to be more engaged and motivated. Motivating student in a traditional way becomes a challenging task in these modern times where technology has a big role for the development of everything (Prestridge, 2012). An effective learning should keep the student to be more active; more generally, students' motivation could be increased through a mixture of intrinsic and extrinsic rewards (Prensky, 2002). While in Moodle, creating a learning environment that motivates and engages students is a challenge, one way of solving this problem is by developing a Moodle Learning system that implements gamification concepts which ensure students motivation and engagement.

Meanwhile, the concept of using games to influence peoples' behavior has brought great changes in the world of education, business, marketing, health-care, etc. It increases engagements for the activities which has no or little motivation (Knaving & Björk, 2013). The gamification concept has started since at least the 1980s, but the implementation started in the year 2008 (Deterding et al., 2011). Since then, many companies start to use gamification as a way to change the people behavior. It has been defined as a design of gamefulness with playful behaviors (Deterding et al. 2011). Ibanez et al. (2014) define Gamification as "the use of game elements in non-game settings to engage participants and encourage desired behaviors". It is the implementation of game mechanics and game dynamics into non-game activities to engage, influence and motivates people (Bunchball, 2012). Gamification can be used in education, training, business, marketing, health, public policy and government. It becomes an alternative way of engaging and motivating people, it changes the way in which peoples can be motivated and influenced toward achieving the desired goals. It uses game-like features like points, badges, ranks, experience levels, and leaderboard as motivation factors to encourage and change the people behaviors (Bunchball, 2012). It provides the ways in which gamified applications and education systems can drive and improve interaction, engagement, awareness, and learning.

The main goal of gamification is to provide a mechanism of increasing engagements for consumers, employees, learners, and other audiences, by keeping them more inspired on participating, collaborating and interacting in some activities (Bunchball, 2012). Many companies now use

gamification as a service layer to promote and motivate people (Deterding et al, 2013). However, little effort has been done on the side of educational sectors – especially the use of gamification in an online courseware.

The application of gamification in the educational environment present means of implementing game-like features on top of the educational activities. It refers to the use of game elements in the educational environment to motivate and encourage learners' behaviors (Kiryakova et al., 2014). It is a new powerful strategy to influence, engage and motivate students. It provides a number of powerful tools for influencing motivation and students' behavior (Iosup & Epema, 2014). Gamification can provide competitive learning experience, which influences students' engagement and improve students' learning. It uses game features like rewards, achievements, leaderboards and badges to motivate and encourage students in the learning process.

2. Literature Survey

2.1 Introduction

Gamification is defined as the use of game elements in a non-game setting to engage people and encourage desired behaviors (Ibanez et al.,2014). Gamification can also be defined as, the use of game elements and mechanics in the non-game contexts (Deterding et al., 2011). Yohannis (2014) defines gamification as a process that integrates game-like features into gameless objects so as to have gameful characteristics. The definitions from Paturusi et al. (2014) focus on changing the desired behavior, while Pastor-Pina et. Al. (2015) emphasis on gameful environments, that is – the experiences that gamification attempt to improve rather than the methods (Huotari & Hamari, 2012). Nowadays many vendors and other game consultants describe “gamification” in terms of client benefits. For example, “the process of using game thinking, game elements and mechanics to engage users and solving problems”. Vendors use “gamification” in their software applications as a service layer of rewards and reputation systems, which uses game features like points, badges, levels and leaderboards (Deterding et al., 2011). It has been identified as a good technique to improve students' engagement which leads positive changes on the students' learning (Ibanez et al.,2014). According to Yohannis et al, gamification process can be described as shown in Figure 1, where *Game elements* – are all elements that support the presence of gameful characteristics. *Gameful characteristics* are those attributes that define games such as defined rules and competitive environments, *Gameless objects* are the objects which have no gameful characteristics.

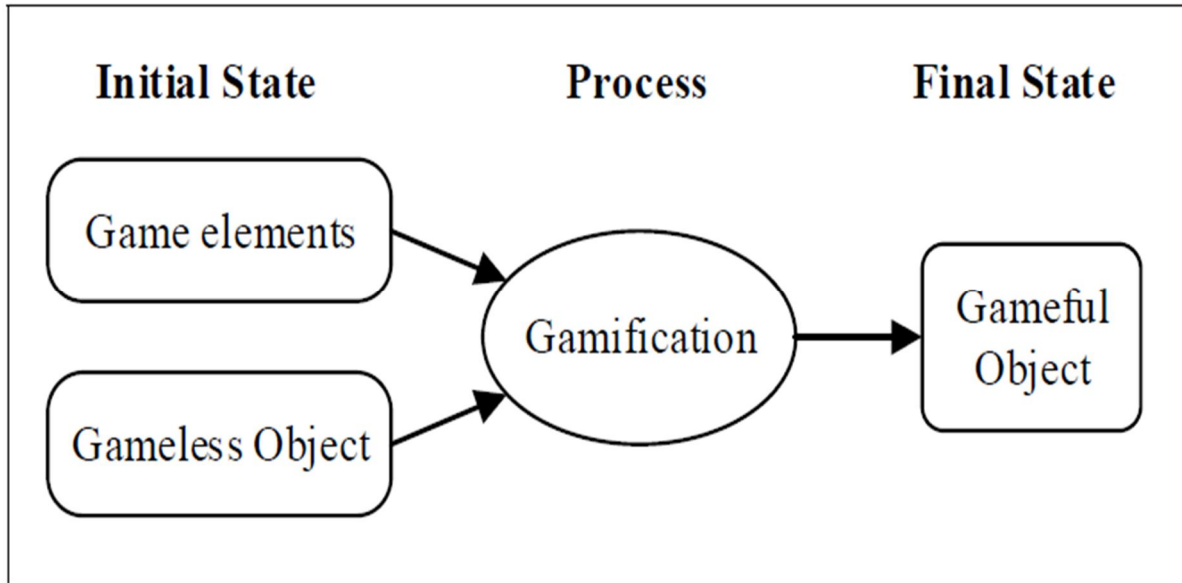


Figure 1. Definition of Gamification from the process point of view

2.2 Gamification in Education

Gamification in education refers to the application of game elements and mechanics into teaching and learning environment so as to make the educational contents be more interactive, which increases learners' motivation and improves learning. It is a process which creates participatory learning experiences and keeps active learning. It encourages the use of different types of resources and other learning styles by incorporating some tools such as audio, images and text into a single learning experience (Glover, 2013).

E-learning systems provide a lot of functionalities that help students to learn (Wongso et al., 2014). However, most of the e-learning systems face the problem of poor engagement levels (Glover, 2013). Gamification performs well in e-learning. Studies have shown that e-learning activities with high intrinsic motivation are typically as engaged as they would be with face-to-face traditional way of learning (Rovai et al., 2007). Glover (2013) insists that adding game features could influence unmotivated learners to be more engaged and motivated in the learning process.

2.3 Student Engagement and Motivation

Engagement is a crucial concept in game-based learning. Previous studies have shown a positive association between engagement and learning, "engagement in the game has a clear positive effect on learning" (Hamari et al., 2016). Hamari (2016) further show that students are more engaged and concentrated in the learning process when there are a challenge and competition in the classrooms. It has also been found that challenges can increase motivation and improve students' learning capability (Fullagar, 2013). Gamification creates student engagement and motivation through the implementation of game-like features in the learning interaction. Thus, combining gamification with e-learning will help on creating a learning environment that makes students feel more motivated and engaged in the learning process.

2.4 Gamification in Moodle

Moodle as a most popular open-source Learning Management Systems, provides a lot of features that have a direct impact in the learning process (Daraghmi et al., 2014). It allows instructors/teachers to create learning course that could be more interactive, which makes the students to be more engaged and motivated. It provides many features that can facilitate the implementation of gamification in the learning process (Kiryakova et al., 2014). The main target of gamifying Moodle is to have Moodle course that would be more engaged that allows students to have active participation in the course activities.

Rewards: provide points, badges, or leaderboards, when the students attain a certain learning goal.

User's pictures/avatar: User profiles – avatar allows students to edit, upload and/or update photo, edit and customize their personal information; it also provides user access to an activity feed where some notifications, news, and updates can be received (Muntean, 2011). These things engage and encourage the students to participate in the social activities.

Progressive learning: progress bars, adapted levels can be used to explore the progress of the students. The progress bar is a block plugin which visually shows the progress, what activities or resources students have to complete.

Levels: The level up Moodle block plugin can be applied to display the current experience level and the student progress towards next levels

Instant feedback: Allows the instructors to provide instant remarks, suggestions, or hints to their students. Tests, quizzes, assignments and some other activities in Moodle provide opportunities for feedback; instant feedback - for correct answers or wrong answers can be used as a stimulus and motivator to the students' activities.

Viewing conditions resources: restrict access, it allows the instructors to restrict some activities until some required actions are met. These activities may include: "Date", prevent user access before or after a specified date and time (Pastor-Pina et. Al., 2015).

This research therefore, tries to use the power of gamification to develop a Gamified Moodle System that can increase student engagement and enhance students' learning. Some literature explained that Gamification should only be used to increase motivation and should not be another mechanism of grading the learners (Glover, 2013). This statement has some limitation, one of the powerful gamification features is a "point system" which can be used to motivate and encourage students at the same time can be used as a way to grade and evaluate the learners (Iosup & Epema, 2014). The point system has a great impact in gamification system, to award some points when the learners attempt some activities has a greater sympathy in the cognitive domain - it motivates learners to do more and more. This research tries to use the concept of experience point as a mechanism to grade and motivate the students.

3. Method

3.1. Research Design

The study adopted Spiral Software Development Process Model. The Spiral Model is an iterative software development process model which combines features of both waterfall and prototype models (Boehm, 2007). It allows incremental releases and or/ incremental refinement through iterations. It provides the ability to change the system requirements through the use of repeated prototypes. It is a type of software process model which keeps more emphasis on risk analysis during the software development process. This study used Spiral Model as a way to reduce risks and keeping the development process to be in a systematic way. Figure 2 depicts an example of Spiral Model.

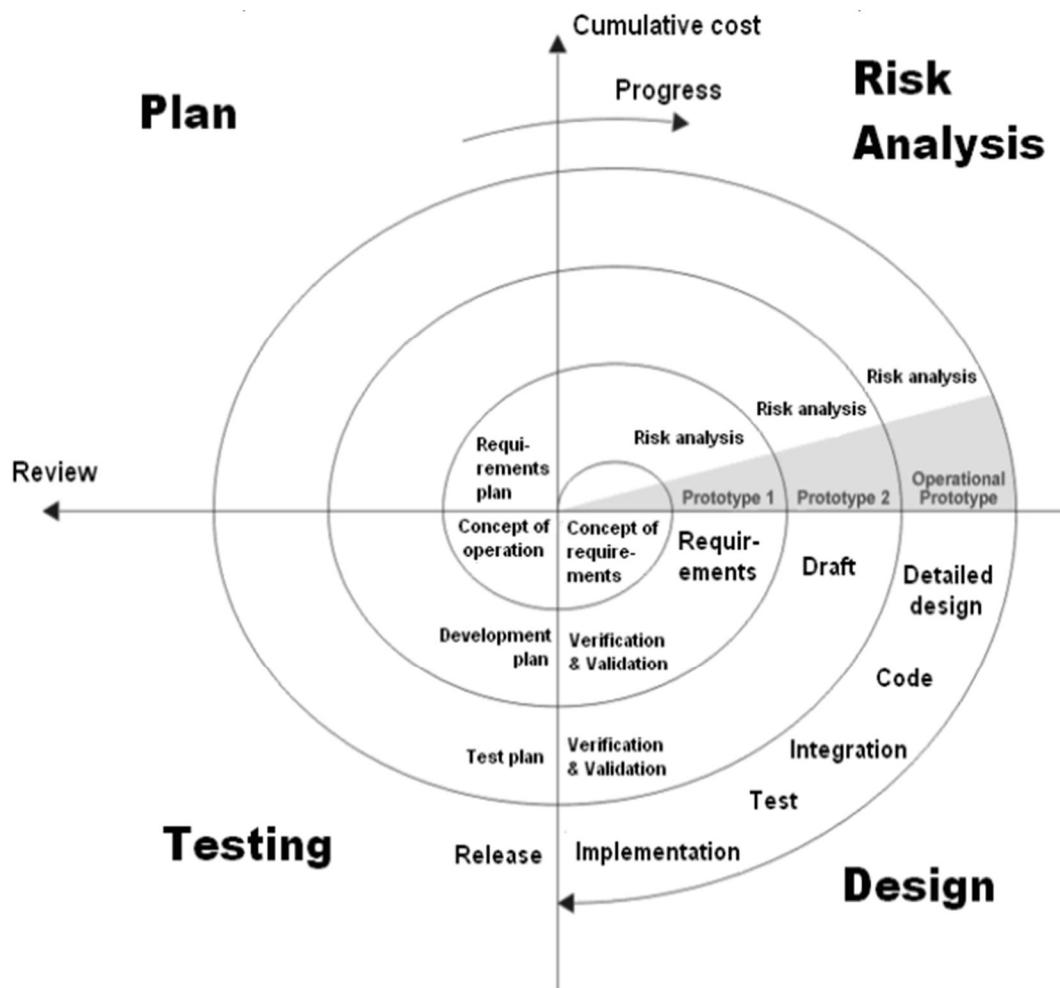


Figure 2. Spiral Model

3.2 Study Sample

The study used sixty-five (65) participants drawn randomly from groups of masters and bachelor degree students. They were exposed to use the Gamified Moodle System (GMS) for some time. Eventually, they were interviewed on their experience on the GMS functionalities and how gamification elements implemented can motivate and improve their performance.

4. Results

4.1. Introduction

The study results were obtained based on two aspects. First was based on the testing results of the designed Gamified Moodle System. Secondly, based on students' experience after being exposed to use the system for some time. The designed Gamified Moodle System had the following major modules and components as shown in Figure 3.

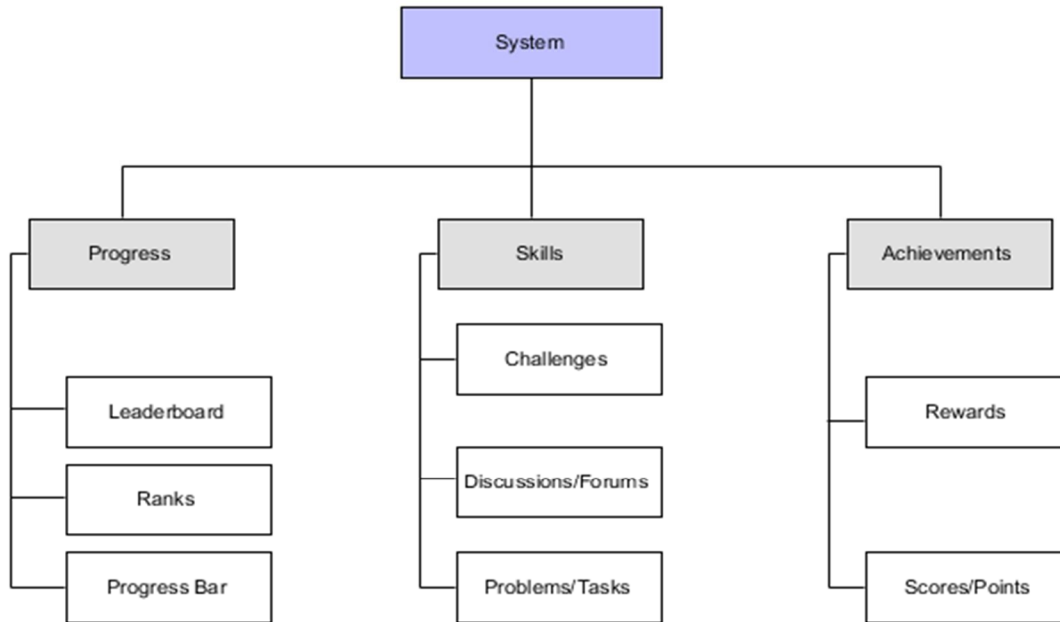


Figure 3. High-level Structure of the Gamified Moodle System

4.2 System Components

4.2.1 Progress Component

The Progress component is designed to track the student progress. First, it displays the Leaderboard that is used to provide inspiration and also to indicate how each student is progressing against other students, secondly, displays the progress bar which is information computed from the number of activities attempted by students. Lastly, it displays ranks as a way to motivate the students; Ranks component displays a list of students according to their academic position of the learning experience. Therefore, the progress component generally, keeps students to be more motivated after realizing their academic positions by tracking those attempted activities and compared to others. It shows the milestone where the student intended to achieve. Figure 4 and Figure 5 show the Gamified Moodle System (GMS) student dashboard with progress information and ranks respectively.

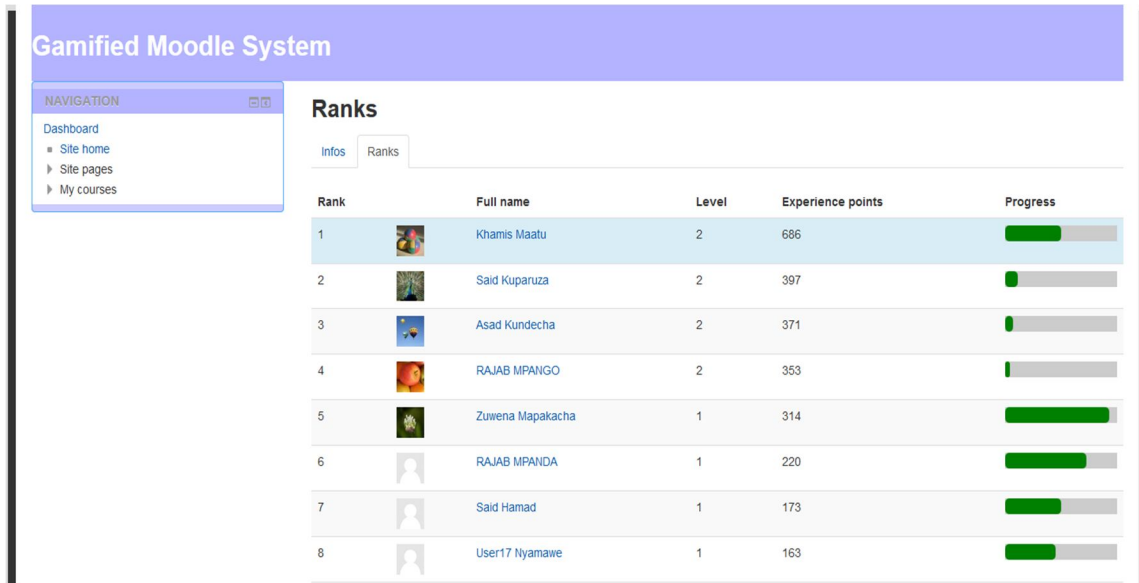


Figure 4. Student Dashboard showing Student Progress

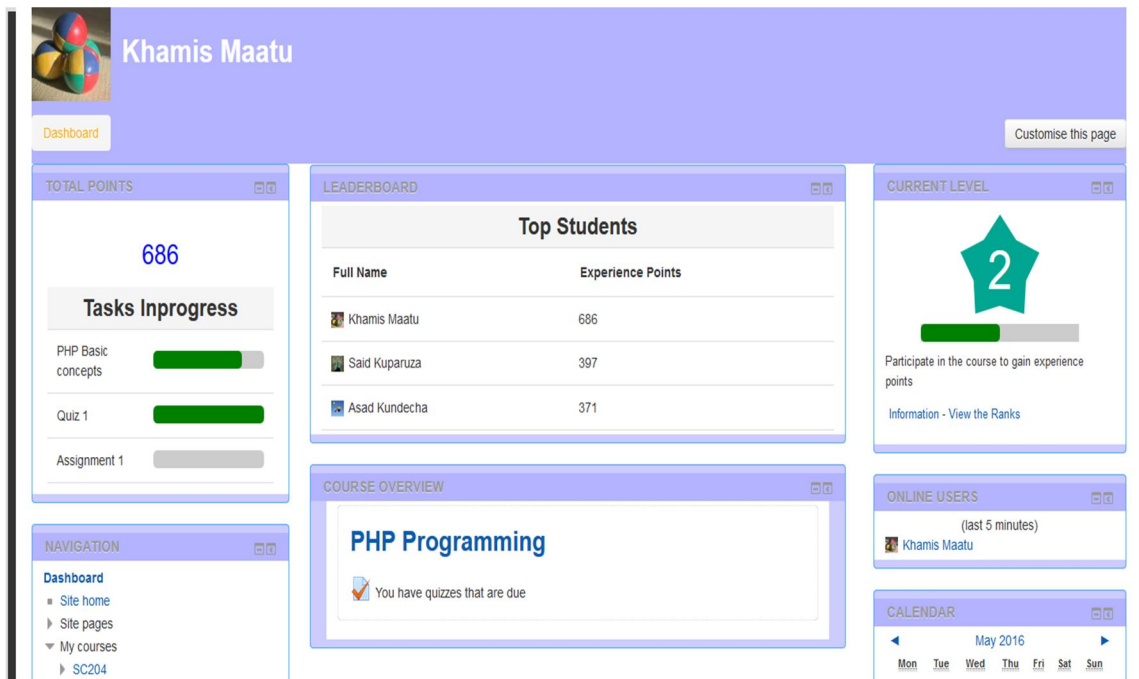


Figure 5. Student Ranks

4.2.2 Achievement Component

Students are highly motivated by seeing their achievements, and the point where they need to achieve. The achievement component has been used to provide student achievement information. It helps students to know activities attempted, points earned and the experience level attained. The Gamified

Moodle System provides experience points as a way of rewarding students after reaching some achievement from the learning activities.

4.2.3 Skill Component

Lessons: A lesson is a type of course activity which includes series of web pages presented in the form of course information and questions. It contains some instructional materials and questions about the materials the students just read. The system uses lessons as a way of providing instructional materials and challenging tasks. It uses lessons to set some instructional materials with some questions of which the students can read and answer. The lesson is organized in such a way that when a student attempt questions correctly, he/she proceeds to the next item; get it wrong the student taken back to the instructional page. While as long as the student reads the instructional page and attempts questions, the system awards points which then are accumulated in the total score. The intention is to make students understand the instructional materials and being more motivated and engaged into the learning activities. Figure 6 shows the lesson activities attempted by the students.

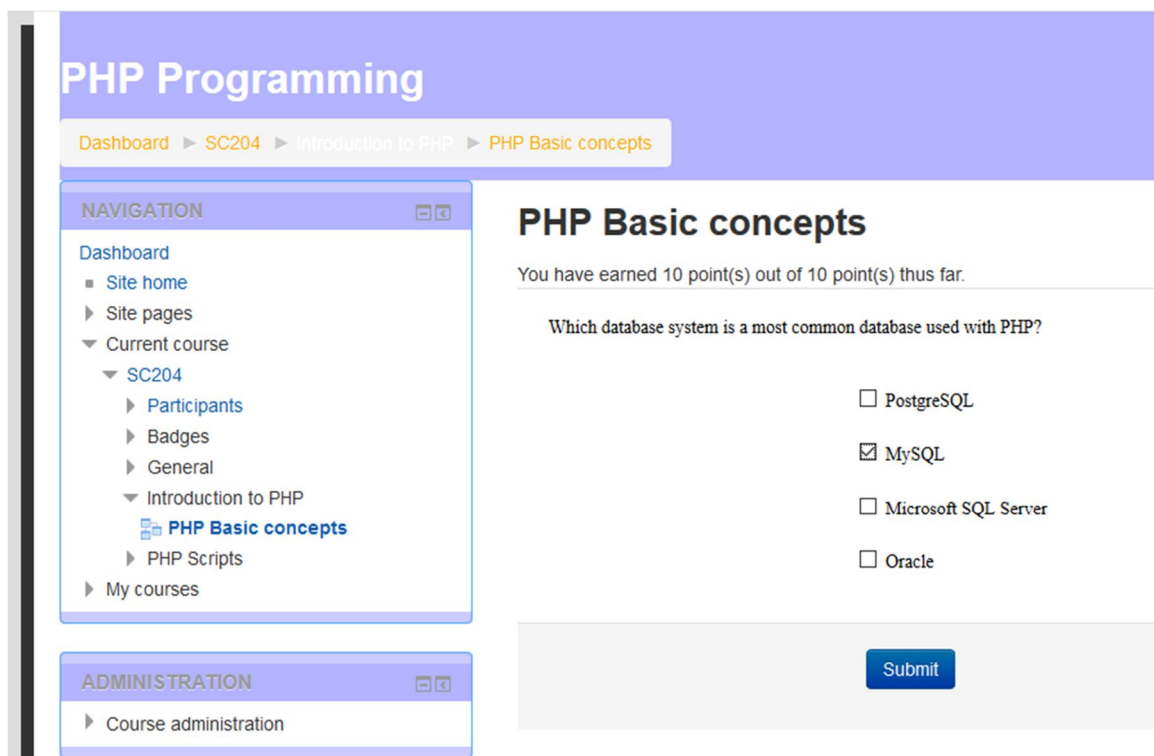


Figure 6. Questions on PHP Basic concepts

Quizzes: The system uses quizzes as a way to engage and motivates students of which some questions were set with a specific time, hence the students attempt questions based on the assigned time. The questions are provided with the appropriate time duration to give student a chance to think so as to attempt correctly. Once the time expires, the system produces the total score points (for all questions) and provides the correct answers for the missed questions.

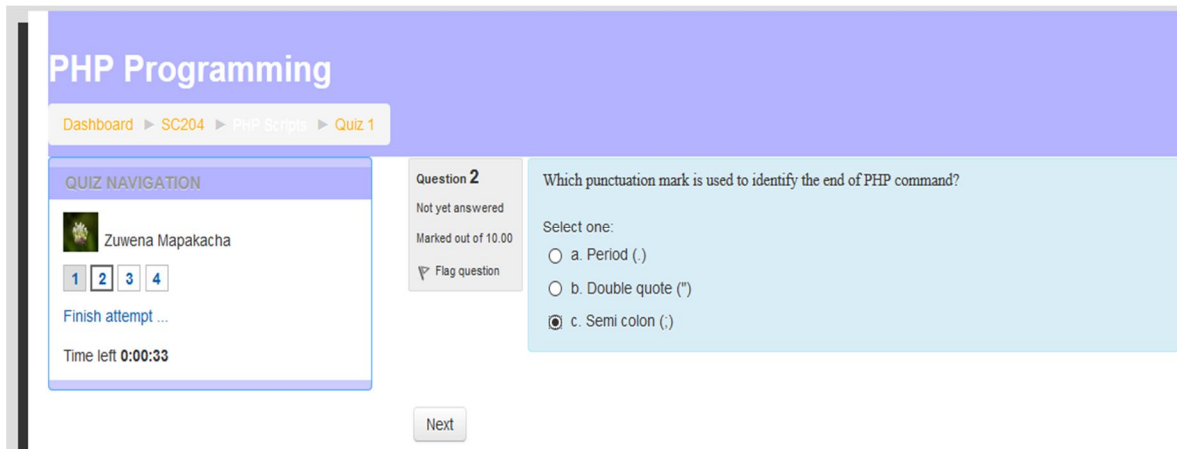


Figure 7. Quiz Session

Discussion/Forum

The system uses discussion/forum as a way of encouraging collaboration and communication between students and instructors. The forum is a powerful feature in terms of motivation, engagement, and imparting knowledge. The student can use forum to post some questions to get some clarifications on some issues and concepts that he/she does not understand very well. Also, through forum, the students get a chance to read ideas from others which can absolutely increase the students' skills and knowledge. The instructor can use forum to brainstorming with students by posting some challenging questions that keep the students to be more engaged in the learning process. The Gamified Moodle System provides some points when the student contributes and/or triggers the discussion by introducing a new topic. Figure 8 shows an example of News forum where the students and instructors collaborate and share some ideas.

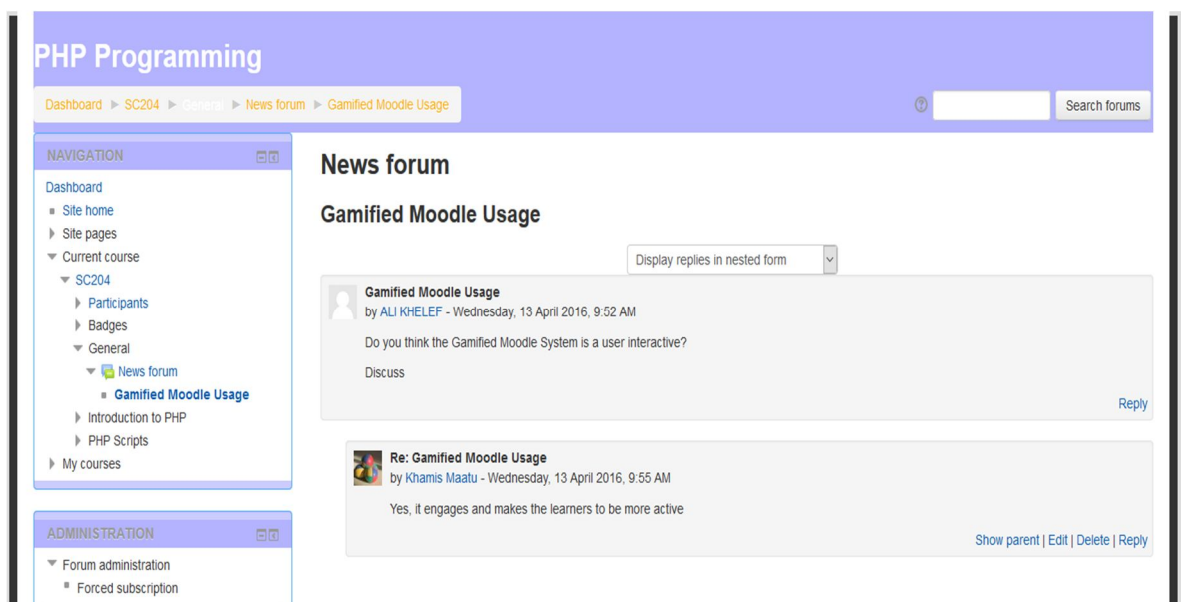


Figure 8. Discussion Forum sessions in progress

4.3 System Testing

System Testing is a software development process which assures that the system application which has been developed meets the business cases, technical requirements and works as expected (Bentley et al., 2015). It refers to any activity aimed to attribute the capability of a system and identifying that the software meets its intended results with no bugs (Hetzl, 1988). It is an essential role which seeks to perform experimental investigation so as to present the proper information to the stakeholders about the efficiency and quality of the product. In this study, unit test, integration test, and system test were done to check and ensure that the Gamified Moodle System behaves as expected. The details for the test results are indicated in Table 1

Table 1. Test Results

System Name	Gamified Moodle System
Test Type	Unit, Integration and System test
Test Summary	
Components Tested	Leaderboard, Ranks, Progress Bar, Challenges, Discussion Forums, Problem Tasks, Rewards and Score Points.
Variations	Some variations were observed on using different browsers. The Internet explorer has shown less efficiency on display.
Conclusion	Generally, the Gamified Moodle System met the intended requirements and operates as expected

4.4. Evaluation process

The Gamified Moodle software prototype was installed locally on one computer as a testing machine. The accounts of all sampled students were created manually, whereby the participants were asked to log in as students and participate in the course activities. The participants were given enough time to use the system and get engaged in the course activities, participate in the discussion forums, posting some comments and asking some questions. Finally, the participants were given the questionnaires as a way to get feedback and other general information about the system. The designed questionnaire comprises of two types of questions; general questions which aimed at getting the general information of the participants while the second type of questions was specific to the Gamified Moodle software prototype which seeks to find out the information about the usefulness of the system.

4.5 Respondents' ability to use e-Learning Management System

Sixty-five respondents were asked to weigh their ability in using the e-Learning management system. The results show that most of the respondents had knowledge of using e-learning systems; 60% - have some knowledge, 13% - good knowledge, 13% - very good knowledge and 14% have very little knowledge as shown in Figure 9. The result supports that Moodle is a most popular Learning Management System.

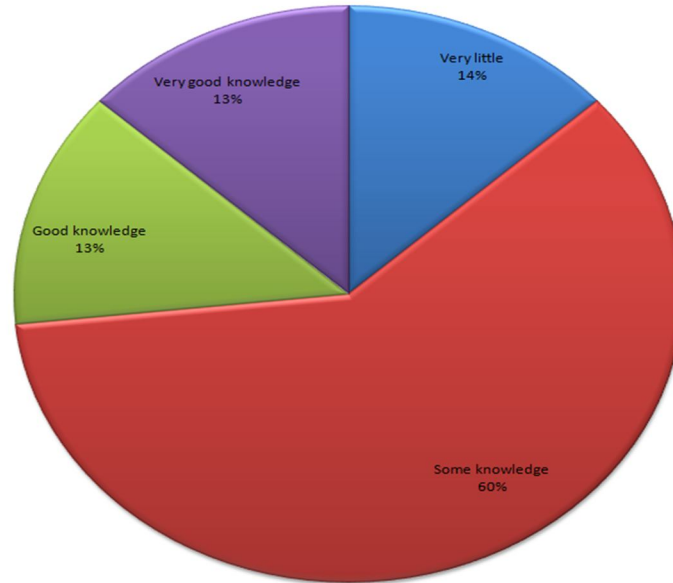


Figure 9. Students' knowledge on using e-learning Management system

4.6 Students Knowledge on importance of Gamification

Besides the fact that gamification is a new technology. Overall respondents who were asked on motivation and engagement on the use of Gamified Moodle System. The results as depicted in Table 2 indicates that gamification can motivate (54%) and engage (31%) students. This information gives message to those e-learning communities which have not started thinking about the use of gamification in their education world, to change their education system by implementing gamification.

Table 2. Importance of Gamification

Comments	Number of Responses	Percentages
It motivates students	35	54
It engages students	20	31
It creates awareness	5	8
It enhances learning process	5	8
Total	65	100

4.7 GMS User interactivity:

The results indicates that the Gamified Moodle System had good user interactivity; 40% of the respondents said that the user interactivity is good, 33.3 % - high, and 13.3% -very high (Table 3). User interaction is a key feature of any system; when the system has good user interactivity, it engages and motivates more users to use the system.

Table 3. Respondent's comments on the GMS user interactivity

Comments	Number of responses	Percentages
Fine	10	13.3
Good	30	40.0
High	25	33.3
Very high	10	13.3
Total	65	100.0

4.8 Gamification features

The point systems feature provides points when the student interacts to the system; such as login, viewing course materials, attempting quizzes, assignments, and post comments on a discussion forum. The results have shown that most of the respondents (32.1%) were interested on the use of experience points. It has been also noticed that respondents were interested on the use of Leaderboard (14.3%), Ranks (21.4%), Levels (10.7%), and Progress bar (21.4%) (Figure 10).

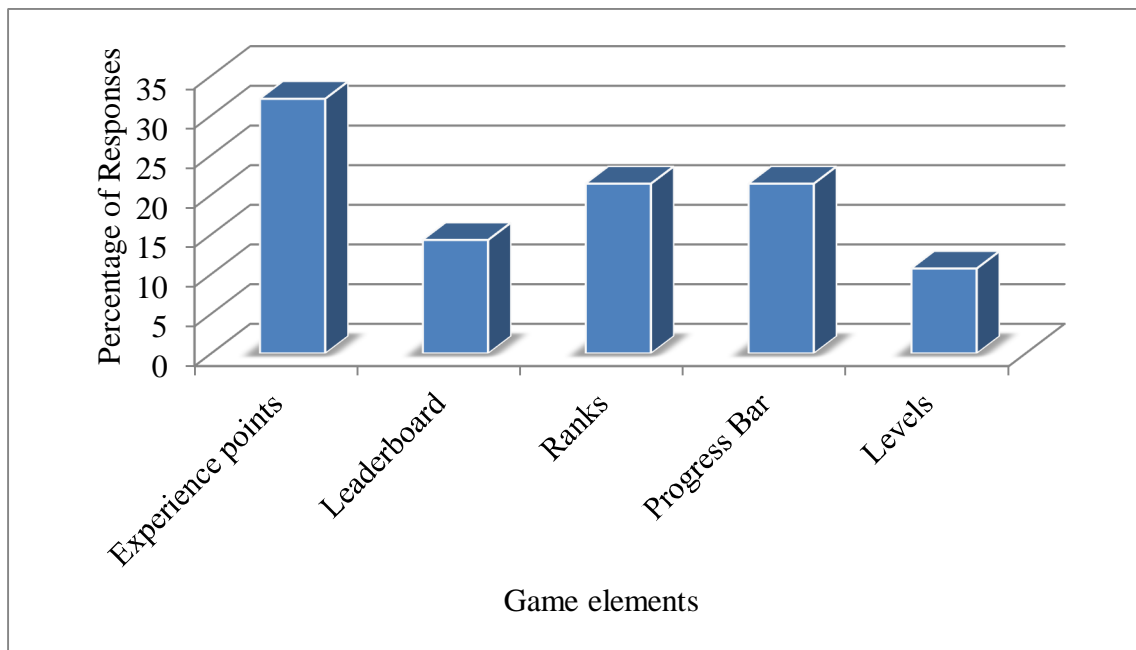


Figure 10: Distribution of Game elements used in GMS

4.9. Performance Enhancement

Finally, when the respondents asked about the use of GMS, all of them agreed that the system can improve the students' performance; 93.3% - strongly agreed and 6.7% - agreed (Table 5).

Table 5. Respondents' comments about the use of GMS on improving performance

Comments	Number of Respondents	Percentages
Agree	5	6.7
Strongly agree	60	93.3
Total	65	100

5. Conclusion

The study was guided by the *question "How a gamified Moodle system can improve students' engagement and students' performance?"*

The results from the survey study (system evaluation) have shown that the implementation of the point system, levels, ranks, leaderboards and activity completions – lessons, Quizzes, and Assignments can influence, motivate, engage, and improve the students' performance. 100% of the respondents have commented that the Gamified Moodle system can bring better changes in the improvement of students' performance. Also, the literature has shown that, rewarding students in terms of experience points, instant feedback about their progress, getting information about their academic position like the use of leaderboard and ranks can improve the students' engagement and enhance students' performance.

Furthermore, gamification is the best approach to make positive changes in the students' learning behaviors. Moodle is a suitable Learning Management System which provides an effective learning environment that can be integrated with gamification. Game techniques - game mechanics and game dynamics can be implemented in Moodle learning activities as a way to achieve desired learning, increase student motivation, and improve students' performance. The Gamified Moodle System is a software prototype designed to increase motivation, engagement, and improve students' learning. The system uses the concept of experience points as a key factor to increase motivation and engagement. It provides experience points when the student interacts and/or attempting course activities. It also displays leaderboards, levels, ranks, and progress bar information as a way to increase motivation, engagement and improve student learning. The survey results have shown that the Gamified Moodle System could be suitable e-learning software prototype for increasing motivation, engagements and improving students' performance.

6. Future Scope

This study based mainly on extrinsic motivations - the use of points, levels, ranks, leaderboard as reward mechanisms to improve student motivation and enhance students' learning. The research should be done to examine how Moodle learning tools such as forums and wiki can be used to increase intrinsic motivations of the students. Moodle is not user-friendly in terms of setting game-elements, it needs a great effort to learn how to set Moodle courses. Therefore further study should be done to find the easiest way in which instructor/teacher/course creator can implement content gamification in Moodle courses.

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