

**Integrating Gamification in LMS for Enhanced Learning
by Increased Instructor-Student Interaction and Feedback**



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Dedication

I dedicate this thesis work to my parents who from the start encouraged and supported me.

It is also dedicated to my friends and to my teachers with whom I have an exceptional and admirable relationship.

Certificate of Originality

I, **Nazish Zehra** hereby declare that this submission is my own work and to the best of my knowledge it contains no materials previously published or written by another person, nor material which to a substantial extent has been accepted for the award of any degree or diploma at NUST SEECS or at any other educational institute, except where due acknowledgement has been made in the thesis. Any contribution made to the research by others, with whom I have worked at NUST SEECS or elsewhere, is explicitly acknowledged in the thesis.

I also declare that the intellectual content of this thesis is the product of my own work, except for the assistance from others in the project's design and conception or in style, presentation and linguistics which has been acknowledged.

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Abbreviations

CSS	Cascading Style Sheets
DDL	Data Definition Language
HTML	Hypertext Markup Language
LMS	Learning Management System
MOODLE	Modular Object- Oriented Dynamic Learning Environment
SSA	Student Success Algorithm

Abstract

Gamification is the use of game inspired elements in a system in order to motivate and enhance the engagement of its users. Learning Management Systems as employed by different educational institutes across the world can be adapted in a way to enhance the user engagement as well as to increase students' participation. In this study, a gamified learning system is developed in order to introduce a competitive environment among the university students as compared to traditional Learning Management System. A number of gamification concepts are discussed in the thesis, which are expected to stimulate the students' engagement and performance. Gamification is employed in a number of components in Learning Management System in order to make the learning environment more interesting for the students. The developed system is also intended to provide the instructors with the information which would be inaccessible in a traditional Learning Management System. Different metrics on instructor interface give them an insight into students' engagement activities and therefore provide them with detailed analysis of students' recorded activities in a learning system. The system was tested for a group of students and an increase in students' engagement in LMS was observed, which is further analyzed for their academic performance.

Chapter 1

Introduction

This chapter gives an overview of the gamification and its purpose. It also presents the background and motivation of this research. Moreover, it outlines our objectives and proposed solution using the gamification techniques.

1.1 Gamification

Gamification refers to the use of game elements in a non-game environment in order to make it more interesting and engaging. The main purpose of gamification is to increase users' engagement in a gamified application by gaining their attention and increased duration in the activity by incorporating different game elements [1].

The gamification term was first used in the early 2000's by Nick Pelling, a game programmer who came up with an idea of evolving products into entertaining platforms but could not get more attention. However the term gained attention in 2010's when a lot of gamified applications were introduced in the market related to different areas such as health, education, e-commerce, etc. [2]. Since then many companies have employed gamification concepts in their products in various ways.

The concept of gamification has been employed in different activities to make them more fun with an intention of increased user participation. For example gamification in work can make people more excited about work and can result in an increased productivity. Gamification in commerce can give customers special offers and reward them for their purchases.

The gamification market has hit many areas worldwide and with time more companies are employing gamification techniques in their products. For instance, Nike plus¹ is a set of applications designed for active runners to improve their exercise and workout activities by using points, leaderboard and other game elements. This helped the users to track their running activities, therefore motivating them for routine running and exercise. Moreover, these applications increased the market shares of Nike by nearly 14% [3]. StackOverflow² is another successful gamification example which provides Q&A site and discussion forum to the programmers and allows them to ask questions and get answers about coding. StackOverflow uses game mechanics of reputation points, badges and exchange gifting in order to make its forum more cooperative for its users [4].

All the previous work done and discussed so far supports the concept that Gamification can help to increase the user retention and user activity when employed in a given system.

1.2 Problem Statement

Most of the educational institutes use Learning Management System (LMS) to manage their courses online at present. LMS acts as a repository for rich educational data and provides instructors and students with an efficient system to manage their courses.

The main aim of university education is to expand the knowledge of students in a given field. To fulfill this requirement, students need to attend different courses and comprehend the lectures within a given time. Most of the time, students are unable to understand all of the lecture, resulting in a lot of questions that need to be answered by the lecturer. This situation is likely to demotivate students in a given course. Lecturer needs to be aware of the parts of a lecture which are not understood by most of the students. The thesis is aimed to solve this problem with the application of gamification in LMS in order to motivate the students and increase their engagement in LMS. This will provide gamified feedback system where students will be able to evaluate the lecture at earliest. This will also help the instructor to get feedback about the lecture content on time and make it more understanding for the students.

¹<http://www.nikeplus.com.br/>

²<http://stackoverflow.com/>

1.3 Proposed Solution

A new LMS design is proposed in order to motivate students to better understand a given lecture and reduce the interactivity gap between the instructor and students. Gamification is employed in LMS in a way to make the components in LMS more engaging for the students. In order to achieve this objective, the thesis aims on the following techniques:

1. Gamify Lectures component, which deals with view and download of lectures in LMS, in order to make it more effective and engaging for the students.
2. Gamify Questions and Discussions forum to make lecture understanding more promising.
3. Employ the concept of Points, badges and leaderboard as a part of game design elements to motivate the students.
4. Show progression in a course in the form of levels to show how good student is going in gamified environment.
5. Additional LMS components are also developed that make LMS more interactive and engaging for the students as compared to traditional LMS.

1.4 Objectives

The objectives of the research are to make the lecture understanding effective and investigate the impact of gamification on students' learning activity in LMS. A gamified Learning Management System is proposed by observing the traditional LMS and developing a new LMS with different components by incorporating game design elements in order to enhance the learning activity of the students. The main goal of this research is to design a system which increases the students' engagement in LMS therefore enhancing their learning activity by pursuing them to the system meanwhile also making student-instructor interaction more promising. The developed system will be a step ahead of traditional Learning Management System by motivating its users in the form of points, badges, levels, and rewards along with competitive elements which will boost up the students to do their best. After the gamified system is developed, the thesis

aims to investigate the relationship between gamification and academic performance of the students along with the other factors by exploring their activities in gamified LMS. Another objective of thesis is to use the data generated by learning systems in order to analyze the learning behavior of students as part of learning analytics.

1.5 Tools and Languages

Following tools and languages are used in the development of gamified LMS:

a. Languages:

- PHP used as server end language in gamified LMS development.
- MySQL as DDL on backend.
- HTML and CSS for front end LMS development.

b. Tools: PHP designer 8.0

c. Libraries:

- Bootstrap for front-end web development.
- Font awesome to use vector icons in LMS.
- asPieProgress to integrate animated progress bars in LMS.

1.6 Structure of Thesis

In Chapter 2 we will discuss related work and the applications of gamification in education and learning. In chapter 3 we will discuss the methodology and explain how gamification is incorporated into LMS, which game elements are used and their significance. Chapter 4 discusses the experimental phase of the developed gamified LMS on a group of students and the results gathered from the experimental phase. Chapter 5 gives final conclusions and future work which can be done as part of this research.

Chapter 2

Literature Review

This chapter discusses the work done in education domain and its advantages with respect to gamification. The detailed design and study of gamification applications in education domain is also discussed. The gamification design presented in different applications along with their details are discussed. The purpose and analysis of learning analytics and studies incorporating learning analytics are also discussed in this chapter.

2.1 Gamification in Education

Gamification in learning has proven to have great impact on motivating students and engaging them in learning activities. Gamification in education is emerging as a new field over time and a large number of gamified learning systems are designed so far.

The gamification of education is an interesting topic as it can make the learning more fun and motivating for the students. Moreover gamification significantly helps in capturing the attention of those who have hard time focusing on learning in a traditional learning system. Khan Academy¹ can be taken as a successful example in this regard. Khan Academy is an online learning platform that uses a number of gamified elements with the mission to motivate the learners who seek education [5]. Duolingo² is another online platform which allows its users to learn different languages. Duolingo allows the learners to develop language skills through different learning exercises, gaining points and different badges [6].

¹<https://www.khanacademy.org/>

²<https://en.duolingo.com/>

2.2 Gamification in University Orientation

Queensland University of Technology Australia developed a gamified application in order to engage the fresh students in the university and encourage them to explore the university as part of their university orientation. For this purpose, an iOS application was developed for the students in order to make orientation activity more fun and engaging for them. The game elements were introduced in the application and new challenges were weekly added into it to motivate the students to explore university and interact with the new class fellows themselves. These challenges were based on different tasks including exploration of the university campus and class interaction as a part of proposed gamified design. Location-based challenges were set in which QR codes were placed at different locations and students had to find and scan those codes to complete the challenge. Event-based challenges used in the application were meant to inform the students about current and future events in the university and in order to complete these challenges students had to check in for these events. Moreover students were also given tasks related to adding friends in their contact list in order to increase the social interaction among the class mates. For each set of challenges, a leaderboard was made to promote competition among the students. Students were also awarded with gift vouchers and prizes as part of rewards through a lucky draw. A survey was taken from a group of newly enrolled students who used the application. The results showed that students were motivated to learn and explore more about the university with these set of challenges and gamified system [7].

2.3 GradeCraft

Gamification finds its applications in curricular activities also. For instance, GradeCraft [8] is a gamified e-learning system where students were allowed to model the course grade according to their skills by selecting a set of assignments to be completed. A new grading strategy was developed in order to allow the students to select the assignments of their choice and also give weightage to those assignments therefore giving them the power of self-assessment, chance of risk taking; both are important design elements in a game. Instructors can analyze the assignments selected by students and the weightage given by them to those assignments which helped them to know if the students are aware of their

own skills and willing to gain learning in a course or not. Furthermore, gamification is incorporated in the form of badges, points and showing individual's class standing whereby student could visualize his current score as compared to the class average score. Badge analytics option allows instructor to visualize the distribution of badges attained by the class. GradeCraft also provides learning analytics to instructors to make them aware of the path of progress and performance of single as well as all the students in the learning environment. Instructors can use GradeCraft to view the learning objectives of the course achieved by the students as part of their course activities. Student engagement can also be investigated by the instructor by analyzing the access data of students in the learning system [8].

2.4 Gamification in LMS

In [9], some of the built in components of LMS were gamified in order to increase the student engagement. The prototype design and the process of incorporating game elements in LMS are discussed in detail in this study. Points, levels, badges, leaderboard, feedback and progress bar are the game design elements that were incorporated in different LMS components. Moreover rules of gamification set for each component are also discussed. For instance, Documents/Files component where students can view or download course material or notes, was gamified by presenting student with a set of questions related to last downloaded document or reading in order to test their document understanding and after the test, next document/reading is made available for download. Points were awarded on the basis of questions answered. Assignments submission process was also gamified by giving extra points to students for early submission of the assignment. In the forum component students were provided with excellent and like button for each post and extra points were rewarded to a student for excellent like on his/her post. Profile provided the information about student's achievements and total time spent on LMS. Instructor was given admin privileges and considered as an active participant to manage the LMS components. Leaderboard for each component was defined separately. This study presented LMS as more engaging and motivating tool for students in order to trigger their learning process.

2.5 Gamification in Programming

In order to enhance students' programming skills, Swacha and Baszuro [10] discuss a gamified platform developed for programming course to make coding exercises more interesting for students and motivating them to participate in group discussions and other course activities effectively. The proposed system employs gamification mechanisms of progression, collaboration, bonuses rewarded along with the points, leaderboard and badges to motivate the students to gain programming skills. The points were distributed among different activities. For instance, students could gain points by challenging other students, by accepting challenges, by working in groups, answering questions on forum etc. These activities could help students in extending their programming knowledge therefore making them more competitive in a professional environment.

2.6 Gamification: Practical Implications

A game design built and incorporated into a learning platform was assessed and theoretical and practical aspects of the gamification were discussed in a study [11]. Lessons and exercises within a course were presented as challenges and tasks to be completed by the students. Rewards in the form of trophies were awarded to them on completion of the challenges. The leaderboard displayed rankings of the students based on their achievements gained by completing the tasks. However the gamification design presented in the study is more specific according to the course needs rather than generic.

2.7 Learning Analytics

Along with the gamification, learning analytics is also an important field which considers the data generated by learning systems as an excellent repository to be analyzed by institutes in order to get insights into learning behavior of the students. According to NMC Horizon's Report 2014, data sets generated by Learning Management Systems in educational institutes can be used to provide learning analytics helping in development of decision systems and providing institutes with rich educational data to analyze students' behavior and develop new learning patterns [12].

A study using the learning analytics was conducted to track the students' behavior in an online courses and learning activities in order to analyze the relationship between their participation and success rate during the course. A total of 354 students participated in the study. The results were generated using student access logs including their frequency and duration of participation in the course. The study showed that there was significant difference in engagement rates between the successful and unsuccessful group of the students [13].

Another study in [14] discussed a virtual environment developed to record personal learning activities of the students. Utilizing this technique a prediction model was presented to predict students' academic achievements.

Course Signals at Purdue University is an example of early warning system which uses educational data to provide students with a feedback based on real-time data which can help them to improve their academic performance. Course Signals uses Student Success Algorithm (SSA) to predict the success rate of students by taking performance, effort, academic history and characteristics of the students as an input. Performance of students is measured by considering their percentage and grades in a course. Effort is measured through student's interaction with LMS as compared to his class mates. Academic history is measured by using High School scores of students and other characteristics include residency, age and credits attempted by student in a course. This provided students with an opportunity to know about their performance in the course and helped instructors to warn the students at more risk along with tutoring suggestions for improvement. The study results showed that Course Signals proved to enhance the performance of university students by observing an increase in the retention rate and improvement in satisfactory grades among the students [15].

Chapter 3

Methodology

The main aim of the thesis is to make lecture understanding more effective for students by increasing student-instructor interaction and student engagement in the LMS. For this purpose game elements are introduced into LMS. Game design elements are the key elements in design of a gamified application. These elements determine the success of any gamified system. This chapter discusses the existing LMS, proposed design and the game design elements selected to gamify the LMS. The gamified components of the proposed system are presented in detail in this chapter.

3.1 Existing LMS Design

Learning Management System (LMS) is mainly used by students and instructors in order to manage the course contents, communicate with each other and monitor the learning process to some extent. Learning Management Systems act as repository for educational data which can be gathered and analyzed to get an insight into students' learning behavior [16].

Though acting as efficient repository and providing management facility to both students and instructors, existing Learning Management System seems to lack in capturing the interest of students. As discussed earlier, the main purpose of this thesis is to make the students understand their lectures by increasing their engagement in the system. Lectures Component in existing LMS assists instructors to upload the lecture with the time. The Lectures component in current LMS provides the student with an option to

download lectures and other resources. However this traditional system does not let students to rate the parts of lectures which are difficult. Instructor on the other hand, is not aware if the lecture and other resource content is satisfactory for the students or not.

3.2 Proposed LMS Design

A study conducted has shown that new learning experiences and the use of technology in learning can affect the students' learning activity [17]. Therefore students' engagement in a system is the key element to determine their path in the learning process. Keeping this in mind, gamification design for LMS is proposed in order to achieve the goals of the thesis. Fig-3.1, shows the pictorial representation of proposed LMS design. In the proposed design, gamification is employed in LMS, additional LMS components are added to make it interactive and Learning analytics is applied by making the use of activities log generated by recording students' activities. The purpose of proposed design is to analyze effect of all these applied techniques on the learning behavior of students.

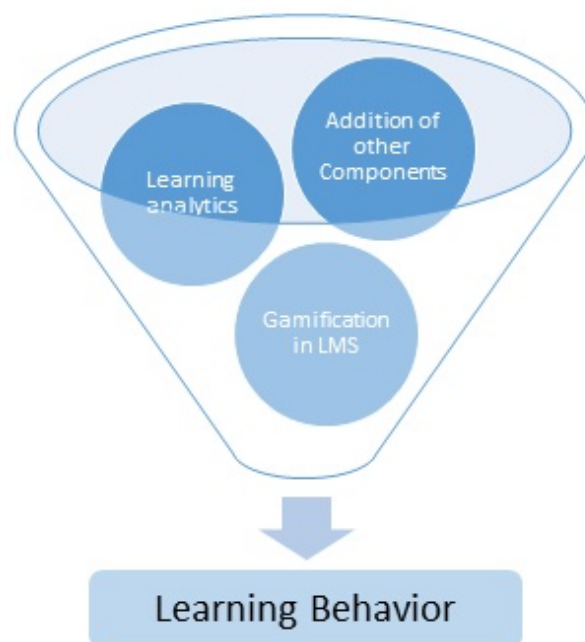


FIGURE 3.1: Overview of Proposed LMS design

3.3 Gamification Design Process

Different game elements are used and designed in order to make LMS more engaging meanwhile also making lecture understanding more promising. The game design elements used in LMS and the way these elements are incorporated in LMS are discussed next.

3.3.1 Game Elements in LMS

Game elements define the basic design of a gamified application and play an important part in the gamification. In this section, we will discuss the game elements used in gamified LMS to increase student engagement and present the reasoning for using each of these game elements.

3.3.1.1 Points

Points act as a basic unit in a gamified system and provide a base for building leaderboards, showing progress, and assigning badges to the users. In the gamified LMS, points were assigned to students based on their activities in LMS. Points bar is displayed to each student on their dashboard.

3.3.1.2 Levels

Levels show the progress of a user and show how far they have come [18]. The level represents how better user is playing or achieving the goals among others. We have included incremental levels that act as point thresholds, meaning that on gaining certain number of points student's level is incremented. Fig-3.2, shows Points bar for different levels used in the system along with the icons and points range within which each level falls.

3.3.1.3 Leaderboard

Leaderboard shows the ranking of each player against others in a game environment to promote motivation and competition among the players. Leaderboards built in different

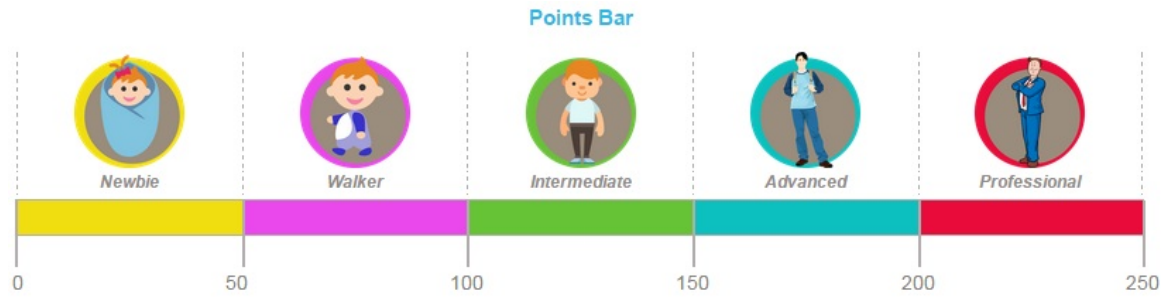


FIGURE 3.2: Points bar showing levels along with the points

systems are utilized in different ways. GradeCraft [8] displays the individual's relative standing within class on the basis of the current score and average score of the whole class instead of displaying the ranking of the class individuals to lessen the effect of demotivation. Some systems use leaderboard to visualize the number of tasks or challenges completed to achieve the goals in gamified system [9]. This helps to make the challenges more competitive among the learners.

Leaderboard built for the proposed gamified LMS provides two mechanisms. One of them is the relative ranking in the form of displaying the ranks of top ten students in a class, their scores (points) and levels as shown in Fig-3.3. Showing the top ten students in the leaderboard will not demotivate the students lower in ranks and let them compete with each other. Trends in leaderboard reflected the previous ranking of the student in class which would help them to analyze their individual progress. The other mechanism is to let the students compare their achievements in the form of the badges awarded for their different activities as shown in Fig-3.4.







Class Leaderboard				
Rank	Student	Scores	Level	Trend
1	 Daim Ali	161	 Advanced	Equal ↔
2	 Abeeha Shafiq	159	 Advanced	▲ 1 Rank Up
3	 Kuldeep Kumar	157	 Advanced	▼ 1 Rank Down

FIGURE 3.3: Class Leaderboard showing rank, points, level and trend of students









Class Leaderboard				
Rank	Abeeha Shafiq			
1	Quiz Badges:  2 Gold  1 Bronze	Assignment Badges:  1 Silver	Participation Badges:  1 Gold	
2	 Abeeha Shafiq	159	 Advanced	Equal ↔
3	 Kuldeep Kumar	157	 Advanced	Equal ↔

FIGURE 3.4: Class Leaderboard showing achievements of students in form of badges achieved

3.3.1.4 Badges

Badges act as a piece of acknowledgement for the players and show accomplishment of certain tasks in a game. Badges can be displayed as locked and unlocked entities during the achievement of tasks in a game environment [9]. Furthermore, different systems provide instructors a privilege to create and customize the badges in order to achieve the skills and objectives set in a particular course [8][9]; however this feature assumes instructor to be an active participant in a learning system.

Presuming that gamified system elements act as basic motivating factor for students, badges in gamified LMS were awarded for quizzes, assignments and participation of the students in order make the students aware of their academic responsibilities along with enjoying the game experience in LMS. Badges are designed in a way to provide immediate recognition to students' success in quizzes, assignments and participation activities. For this purpose three badges - gold, bronze and silver, are designed for each activity. Fig-3.5, shows the badges gained by a student in gamified LMS which are shown on his dashboard. Students can view the badges gained by their peers in leaderboard but not the individual activity points to make privacy a priority in terms of gained marks in class activities.

3.3.1.5 Avatars

Avatars play an important role in game as they give a control to the player that how they look like. Students can select from a list of avatars in gamified LMS along with

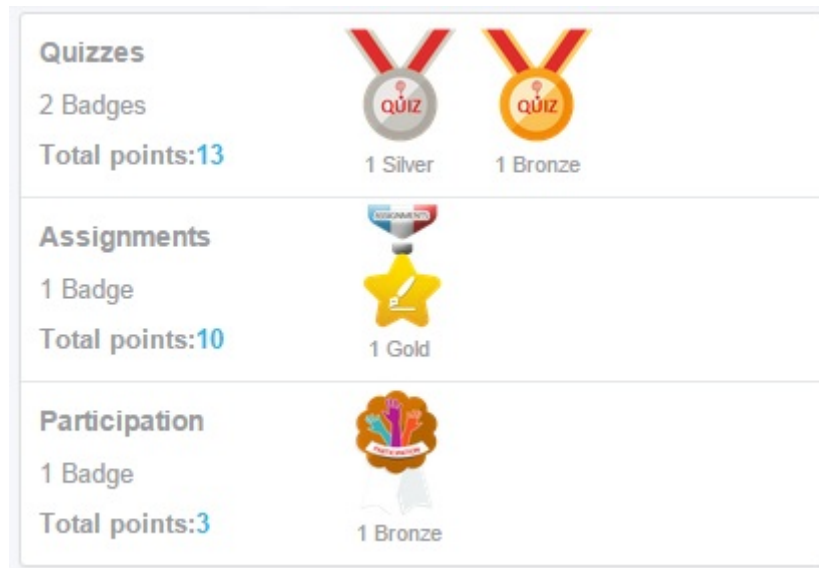


FIGURE 3.5: Different Badges gained in class activities

an option of selecting profile picture. Fig-3.6, shows the list of avatars used in gamified LMS.

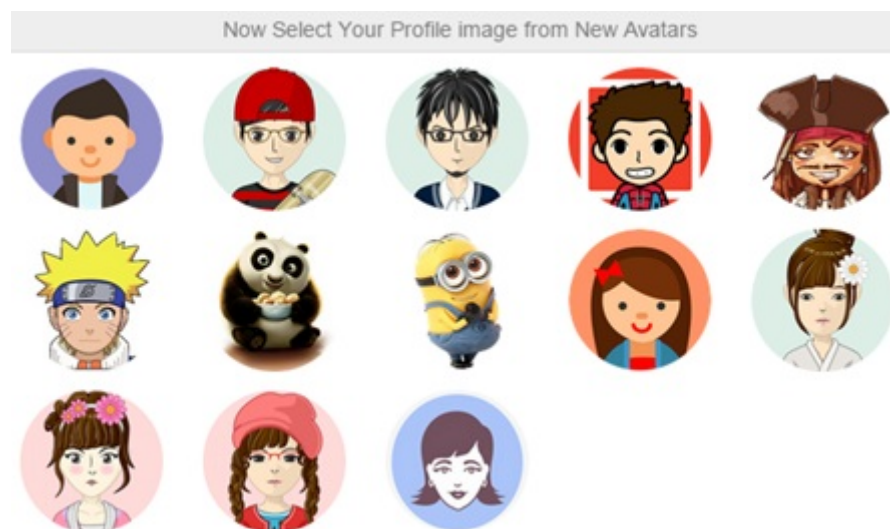


FIGURE 3.6: Avatars list for students

3.3.2 Gamified LMS Components

This section discusses the components of LMS which were gamified using the game elements and techniques discussed in the previous section. The components which are gamified are as follows:

1. Lectures component which is used to view and download the lectures and other readings uploaded by the instructor.
2. Questions and Discussions component where students can discuss lecture questions.
3. Attendance Component.
4. Quizzes, Assignments and Participation components as part of students' academic activities.

Each of the gamified components and other components which can affect students' activities in an e-learning system are discussed for student and instructor perspective separately in detail below:

3.3.2.1 Student Perspective

3.3.2.1.1 Gamified Components

a. Lectures Component:

In order to improve the traditional models of education, new models are presented which focus on increasing the knowledge skills and learning of their learners. By making new and effective strategies and developing new tools for learning, educational goals at institutes can be achieved [19]. Game design used in Lectures component is an example of such a strategy, developed in order to improve the effectiveness of lectures in a class which will help the students to comprehend the lecture.

Lectures component deals with the view and download of lectures and other readings uploaded by the instructor. In order to improve the effectiveness of lectures, students are provided with "Understanding option" for each lecture, where they can check the slides they understood in lecture and leave the others unchecked. This strategy is developed in order to allow the students to extend their knowledge by attempting to read the lecture and to provide the instructor with a feedback showing the difficulty level of the slides in their lecture. In order to incentivize this activity students are awarded with certain points on submitting the understanding of lecture. Submitting the understanding within 24 hours of lecture upload will

award a fix number of 15 points to the students. These points decrease as the understanding of a lecture is delayed by a student and after five days no points are awarded. The primary purpose of this game design is to make sure that students make an attempt to read the lecture as early as possible after it is uploaded by the instructor. The understanding points awarded after submitting understanding on second, third, fourth and fifth days are 10, 8, 6 and 4 respectively. Fig-3.7 shows the Lectures component for students where they can fill lecture understanding. Along with submitting the understanding, students can also ask questions related

LECTURES

Lecture 1 Understanding has been submitted **8pts** ▾

Slides 🕒 Lecture uploaded on: **01/04/2015, 12:00:am** ▾

Understanding ▾

Select the slides you understood from: **Lecture 1**

Understand:	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
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You can ask any questions/queries about this lecture from instructor below. (It will be fully confidential):
 ⓘ You can mention slide number also alongwith your questions for reference.

[Submit](#)

FIGURE 3.7: . Lectures Component for Students

to the lectures. This plays an important role in motivating students' participation and start a new discussion thread, which will be discussed next.

b. Questions and Discussion Forum:

Students' collaboration in an e-learning environment helps them to share knowledge, ideas and help each other. Social collaboration helps in enhancing students' learning activities.

In a study conducted for an online-learning system [20], the interaction of learners with other learners, instructor and system was observed and found to affect their learning in a positive way. Learners' engagement in system and their interactions resulted in an increased and better perception of learning.

In order to motivate the participation of students, points system is built in Questions and Discussion component. A new discussion thread is initiated when a student asks a question in lecture. Each of the questions can be further discussed by the class students and their discussion is rated by the instructor. Instructor has the privilege to rate each question and reply of the student from 1 to 5. This point system will assist in motivating students for active participation in the discussion. Fig-3.8, shows the Questions and Discussion component for students.

The screenshot displays the 'Questions and Discussions' interface for a course titled 'Assignment2-BSCS3'. The top navigation bar includes 'Assignment2-BSCS3' (checked), 'Slides', 'Understanding', and 'Questions and Discussions' (selected). The 'Questions and Discussions' section shows '2 Questions posted for this lecture.' Below this, a thread titled 'Thread 1:' is visible. The first post is by 'Momna Saeed' asking for clarification on the number of topics to choose, with a 'Rated: 3' button. Two replies from 'admin' state 'You need to choose only three.', each with a 'Not rated yet' button. A 'Discuss this thread' button is at the bottom right.

FIGURE 3.8: Questions and Discussion Component for Students

c. Attendance Component:

Attendance component deals with assigning points to the students based on their presence in a lecture. Two points per attendance are awarded to the student. Attendance progress bar is also shown on main dashboard showing the attendance in terms of percentage. These points are awarded in order to encourage students to attend their lectures regularly.

d. Assignments, quizzes and participation Component:

Assignments and Quizzes points are awarded on regular basis as suggested by the instructor and participation points are awarded by instructor on the basis of activeness of students on LMS. These points can be uploaded weekly by instructor and badges are awarded afterwards.

3.3.2.1.2 Other Components In addition to incorporating game elements in different LMS components, some LMS components were modified to make them interactive and easy to use as compared to old LMS. These components are discussed below:

a. Feedback Component:

Feedback component deals with a set of questions asked about the instructor from the students. Collecting students' feedback about the instructor is considered an important factor which informs instructors about their teaching effectiveness in class and helps them to improve teaching and course quality in the future [21]. Feedback in learning environment is an effective way of instructor evaluation by the students.

This component was redesigned to make it interactive which has meaningful and user-friendly interface as compared to feedback system in traditional LMS. Students are provided with feedback questions related to three sub areas namely personal traits, course management and class management to be filled for the instructor. A dynamic and interactive chart is displayed which changes the color values as the student fills the form and selects the options for each question. Fig-3.9 shows the design of Feedback component in gamified LMS.

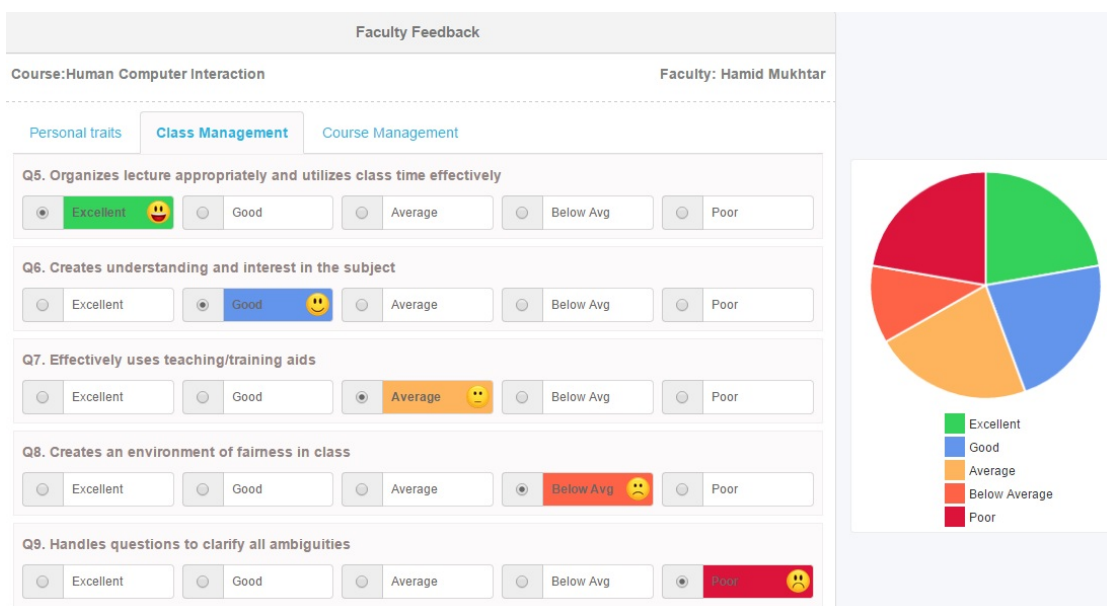


FIGURE 3.9: Feedback Component

b. Messages Component:

Messages component is new where instructor can send any messages to class and students can view them. Student gets notifications about the class messages which disappear after viewed once. Fig-3.10 shows the Messages component for student where student can view and read the messages sent by instructor.

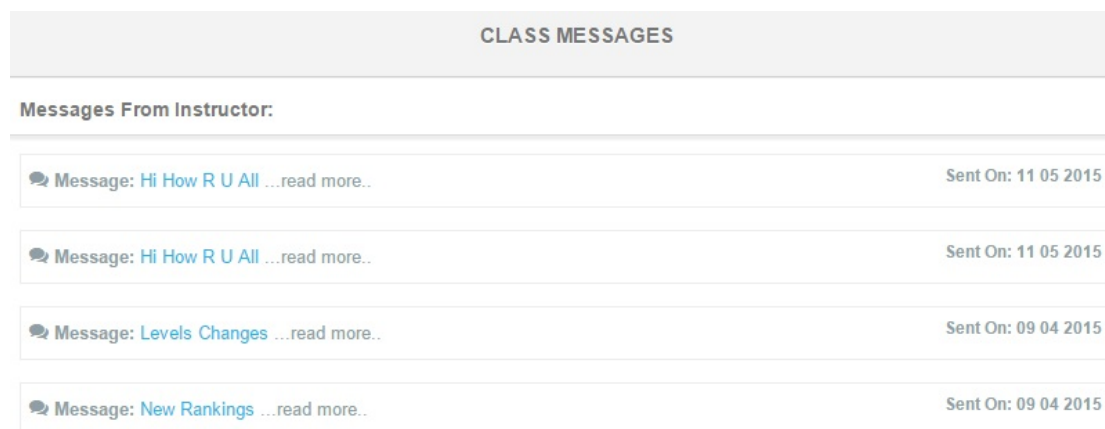


FIGURE 3.10: Messages Component for Student

c. Achievements Component:

Achievements Component is a new component which is shown both to students and instructor. This component shows the recent achievements of the student and his class mates. The important achievements are displayed along with the time of the achievement. The activities highlight the new level attained by the student or any points gained by them. Achievement's awareness through this component will promote an environment of competition among them. Fig-3.11 shows the Achievements component in LMS.

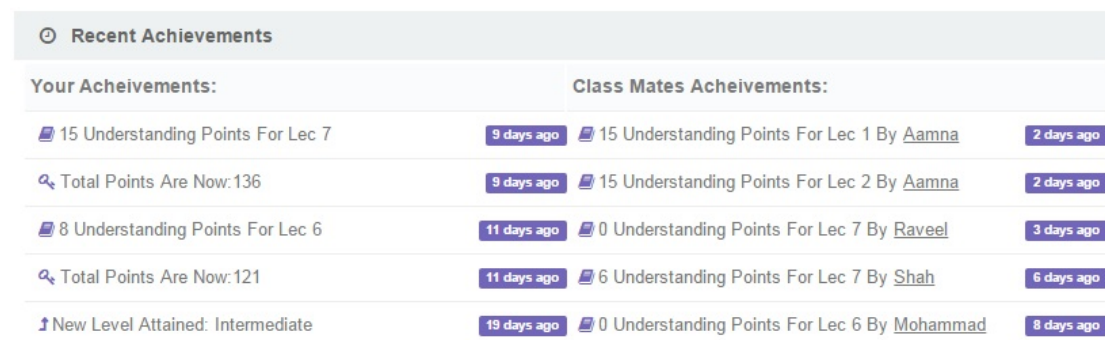


FIGURE 3.11: Achievements Component for Student

3.3.2.2 Instructor Perspective

Instructor is provided with the components mentioned above which give them better understanding of class activities and provide different functionalities which are discussed below in detail:

a. Lectures Component:

Instructors can upload the new lecture in Lectures component and visualize understanding of each lecture per slide by the class. This helps instructors to see if their lecture content needs to be altered or not. Fig-3.12 shows the Lectures component as viewed by the instructor showing the understanding of each slide within the lecture.

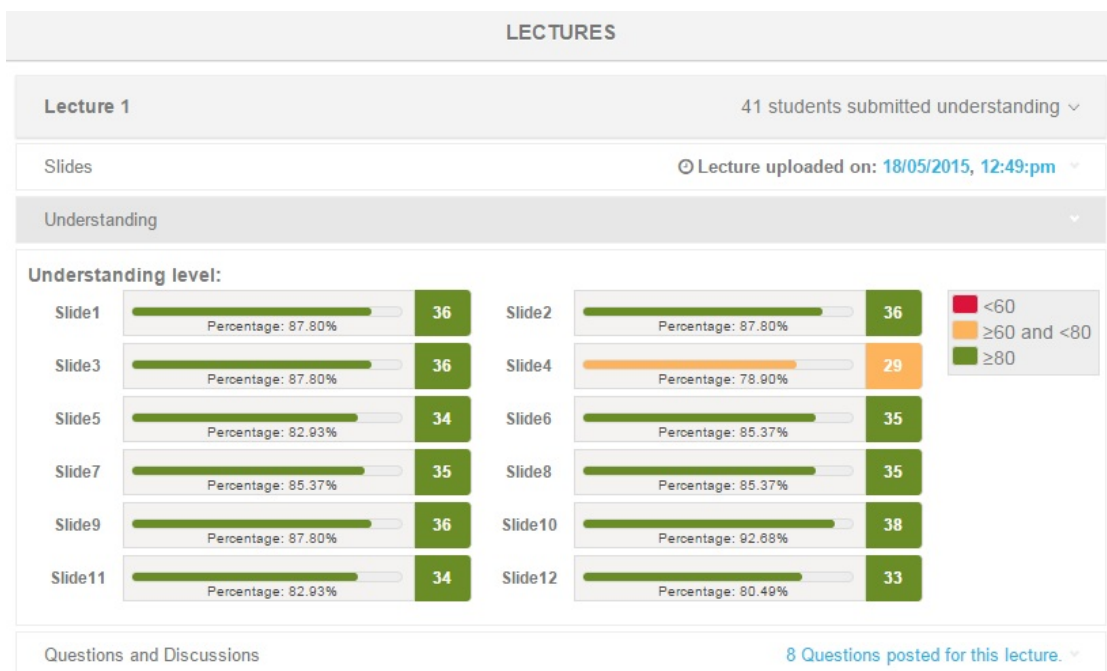


FIGURE 3.12: Lectures Component for instructor

b. Activities Component:

Activities component allows instructor to upload attendance, quizzes, assignment and participation files to upload student marks. Fig-3.13 shows Activities component where instructor is provided with separate panel for uploading excel file for each activity.

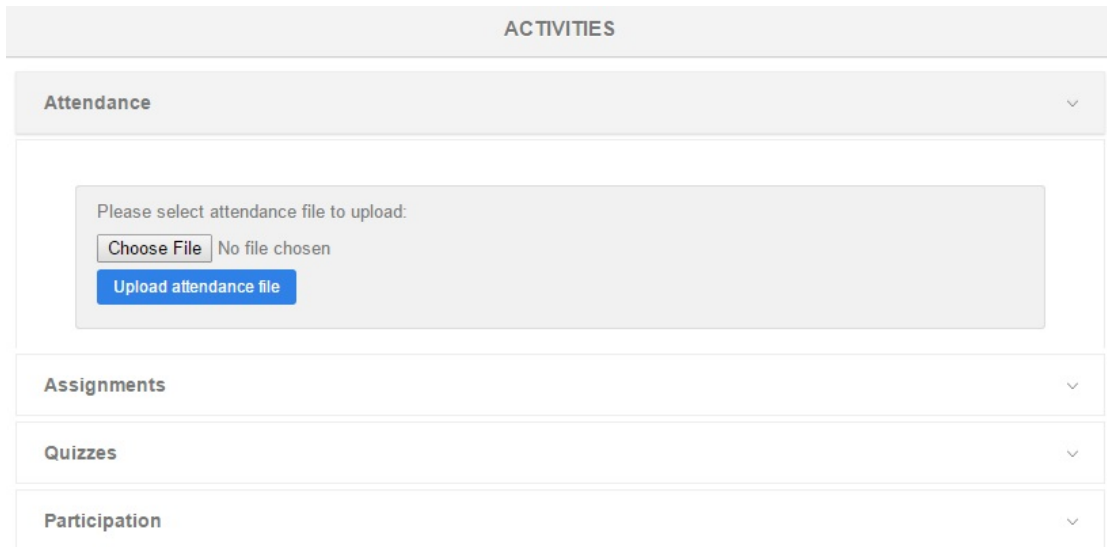


FIGURE 3.13: Activities Component for Instructor

c. Class Points Component:

As discussed in previous section, leaderboard in the proposed system shows the rankings and achievements of top ten students to instructor and class. However, in order to let the instructor have insight into individual points of the students and know their rankings within each activity or component, Class Points component is designed. Instructor can view each students' individual activity points and sort them in order to analyze their behavior as shown in Fig-3.14. Data collected through e-learning system can help the instructor in analyzing learners' behavior throughout the session and provide feedback to the students accordingly as suggested by [8]. Real-time feedback can also be generated in order to increase student performance and let them know their progress in advance [15]. Activities data of students collected as part of log data can lead to such data analytics in future in the proposed gamified system.

d. Feedback Component:

Feedback component informs instructor about his performance in the class and the effectiveness of his course content. Instructor can view how many students have submitted feedback. Feedback is displayed in form of progress bar displaying three different colors to show the acknowledgement level of instructor as marked by the students in the class. It also shows comparison of teacher's performance among different sections for each question. Performance chart in Feedback component represents overall performance of instructor in the class in an enhanced chart view.





Class Points							
Rank	Student	Quiz Points ^	Assignment Points ^	Part Points ^	Attendance Points ^	Understanding Points ^	Total ^
1	 Daim All	26	8	5	22	100	161
2	 Abeeha Shafiq	24	10	3	22	100	159
3	 Kuldeep Kumar	23	7	5	22	100	157
4	 Amal Mubashar	20	10	2	20	100	152

FIGURE 3.14: Class Points Component for Instructor

Fig-3.15 shows the feedback component as viewed by instructor and Fig-3.16 shows the performance chart generated by the component from collected feedback.



FIGURE 3.15: Feedback Component for Instructor

e. Messages Component:

Messages component allows Instructor to interact with the class by sending them messages at different times during the session. These can be any messages related to their performance on LMS, their recent quiz or assignment activity or of instructor choice. Fig-3.17 shows the messages panel for instructor where he can send any message to class with appropriate title.

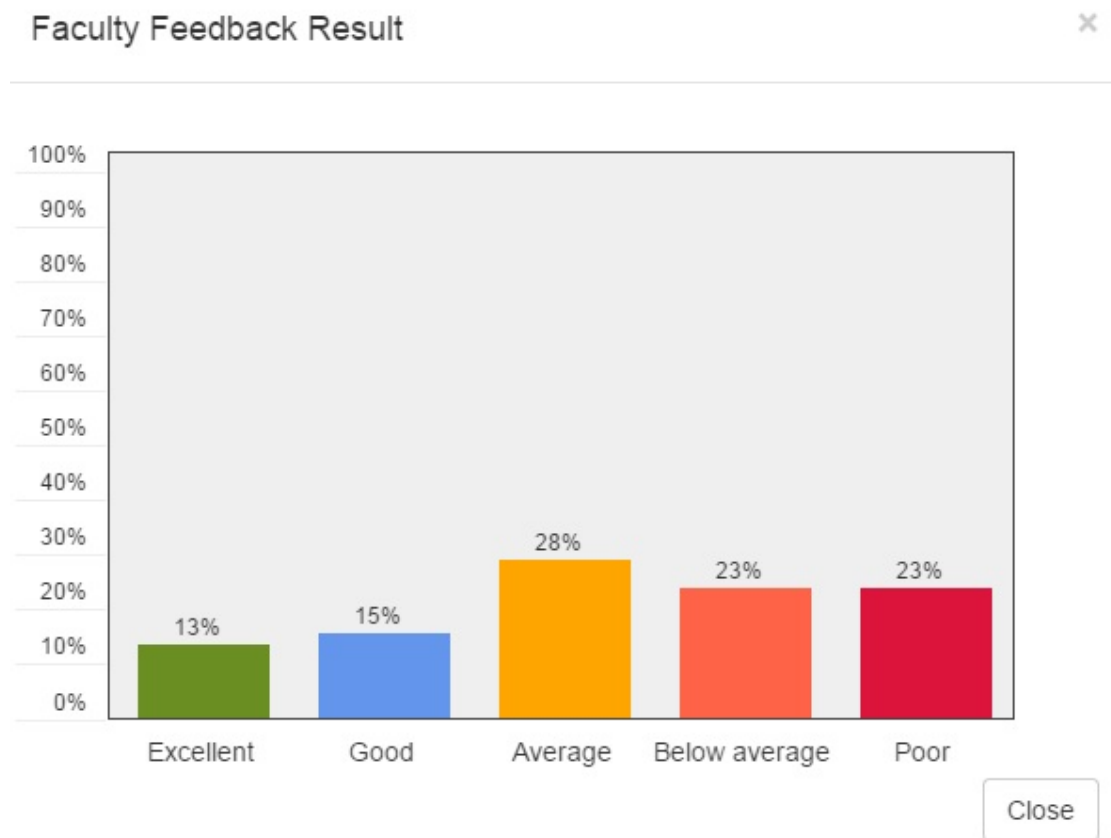


FIGURE 3.16: Performance chart generated by Feedback Component for Instructor

CLASS MESSAGES

Type message title

Type a message to send to class:

FIGURE 3.17: Messages Component for Instructor

3.4 System Implementation

In this section we will briefly discuss the system implementation used. The traditional LMS used moodle, an online open source framework for Learning Management System [22] as e-learning platform for online content. The gamified LMS is developed as an independent web system where server side implementation is done in PHP, with MySQL used for data storage. The client side implementation is done in HTML and CSS. The developed web system can be accessed and used from any software or hardware platform making it available to be used on personal computers or mobile devices.

Chapter 4

Results and Discussion

This chapter presents all the phases of testing used for evaluating the gamified LMS. The activities log was recorded for the gamified LMS and traditional LMS. The results were analyzed by comparing the both activities logs. The interpretation of results in terms of the goals focused by the thesis are discussed in detail in this chapter.

4.1 Testing Phase

The developed system was tested for five weeks on a group of 78 students of fourth semester enrolled in the “Human Computer Interaction” course. The students were divided into two groups. Group A with 35 students was selected as experimental group and Group B with 43 students was selected as control group. Group A (experimental group) used the gamified system while Group B used the traditional LMS only during the five weeks of the experiment. Lectures were uploaded by the instructor in gamified LMS in the same way as in traditional LMS. In gamified LMS, total of 250 points were set as calculated for all the activities and therefore five levels were used because the system was employed for duration of five weeks.

4.2 Data Collection Phase

Data collection phase is a crucial step which provided data recorded from gamified LMS in order to be analyzed for results and evaluation. Gamified LMS is designed in a way

to record the activities of students in the system in the form of activities log. These activities log was collected by recording each activity of students in the gamified LMS. Following six type of activities were recorded keeping in mind the main objective of thesis and comparative analysis technique used for logs between traditional and gamified LMS:

1. login
2. lecture view
3. understanding submitted
4. page visited
5. message read
6. profile change

Each activity has attributes which describe that activity in detail. Table-4.1 shows the attributes of these recorded activities and their description. Activity name represents the activity in a more precise way. For instance, activity type “lecture view” can have a specific activity name depending on the lecture number viewed by the student.

The traditional LMS uses the moodle framework. Moodle records the activities log in LMS automatically and can be saved in the form of log files when needed by the instructor. The activities logs from both gamified and traditional LMS from April to mid-May were explored further for results analysis and interpretation.

TABLE 4.1: Name and Description of attributes of activity

Attribute name	Description
Student	Student who has performed the activity
Activity type	Type of activity from the six types
Activity name	Name of precise activity
Date	The date on which activity is performed
Start time	Start time of activity
End time	Time at which activity ended

4.3 Results and Findings

Activities log gathered during collection phase contained a total of 6800 events for group A from gamified LMS and 3,041 events for group B from traditional LMS. In order to

analyze the events in more detail and get insight into log files, Splunk tool¹ is used. Splunk is a set of products for log search and analysis which assist in detailed monitoring of machine generated data and provide detailed visual analysis of the log data [23].

Activities log was explored in a way to observe and analyze different activities of the students. This provided with detailed analysis of the log data and the events for analysis.

In order to analyze the activities of students in the Lectures component, lecture views of students, after the lecture was uploaded, were analyzed and compared for both sections. Fig-4.1, 4.2, 4.3, 4.4 show the comparison of lecture views between the traditional and gamified LMS for the four lectures, where x-axis represents the date and y-axis shows the number of events. It can be observed that the number of lecture views on the day lecture was uploaded are more on gamified LMS as compared to that on traditional LMS. Therefore we can state that gamifying the Lectures component led to an increase in the lecture views and downloads as early as the lecture was uploaded. In this way students accessed gamified LMS more frequently than traditional LMS for viewing lectures.

Table-4.2 shows the number of lecture views by students on first day of lecture upload for group A (experimental group) and group B (control group). It shows that on first

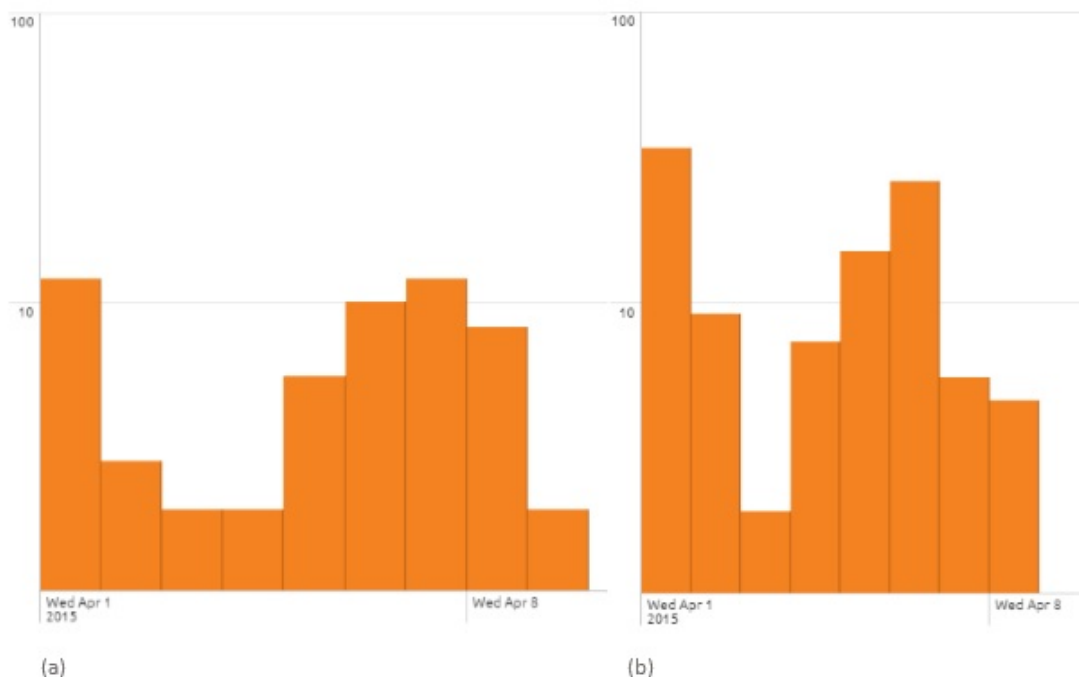


FIGURE 4.1: Lecture views on both LMS (a) traditional LMS and (b) gamified LMS for lecture uploaded on 1st, April 2015

¹<http://www.splunk.com/>

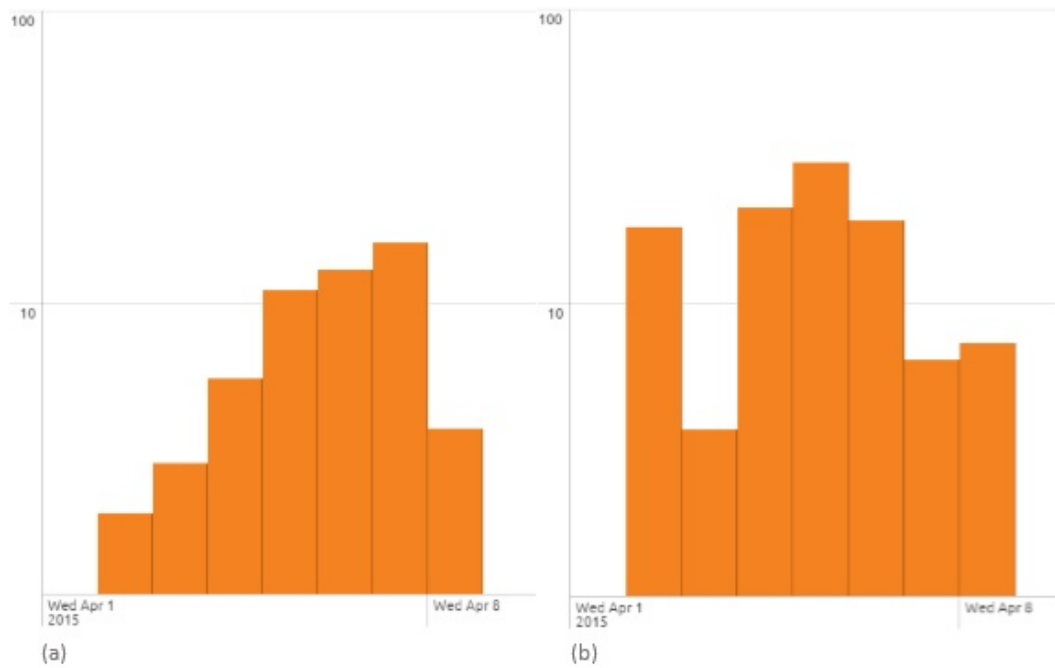


FIGURE 4.2: Lecture views on both LMS (a) traditional LMS and (b) gamified LMS for lecture uploaded on 2nd, April 2015

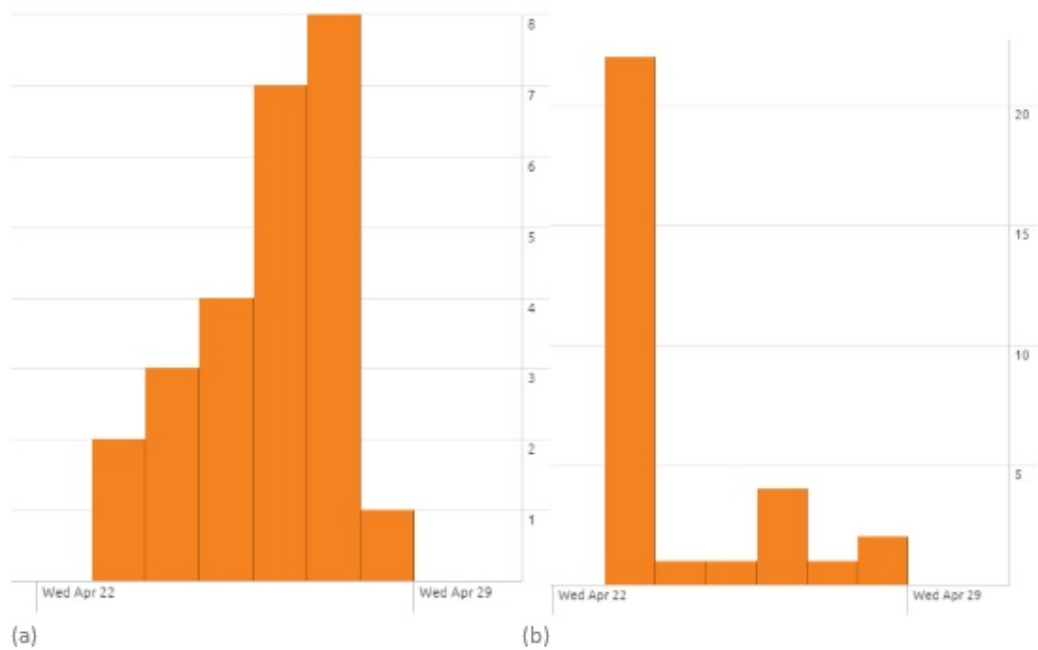


FIGURE 4.3: Lecture views on both LMS (a) traditional LMS and (b) gamified LMS for lecture uploaded on 23rd, April 2015

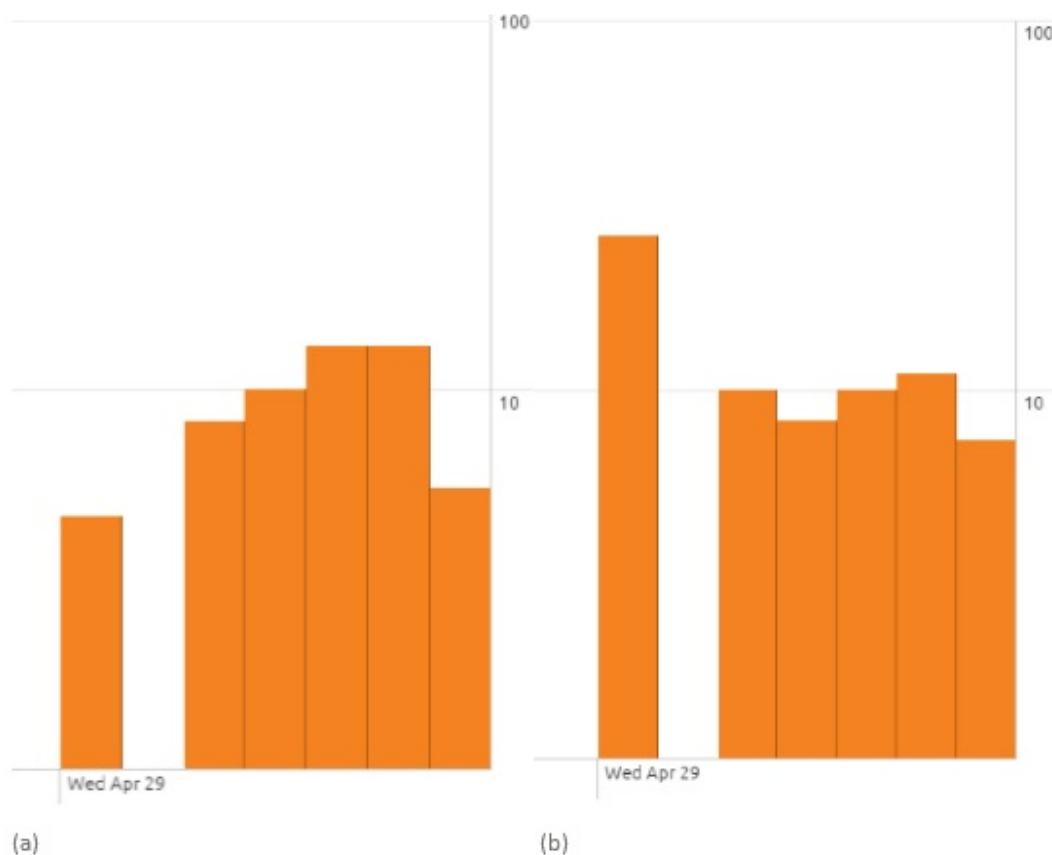


FIGURE 4.4: Lecture views on both LMS (a) traditional LMS and (b) gamified LMS for lecture uploaded on 29th, April 2015

day the number of lecture views in gamified LMS are more than those on gamified LMS.

TABLE 4.2: Number of lecture views on first day of lecture upload by group A and group B

Lecture number	Lecture views by group A	Lecture views by group B
Lec 1	34	12
Lec 2	18	2
Lec 3	22	2
Lec 4	26	4

Another important observation was forum discussion and views on LMS. When forum discussion was mapped to individual students' monthly test and end semester exam marks, the more active students on the LMS were the ones with above average marks in the corresponding exam and test. Furthermore, the top students on the Leaderboard were also among the top scorers in the class. Therefore we can hypothesize that increased

engagement of students in gamified LMS in the form of forum discussion led to have impact on their academic performance.

4.4 Analysis of Understanding component

In order to analyze the understanding lecture component of gamified LMS, which is the most important component of gamified LMS in terms of gamification, in detail, we used bivariate Pearson correlation analysis. Pearson correlation will allow us to find the relationship between the understanding points of students which are recorded on gamified LMS and students' final grades. This relationship will help us to hypothesize about the evaluation of gamified LMS in terms of understanding component. We used IBM SPSS Statistics tool to measure the correlation between understanding points of students and their grades. SPSS Statistics² is a toolkit provided by IBM for using statistical techniques to gather, visualize and analyze data and make important predictions from the available data[24].

4.4.1 Bivariate Pearson Correlation

Correlation refers to the relationship between different variables. Bivariate correlation is a type of correlation which is used to measure the relationship between any two variables. Bivariate Pearson correlation is bivariate correlation between continuous variables which tells us about the type and strength of relationship between those variables. The Pearson coefficient value varies from -1 to +1. If Pearson coefficient is +1 or near +1, it indicates that a positive correlation exists between variables i.e., the larger the X , the larger the Y , whereas if coefficient is -1 or near -1 it indicates that a negative relationship exists between variables i.e., the larger the X , the smaller the Y . Pearson coefficient with value 0 means that no correlation is present between the variables.

In order to analyze the understanding component, we need to find out the variables of interest first. As gamified LMS was tested on group A, therefore students from group A were considered and their understanding points and final grades were taken into account for Pearson correlation analysis. The students' understanding points in gamified LMS are gained by students when they submit lecture understanding. Therefore we consider

²<http://www-01.ibm.com/software/analytics/spss/products/statistics/>

the understanding points scored by students in gamified LMS as first variable. In order to find the relationship between students' understanding points and their grades, we take final grades of students gained by them in class as second variable. However, Pearson correlation works on continuous variables, therefore we converted grades of students into total points gained by them at the end of semester. After selecting the variables, we used SPSS tool to calculate the Pearson coefficient value and significance coefficient value. The Pearson coefficient and significance coefficient are the important values in Pearson correlation analysis. Pearson coefficient (r) tells us about the type and strength of correlation between the variables that whether it's positive or negative relationship. Significance coefficient (p or Sig) tells us if there exists statistically significant correlation between the variables or not. In 2 tailed test if Sig or p value is less than 0.05 then it means that correlation between the variables is significant. In order to analyze these values we conducted Pearson correlation (2-tailed) test on log files, with students' understanding points in gamified LMS and their grade points as variables of interest using IBM SPSS tool. Table-4.3 shows the results of Pearson correlation as calculated by IBM SPSS tool. The first variable is students' understanding points represented by *under_scores*, second variable is *grade_points* representing students' final points as converted from their grades gained by them at the end of semester and N represents the total number of students whose data was recorded from group A.

TABLE 4.3: Pearson correlation results for students' grade points and understanding points

		grade_points	under_scores
grade_points	Pearson Correlation	1	.371
	Sig. (2-tailed)		0.028
	N	35	35
under_scores	Pearson Correlation	.371	1
	Sig. (2-tailed)	0.028	
	N	35	35

The Pearson coefficient value for grade points and understanding points of students is positive which shows that positive correlation exists between both. Significance coefficient value (Sig.) is 0.028 which is less than 0.05, this implies that there is a significant correlation between the grade points of students and their understanding points on gamified LMS. Therefore we can hypothesize that positive and significant correlation is present between grade points and understanding points of the students. This means

that the students who have submitted lecture understanding on time and gained high understanding points are shown to have the corresponding high grades at the end of the semester in class. Therefore we can hypothesize that a positive correlation exists between grade points of the students and their understanding points on gamified LMS.

4.5 Summary

In this chapter, the experimental design and all the phases of testing and analysing the developed gamified LMS are discussed in detail. Fig-4.5 summarizes the whole procedure stepwise. In testing phase the gamified and traditional LMS are setup for separate groups. Then in data collection phase, activities log files were collected from both the groups. Then finally Splunk tool was used to analyze and compare the log files in Data analysis phase. The results and findings suggest that an increased engagement of students is observed in terms of lecture views and discussion forum. Furthermore, in order to analyze the understanding component of LMS which is the main component of gamified LMS in terms of determining the total gamification points of students, we used bivariate Pearson correlation analysis technique. With the help of IBM SPSS tool, we performed Pearson correlation analysis on understanding component and determined the relationship between understanding points of students and their final grade points at the end of the semester. As the Pearson correlation coefficient value calculated is positive and significance coefficient value is less than 0.05, therefore we hypothesized that a positive correlation exists between understanding points and students' final grades.

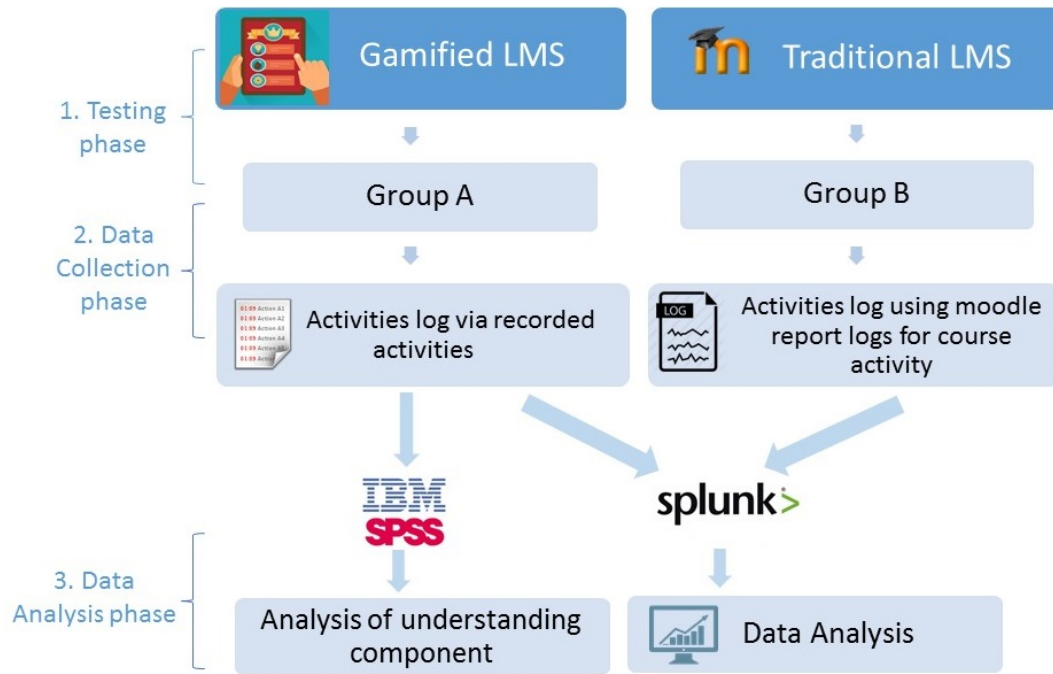


FIGURE 4.5: Overview of Experimental design and different phases

Chapter 5

Conclusion and Future Work

To fulfill the requirement of higher education at university, students need to understand their lectures properly and on time. The present thesis provided a design to engage the students in online learning system in order to understand the lecture and give a feedback to instructor about the lecture content. Furthermore, this study provided the design of a gamified LMS and the game elements utilized in order to motivate the students to use LMS and ensure increased participation of the students and competition among them. The game elements implemented with the point system is discussed in detail along with the gamified components. The system was employed for a course at the university for five weeks and the results observed from activity log showed an increase in student participation and motivated them to understand the lecture as early as possible after its delivery.

There is always a room for improvement in any developed system, therefore the gamified LMS can be further modified and upgraded in the future. LMS can be gamified in a various ways to increase the student engagement and participation which can affect their learning. The understanding submitted by the students can be made more precise by giving them an option of percentage of the lecture slide or part they have understood. This will provide instructor with a more precision of his/her lecture content. Moreover, an online quiz can also be taken from previous lecture before the students are given option to download the next lecture. This will let the students to self-assess themselves and instructor will get the feedback about students' performance in the quiz and their level of understanding in the lecture. Another way in which gamification can be employed

into LMS is by gamifying the lessons and exercises in a course. Gamifying a course will require a proper understanding of the course contents and the objectives of the course. For instance in order to improve the coding skills of the students, programming courses in a university can be gamified by testing and rewarding the skills of students on the basis of completion of coding exercises. The students' progress can be presented in the form of completion and level of understanding of programming exercises, which will also require instructors to act as active participant. Different rewards and gifts can also be provided to top scorers on leaderboard at the end of the semester in order to motivate them to explore the gamified lessons more frequently. Moreover, activities log generated by LMS can also be taken as a valuable source to predict the performance of students during the whole semester. This data can act as excellent source for instructors to analyze the students' learning behavior and provide them with feedback and inform them on time if they are not performing well.

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