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GAMIFICATION AND STUDENT PERFORMANCE IN ELEARNING: AN EMPIRICAL STUDY

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gamification; gamification in eLearning; effectiveness of gamification in eLearning; gamified eLearning; academic performance.

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Abstract
Gamification is the intentional application of game mechanics and dynamics outside the context of games. This paper aimed to investigate the impact of gamification on students' academic performance under the context of an eLearning platform supported using the Moodle-based LearningZone LMS. Gamification components such as points, grades, badges, feedback, and leaderboards were integrated into the course. A quantitative quasi-experimental study design was employed. A total of 192 University of Turbat students, and Balochistan Residential College Turbat, participated in the study. Pre- and post-testing examinations were administered to collect data. According to the paired samples t-test findings, the performance of the students improved significantly after the gamification intervention. A significant learning benefit of gamification was proven to be evidenced through the increase of the mean score from the pre-test (35.49), to the post-test (40.71), with a t-value of 32.33 and $p<0.001$. The research indicates that to enhance the participation of the students, along with academic achievements, gamification has to be implemented carefully into eLearning aligned with the learning objectives. Educational institutions must ensure the provision of technical support to the learners to ensure an impactful integration of gamification in eLearning.

INTRODUCTION

Gamification is the strategic integration of game mechanics such as challenges, rewards, and game principles in a non-game context to increase participation [1], [2]. In the early 2000s, researchers began considering the incorporation of game components in educational settings, it gained widespread recognition a decade later [3].

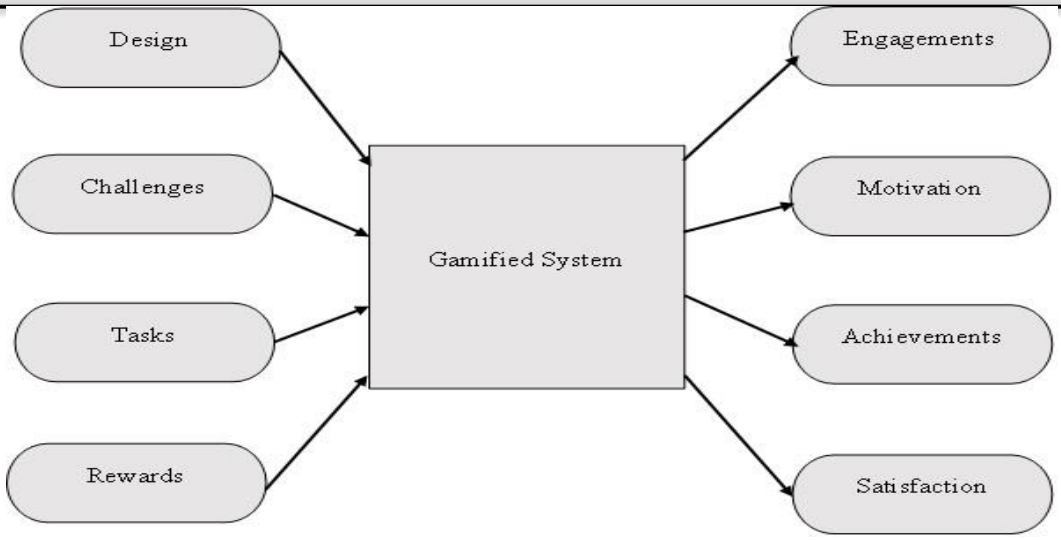

Figure-1 Gamified System

Gamification applies the ideas from games to real-world situations. A system used to implement the game concepts is known as a gamified system. A gamified system provides a feeling of collaboration, competition, accomplishment, and gratification to the users.

Gamification of eLearning is the intentional introduction of selected game mechanics, for example, points, grades, badges, feedback, and leaderboards to the education environment to increase learners' motivation [1]. It provides a more interactive, enjoyable, and engaging education process that encourages motivation and active learner engagement.

Research Objective

To investigate the impact of gamification of eLearning on students' academic performance.

Significance of the Study

Gamification of education is on the rise, and currently, there is not enough evidence-based research on the potential benefits and limitations of gamification of eLearning [4], [5]. This paper aims to determine whether a gamified eLearning system is effective at improving learners' academic achievements. The research findings will benefit instructors, instructional designers, educational bodies, and policymakers.

Literature Review

Benefits of Gamification in eLearning

When applied, gamification captures attention, increases interest, and provokes active engagement within the learning process [6]. Gamification integrated with eLearning makes it highly interactive, subsequently increasing the user's engagement with content [7]. Gamification in eLearning increases intrinsic motivation by giving a sense of autonomy, competence, and relatedness to the learner [6]. It motivates the learners to continue their learning path by involving game mechanisms, such as rewards, accomplishments, and a measure of progress [7]. Gamified learning environments enriched with interactive components have indicated positive effects on learning outcomes, improving learning experiences. Gamification supports active learning in applied settings to help gain knowledge, and develop critical thinking and problem-solving skills [7] [8].

Challenges and Considerations

The education principles and objectives are key considerations when designing and implementing a gamified eLearning system. An effective gamified eLearning system must include game mechanics aligned with the principles and objectives. The application of gamification in eLearning must consider individual learner characteristics, such as prior experiences, preferences, and motivation levels [9]. The system should enable the learners to

customize settings according to their needs and preferences. The system must also offer diverse content for selection to address the diverse needs of the learners. The gamified eLearning system must include innovative methods and tools to assess learning outcomes [10]. This requires a suitable design that reflects the use of gamification elements capable of accurate, and timely assessment of learner progress and achievement.

Best Practices and Guidelines

To keep the learners on track with their learning progress, gamified eLearning systems need clear and specific learning goals, and objectives aligned with the desired educational outcomes. A strategic integration of meaningful game mechanics that boosts intrinsic motivation and participation of the learners [6]. The incorporated game elements must relate to the subject and strengthen knowledge level and applied skills. Time-bound productive feedback over progression, when unlocking new challenges leveling up, is important to any successful Gamified Learning Environment [11]. The system must give a strong sense of community with social elements and collaboration. Such features shape a supportive learning environment, foster engagement among learners, and encourage information sharing for more constructive learning [12].

Materials and Methods

Research Design

The study adopts a quantitative research paradigm with a quasi-experiment research approach for investigating the impact of gamification on students' academic performance. It is a causal-explanatory study that seeks to analyze the link between gamification components and students' performance. Data collection employed a cross-sectional approach, where the data was captured once, from one point in time. A non-probability sampling using a convenience sampling approach was applied to students who were easily available and willing to participate. The participants already had access to the gamified eLearning platform.

Gamification of the eLearning system

This study considered the open-source learning management system Moodle for the practical implementation of gamified learning experiences. For this purpose, a learning management system named LearningZone LMS based on Moodle was developed to conduct the study.

Resources and activities were the building blocks of the course within the LMS. A resource is an item used by teachers to assist the learning process, such as a file or a link to a file or page. However, activities are actionable components of an LMS, they enable learners to interact with their peers and teachers and participate in the course. The idea of incorporating gamification in Moodle was to create an interactive and attractive environment. The game design features like points, grades, badges, and leaderboards are used to reward students' participation and achievements.

The implementation of gamification of the eLearning system took place within the departments of Computer Science, and Education at the University of Turbat, and at the Balochistan Residential College Turbat in Balochistan, Pakistan.

Course Design

A course, titled "Introduction to Computing," was designed to be easily usable to students who have no or minimal experience with such learning environments. Technical help was made available across the course to help participants. This method aimed at developing a supportive learning environment that boosts the confidence of each student.

For the proper positioning of the classes and direct communication with the participants, the Calendar and Announcement items were added to the LearningZone Learning Management System.

Course materials such as PDF books, instruction videos, and PowerPoint slides were selected very carefully to put a knowledge base in place supporting the learning progress of the participants.

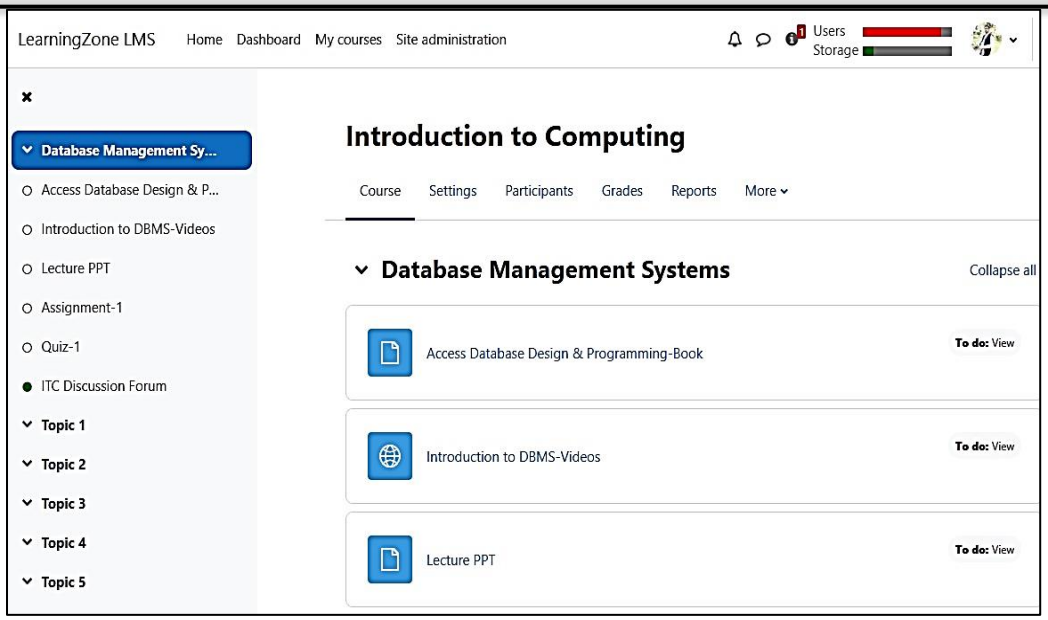

Figure 2 Resources in the LMS

The activities with the LMS were purposely designed for the engagement, communication, collaboration, and evaluation of the different segments of the learning experience. The adoption was targeted to promote leading, engaging, and meaningful interactivity in a dynamic and interactive web-based environment among students.

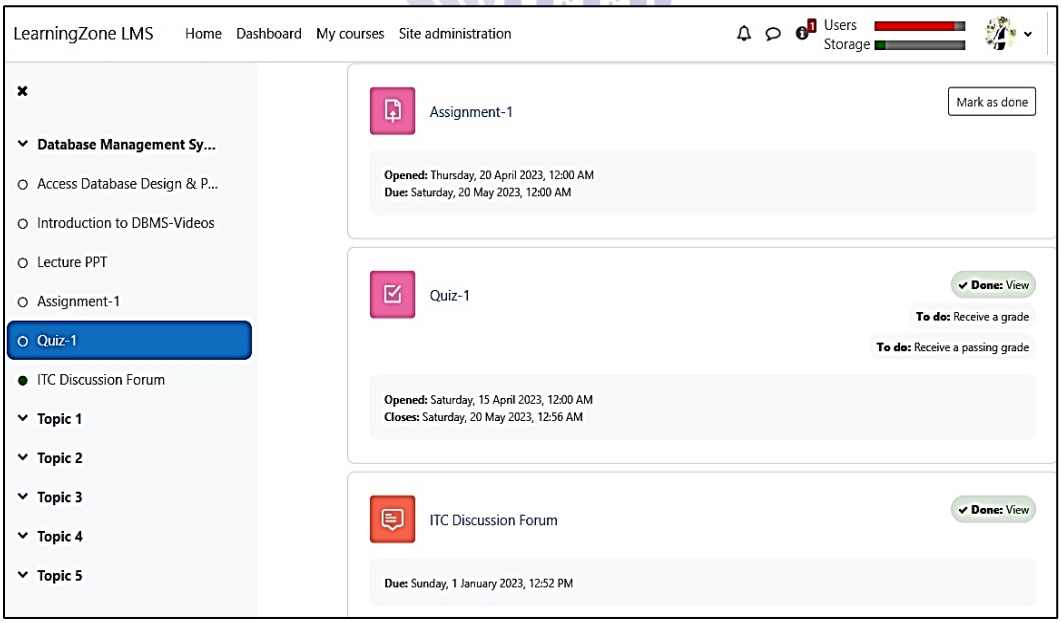

Figure 3 Activities in the LMS

Gamification Strategies

A points system was placed to promote and reward the improvement and achievements of the students throughout the course. The points were derived from the quizzes and forum discussions. For quizzes, it allowed the automatic awarding of points based on the given answers. Discussion on the forum accumulated points either from the instructor or

other students where informed answers and active participation gained recognition.

The leaderboard demonstrated a quick and easily understandable overview of the participants' performance in the course. This enabled progress tracking through the handling of points and grades from participants.

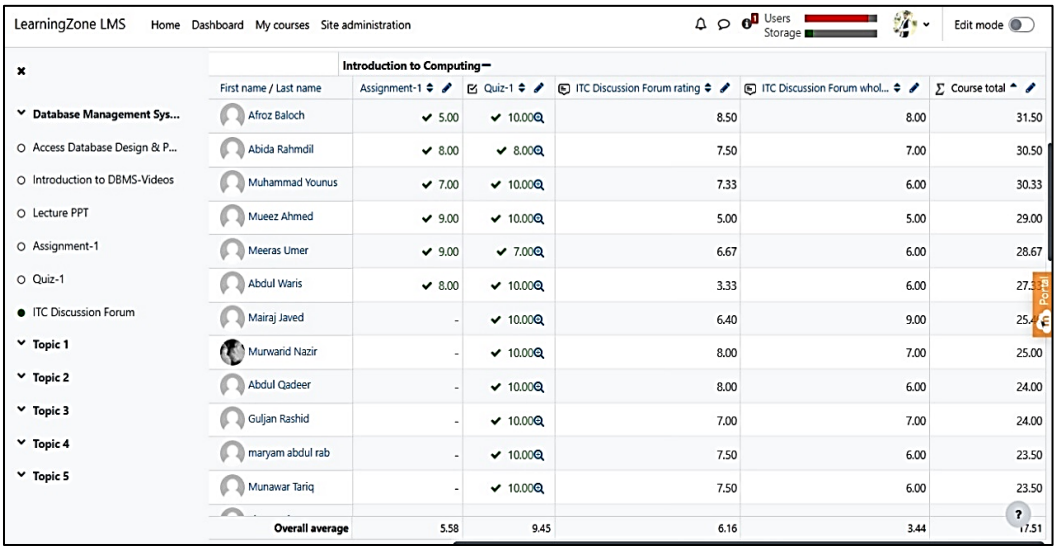

Figure-4 Gradebook in the LMS

Pre-test and Post-test Measurements

The pre-test and post-test technique is a widely used technique for evaluating the effect of an intervention on a given group. It is a process whereby a pre-test is conducted before the intervention, then a post-test is carried out after the intervention. It is widely applied in research on education to test changes in learner's performance following an experiment [13].

This study evaluated the effect of gamification on students' academic performance through pre-test and post-test measurements. The evaluation adhered to guidelines for pre-and post-testing [14]. A pre-test was taken before the implementation of the gamified course and a post-test right after the course. All the information the users needed was given to them to maintain transparency and understanding. Pre-test & post-tests were done in an undisturbed environment, enough time was provided to ensure that all participants fully expressed themselves. The researcher supervised the testing processes and provided support. Academic integrity was followed; and appropriate and strict instructions were given to the participants against cheating, plagiarism, and other unauthorized collaborations to ensure a fair and ethical environment for carrying out the research.

Pre-test responses were collected from the selected test users before the interventions and post-test responses were collected right after the intervention. The paired sample t-test was applied to the results to examine the statistically significant differences in the scores [15].

Data Collection

This study collected data in the form of students' scores in the Pre-Test, and Post-Test measurements.

Data Analysis

A paired samples t-test was conducted using the Python programming language on Pre-Test, and Post-Test measurement scores, to obtain insights about the difference between the scores to analyze the potential effect of gamification within eLearning environments.

Results and Discussion

Demographics

Table 1 Demographics of the Respondents

Group	Categories	Frequency	Percent
Gender	Male	108	56.25
	Female	84	43.75
Age	15-24 Years	192	100.0
Education	HSSC	22	11.46
	Under Graduate	170	88.54
Discipline	ICS	22	11.46
	BS in Computer Science	84	43.75
	BS in Education	86	44.79
eLearning Experience	Yes	62	32.29
	No	130	67.71

A total of 192 learners participated in the study including 108 males (56.25%), and 84 females (43.75%). Designated under three age groups of 15-24 years, 25-34 years, and 35 or older, all of the respondents fell into the same age group of 15-24 years. The majority of the participants (170) were undergraduates and 22 respondents were pursuing their education as HSSC students. From the sample of 192 students, 11.46% (n = 22) belonged to the discipline of Intermediate in Computer Science (ICS), 43.75% (n = 84) were pursuing a Bachelor's degree in Computer Science, and 44.79% (n = 86) were enrolled in a Bachelor's degree program in Education. A large number of the respondents, 130 (67.71%), had no prior experience with eLearning systems, while 62 (32.29%) had experienced eLearning environments.

Impact of Gamification on Learning

This research aims to probe into the effectiveness of gamification in eLearning through a pre-test and post-test design. The test deals with the evaluation of scores. It was used to evaluate the data obtained from the pre-test and post-test measurements to find out any significant difference between scores.

```
Import pandas as pd
from scipy.stats import ttest_rel
file_path = r'C:\Users\Jamil Murad Baloch\Desktop\phd survey data.csv'
data = pd.read_csv(file_path).dropna()
pre_test = data['Pre_Test']
post_test = data['Post_Test']
pre_test_mean = pre_test.mean()
post_test_mean = post_test.mean()
t_statistic, p_value = ttest_rel(post_test , pre_test,)
spss_p_value = '{:.3f}'.format(p_value)
print("Paired Samples t-test")
print("Mean scores - Pre_Test:", pre_test_mean)
print("Mean scores - Post_Test:", post_test_mean)
print("t-statistic:", t_statistic)
print("p-value:", spss_p_value)
```

Output

Paired Samples t-test

Mean scores - Pre_Test: 35.489583333333336
Mean scores - Post_Test: 40.7135416666666664
t-statistic: 32.33159592054183
p-value: 0.000

The insights from the pre-test and post-test using paired samples T-Test produced the mean score for pre-test=35.49 and for post-test = 40.71, indicating an increased mean difference of 5.22. The t-statistic 32.33, indicates a significant difference between the means. The extremely low p-value of 0.000 is a powerful indicator and is way below the conventional significance level of 0.05.

These results are highly encouraging, indicating considerable improvement from the pre-test to the post-test scores, and point out that the incorporation of gamification elements into eLearning retains a very positive influence on overall learning outcomes. More importantly, the current findings are in line with earlier research within this provision of study, thus

confirming both consistency and human-centered improvement observed [17], [18].

The substantial difference in the post-test and pre-test scores shows that students benefited from the learning experience. Gamification elements like points, grades, badges, and leaderboards must have increased student motivation, while instant feedback allowed them to correct mistakes immediately. Additionally, repeated exposure to the content and hands-on exercises allowed students to understand and memorize more. Gamified learning also supports active learning, and learning at one's own pace, which can lead to better understanding. Additionally, a fun and less stressful learning environment could have reduced stress and allowed focus and enhanced performance.
The insights further proved that the pre-test and post-test methods useful measurement techniques for evaluating the effectiveness of gamification in eLearning [19].

Conclusion

Employing gamification in eLearning is very beneficial from different prospects, it effectively engages the learners and increases learners' interest and active participation with the utilization of interactive content. Gamification further promotes self-motivation of the learners giving them a sense of control, capability, and relatedness in learning. Incentives like points, grades, badges, etc. progress monitoring, and accomplishments give them a sense of progress and achievement. Gamification increases the acquisition and application of knowledge.
The current study aimed to examine the effectiveness of gamification in eLearning aiming to determine best practices for effective integration. This study seeks to contribute to the literature on knowledge and understanding of gamification in the eLearning setup. The study utilized pre-test and post-test assessments to assess significant variations in the test scores of the gamified eLearning course participants. The statistics of the paired samples t-test demonstrated a significant increase from the pre-test mean score of 35.49 to the post-test mean score of 40.71. this resulted in an increase of 5.22 in mean scores. Additionally, the obtained p-value of 0.000 is highly significant. These findings indicated a positive and significant impact of gamification in eLearning.

Recommendations

Based on the empirical insights the study recommends:

Implementation of Gamified Learning: It is crucial to upsurge learners' engagement, motivation, and performance by adopting a gamified eLearning system that provides a user-friendly environment to integrate game ideas such as quests, challenges, and rewards through the use of points, grades, badges, and leaderboards to create an interactive and enjoyable learning experience that improves collaboration, and learner satisfaction.

Provide technical support and resources: An enabling environment within the academic institutions, resulting from strong technical support, availability of resources, and harmonious training would lead to a seamless user experience for maximization of the gamified e-learning systems.

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