

Playful learning: A case study for impact analysis in the gaming environment

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Declaration

We, hereby, declare that the work presented in this thesis is the outcome of the investigation performed by us under the supervision of Rasel Ahmmed, Lecturer, Department of Electronics and Communication Engineering, East West University. We also declare that no part of this thesis has been or is being submitted elsewhere for the award of any degree or diploma.

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Letter of Acceptance

This thesis report entitled “*Playful learning: A case study for impact analysis in the gaming environment*” submitted by Quazi Mahabubul Hasan (ID: 2014-1-50-006) and Nabila Ahmed (ID: 2014-3-50-015) to the Department of Electronics and Communication Engineering, East West University is accepted by the department in partial fulfillment of requirements for the Award of the Degree of Bachelor of Science and Engineering on April, 2019.

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Abstract

In recent years, Researches are being introduced several ideas to make education more enjoyable and enhance student's engagement in the learning process. We proposed a new concept to implement gaming attributes in the education field. We assume that this method would improve the student's performance in the learning process. To support our study, we analyze the impact of gaming environment in classroom education and compare it with the traditional method. We also compute students enforcement by scoring on their performance in different parameters. To understand their experience we accumulated data from their survey questionnaires. We applied T-test and the ANOVA test for statistical hypothesis test and analyzed statistical significance on the different educational environment.

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As it is true for everyone, We have also arrived at this point of achieving a goal in our life through various interactions with and help from other people. However, written words are often elusive and harbor diverse interpretations even in one's mother language. Therefore, We would not like to make efforts to find best words to express our thankfulness other than simply listing those people who have contributed to this thesis itself in an essential way. This work was carried out in the Department of Electronics and Communication Engineering at East West University, Bangladesh.

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Chapter 1

Introduction

1.1 Introduction

Learning is a process of acquiring knowledge through study, experience and being taught. Over the years, learning has always been both an exciting and challenging term in the field of education. As it depends on student engagement and their performance. Engaging students directly in the process of learning is still one of the best way for active learning. So to make this process more enjoyable and fruitful many research has been done over the years.

1.2 Gaming Elements in Education

In recent years, research on gamification and game-based learning are being conducted to verify the positive outcome of an enjoyable and meaningful learning process in a classroom environment. The method of learning in a gaming environment has drawn significant attention from researchers and educators as it is an effective way to increase student motivation and engagement. To make education more engaging and relevant, using the games and the gaming attributes would be an excellent solution for an interactive way of learning. This environment also improves cognitive abilities and promotes an in-depth understanding of the student's through active participatory engagement.

1.3 Gaming Environment in Classroom

Though gamification and game-based learning have a different operation in terms of assisting the learning process, they both play an important role in today's era. With the help of technological advancement, learning process has become much easier. Technology has also played an effective role in changing the classroom environment. But still, students face problems with the learning process in the classroom. Sometimes they lack concentration on the topic or are less engaged with the learning process which causes them falling behind comparing other classmates. Using Gamification and Game-based learning in the classroom environment can easily solve this problem.

1.4 Our Contribution

In this case study, We have proposed a hypothesis that students are more engaged in a strategic and challenging environment in education and gaming modules may be able to make the classroom environment more fruitful. We have implemented both traditional and gaming attributes and game-based learning methods in classroom environments. We try to find the differences between traditional and gaming environment based on student's performance. We analyze the data from their performance mainly on five perspectives.

Our contribution of this paper can be summarized as follow:

- Provide a hypothesis to improve classroom learning environment
- Implement gaming attributes in the classroom lecture to enhance student's performance
- Analyze student's performance in both gaming and traditional education and compare both atmosphere.
- Analyze student's experience and teacher's viewpoint in different learning atmosphere

1.5 Organization of this book

We organized this paper as In Section II presents some background study, section III describes the research methodology. The experimental result is in IV and discussion demonstrated in section V, and the last part VI is the conclusion.

1.6 Conclusion

The process of learning will be updated continuously. With the help of Technology, gaming attributes and game-based learning can make the learning process more enjoyable and fruitful in a classroom environment.If we can implement this method properly then students will be more engaged in the classroom and will give a positive output.

Chapter 2

Literature Review

2.1 Introduction

Many research has been done to improvise the concept of gamification and game-based learning in the recent years. With the updates of technologies, researchers are proposing many different modification and changes and discussed their impact on education and other sectors. To improve the effectiveness of gaming environments in different sectors continuous researches are going on. We have discussed about some of these researches mainly focused in education secotr.

2.2 State of the Art

In the recent years, Many suggestions and improvements were proposed by researchers to improved gamification and game-based learning in education and general purpose. In this section, we have talked about those research works. We have discussed about the related works to find the limitations and the impacts of gaming environment in different situations.

2.2.1 Related Works

Researches are going on to improve the gamification and game-based learning and upgrade it to another level. Gaming attributes are being seen as one of the most efficient methods for an active learning process. Besides gaming attributes, games are also con-

sidered as strong tools to engage and motivate learners [1]. However, more research needs to be done on gamification and game-based learning. As some researchers strongly recommend that future research on gamification in education should put importance on different reasonable implementation and the continued purposes of the gamification explications [2]. Gamification can significantly increase the learning rate with a better engagement level and in a pleasant way. As it has has a better impact on student's perception, accomplishments, and cognitive load levels [3]. While some researcher's found out that primary level students enjoy colorful gaming attributes more which help them to have a more engaging environment. They were asked to do some learning tasks in a website with colorful gaming attributes. The tasks were breaking down into several parts so that they can understand it easily. The result shows a positive outcome for the students [4]. Though game-based learning has been used in primary level education for years, the use of the gaming environment in higher education is still minimal. Recently some researchers conducted research on traditional game design for enhancing student engagement and perception of learning in higher education. They suggested that game-based learning method relies on the disciplinary culture and the subject matter [5]. Since researchers investing the impact of gamification, the discovered the diversity of this. They also found that present research focuses mainly on practical fields rather than theoretical. They have also questioned about the insufficient amount of content to gamify any specific topic [6]. Nowadays E-learning is also a popular medium for learning among young people. But researchers found that Elearning with recent advancements of web applications and components of gamification depending on user characteristics and experience [7].

According to some researchers, the application of gamification in online courses played a vital role to improve educational efficacy. Which resulted in a great influence in the process of students learning [8]. Methodical application of gamification results adding gaming attributes in the learning content without any need to change [9]. While many

researchers are looking to add gaming attributes in the topic, some also suggested that using the elements of game design can also be used as a mechanism to maintain and generally enhance students commitment and activity towards the topic [10]. Styding on their research, another group of researchers finds that gamification has different impact for students with different motivations. They have shown that this method is particularly positive for students with basically motivated either by the motivation to learn or their motivation for the incitement [11]. But creating an impactful educational game can offer much more than creating educational content and an engaging game [12]. Researchers also prefer to do a playtest session in the making of educational games. According to them during the making of a game for getting to know the information knowledge, faults can be recognized and can be removed or reduced [13]. Views are a vital factor to some researcher, the related opinions with learning stats that has a peremptory change after getting the gamified guidance. Researchers also found sustainable knowledge gain as a result of gamified guidance. They have also found that gamified modules were flourishing as it was able to change the student's beliefs in a certain direction and with the increment of their execution [14]. While the term gamification and game-based learning both are used to teach, serious games indicate to provide exercise and training without much entertain. Meanwhile, gamification is able to use gaming attributes such as points, level upgrading [1]. Some researchers prefer to use the term 'gamefulness' in terms of design goals, user, and experiences. They found that it has significance as a helpful and lasting benefaction for studying gamified methods [15]. However, in higher education, students prefer gamified contents than game-based learning. Rather than playing a full game, they want to study with gamified topics. As they are intended to work with the topic immediately after understanding [16].

2.3 Conclusion

From the related work section we can see that many methods and suggestions was given to improve the gaming environment in study. In this book, we propose a hypothesis which can improve the classroom environment where students can learn more enjoyably and with better engagement to the topic with the assist of gaming environment in education field.

Chapter 3

The Study Design

3.1 Introduction

In this case study, we examine the effectiveness of both the gaming environment and the traditional method in the classroom environment. We investigate both outcomes to find the effectiveness of the gaming environment in the classroom atmosphere. We used both gaming attributes and games to find the impact. Strategic Storytelling, Problem Solving, Challenging situation, Difficulty level, Prize for a better result as a part of encouragement were some of the gaming attributes we used.

3.2 Hypothesis

The assumption demonstrates students are more engaged in the strategic and challenging environment in education. The basic gaming module may be able to make the classroom environment more fruitful.

3.3 Study Design

In the beginning, we arranged several workshops for first-year engineering students from the university to find out their effective thinking on problem-solving in both traditional and gaming environment. We divided our study design mainly in two parts. One is Gaming Attributes and games that helped to create a gaming environment and another



Figure 3.1: The basic gaming element for game based education environment

one is content delivering to students.

3.3.1 Gaming Elements

We took several gaming attributes to create our gaming environment in the classroom. We used strategy based storytelling, provided challenging tasks, rewards, theme finding, time pressure, competitive environment, chance to learn a new skill, group discussion, points, flow theory, tactics, motivational design, virtual environments, and engagement. The basic gaming element is demonstrate in figure 3.1

3.3.2 Content Delivering

We designed our contents with four types of puzzle and game. In the first step, we provided students a storytelling puzzle called 'The Meanie Genie'. In this puzzle, students had to apply their strategic thinking to recognize the problem and solve the puzzle. After that, we provided students some playing cards and asked them to sort the cards with the fewest number of steps. This was a group task so that students can discuss the problem

between their group members and find the quickest way to sort the cards. There were points for both individual and group performance based on their concentration on the task, time to solve the problem. In the next part, We let them play a game called 'Tower of Hanoi'. We created a virtual environment for them. In this game, they had to move disks from one bar to another bar with a sequence. They had limited time for this. There was an option to do it with the lowest moves. The main purpose for this game was to find the order for each n number of the disc and to concede the recursion formula. We provided a sheet for each student so that they can track their prospectus on each task.

3.4 Data Collection

After giving the lecture and student's performance on both traditional and gaming environment, we collected the sheets from the students and graded their performances on a scale of 0 to 10. We graded them on four different criteria. They are Problem Identification, Problem Solving, Encouragement, Motivation, and Rethinking. We fixed these criteria based on their ability to identify and solve the problem and their effort to solve the problem in an adequate and efficient way. At the end of the lecture, we asked the students to participate in an online survey to share their experiences and views in these two different learning environments. We also took interviews of several faculties to know their point of views on applying gaming environments in the classroom and the effectiveness of the gaming environment in education.

3.5 Conclusion

In this chapter, we describe our proposed architecture and three major portion of our proposed model. We also discuss about the problem formulation of our proposed model.

Chapter 4

Experiment and Result

4.1 Introduction

We studied on the impact of gaming environment in education system. In this chapter, we will discuss the evaluation of student's performance and also will show analysis with three different parameter, They are Cognitive ability analysis, Encouragement, Motivation and Rethinking, and Student's Experience. The result shows an outstanding improvement of the students by judging these parameters. We also collected there opinion from their experience from both traditional and gaming environment method. They enjoyed the both class but slightly prefer the gaming environment over traditional method as it was more enjoyable and easily understable and challenging.

4.2 Environment Setup

We implemented our analytic experiment with Python programming language using Spyder IDE comes with Anaconda Navigator (Version Python 3.7.1). All the simulations are done on 64-bit Intel core i5 3.20 GHz machine.

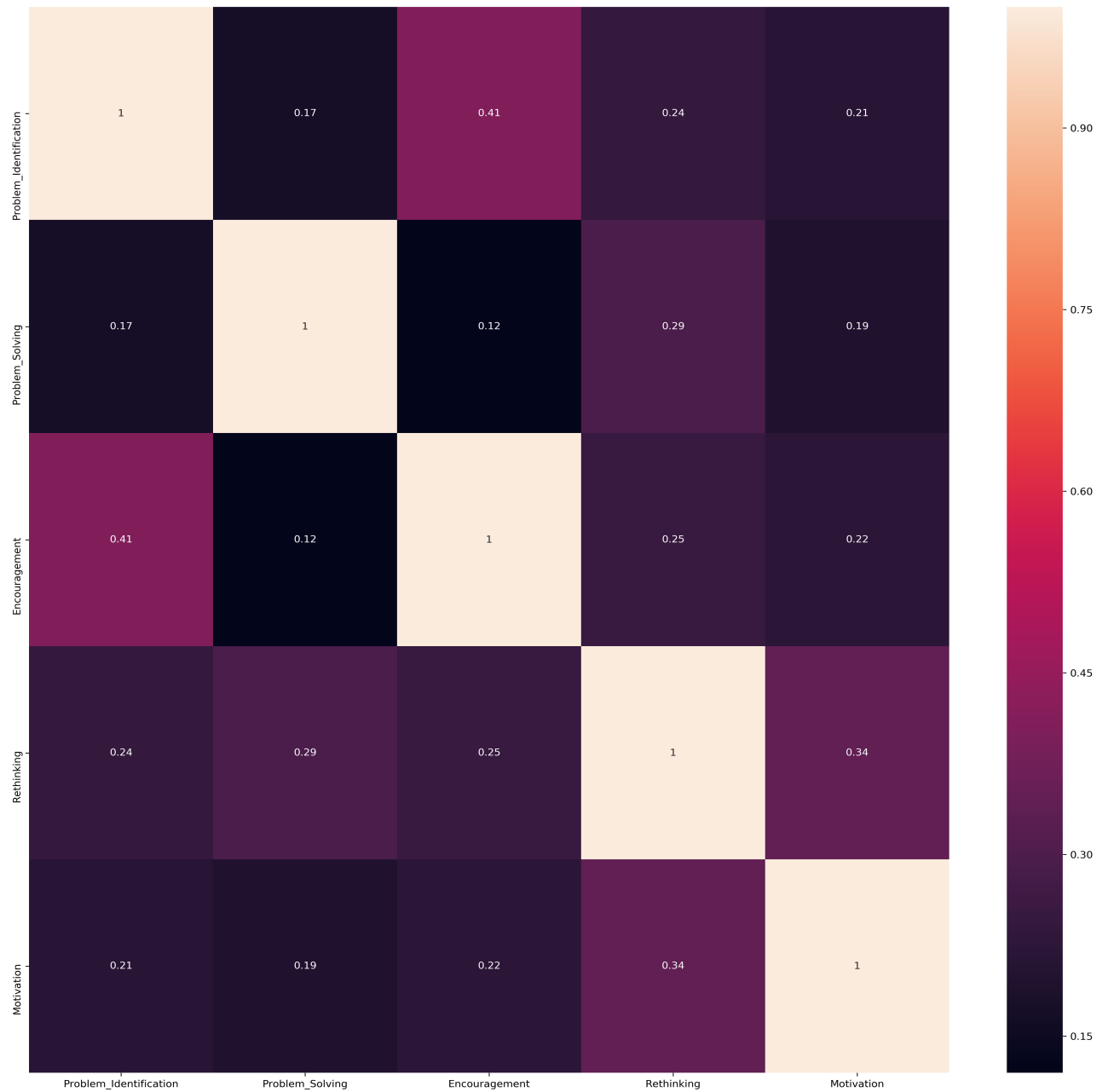


Figure 4.1: A correlation heatmap of different performance parameter of the students

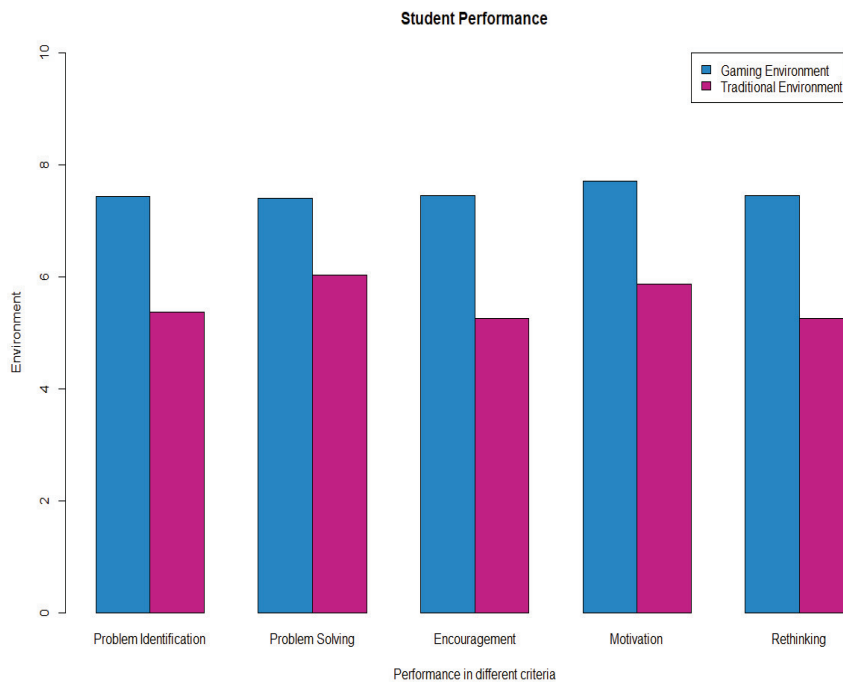


Figure 4.2: A comparison on Gaming environment and Traditional learning environment

4.3 Dataset

We mainly focused on the impact of gaming environment in education system. We gather the data on three different parameter. First one is student performance which is taken from the workshop in both traditional and game-based environment. The Second one is from survey questionnaires which give us comparatively a clear inside to find their views on this new education environment. We have collected data from 300 students who participated in the workshop, Then we analyze student's performance in both traditional and gaming environment system.

Table 4.1: Summary statistics on Student's performance in both learning environment

	Problem Identification		Problem Solving		Rethinking		Encouragement		Motivation	
	GBL	Traditional	GBL	Traditional	GBL	Traditional	GBL	Traditional	GBL	Traditional
Mean	7.44	5.37	7.40	6.03	7.46	4.02	7.45	5.26	7.71	5.83
SD	1.83	2.66	1.78	2.44	1.78	2.54	1.67	2.75	1.65	1.73
First Quartile	6	4	6	4	6	2	6	3	6	4
Median	7	6	7	6	8	4	7	6	8	6
Third Quartile	9	7	9	8	9	6	9	7	9	7

SD = Standard Deviation

4.4 Result

At first, in our analysis we investigate explanatory statistics of the different learning environment to recognize the significance of the data. A correlation heat map of different performance parameter of the students 4.1. We found a better outcome in the gamification and game-based education system with the mean performance of 7.50 and the standard deviation of 0.93, where the performance in traditional method is mean of 5.65 and the standard deviation of 0.98. Visualization of the student's performance is represented in Figure 4.2. The summary statistics on student's performance is given in Table 4.1.

We organized our result with three type of analysis. One is student performance, Second one is from survey questionnaires.

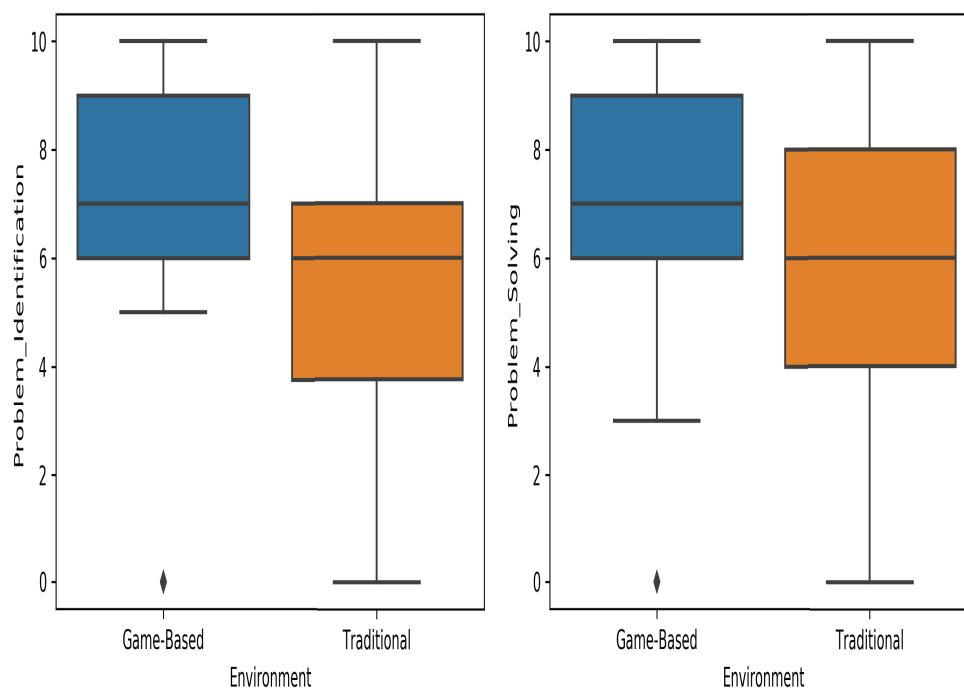


Figure 4.3: Cognitive Ability measuring by analyzing performance on Problem Identification and Problem Solving

4.4.1 Student's Cognitive Performance

We measure student's cognitive performance by analyzing their ability to identify a problem and their way to solve this problem. We implemented T-test and F-Test or ANOVA test for this and notice the impact for different learning environment. For this, A box plot for problem identifying and problem solving has been shown in figure 4.3. The hypothesis test shows a p-value of 5.4×10^{-26} for problem identifying and 1.84×10^{-14} indicates that gaming environment is more impactful. In our hypothesis test, we found that student performance is better in gaming environment. Students performance shows in Kernel Density Plot 4.5. The statistical analysis is shown in Table 4.2.

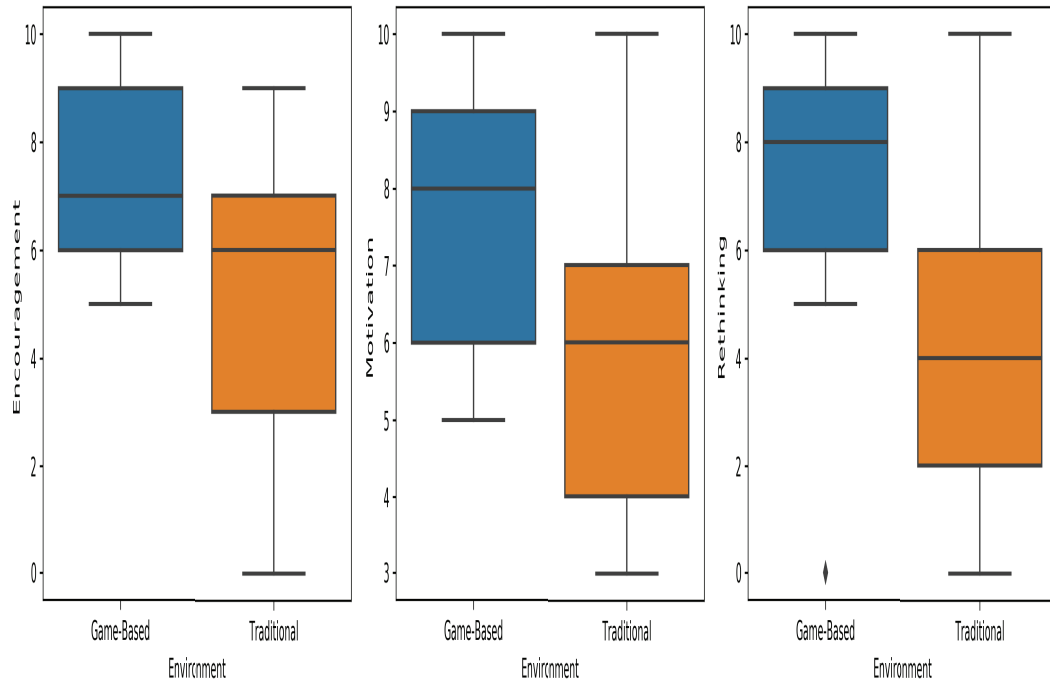


Figure 4.4: Student's performance on Encouragement, Motivation and Rethinking

4.4.2 Encouragement, Motivation and Rethinking

We graded students performance in different parameter which are student's encouragement, motivation and rethinking. Their performance is given in 4.4. We analyze the statistical significance in both traditional and gaming environment, from the result we can see a significant difference in our result. We got a p-value of 5.8×10^{-29} for encouragement and 1.6×10^{-35} for motivation and 2.8×10^{-64} for rethinking. This shows that there is

Table 4.2: Statistical hypothesis analysis on Problem Identification and Problem Solving

	T-Test	F-Test	p-Value
Problem Identification	11.06	122.32	5.4×10^{-26}
Problem Solving	7.85	61.72	1.84×10^{-14}

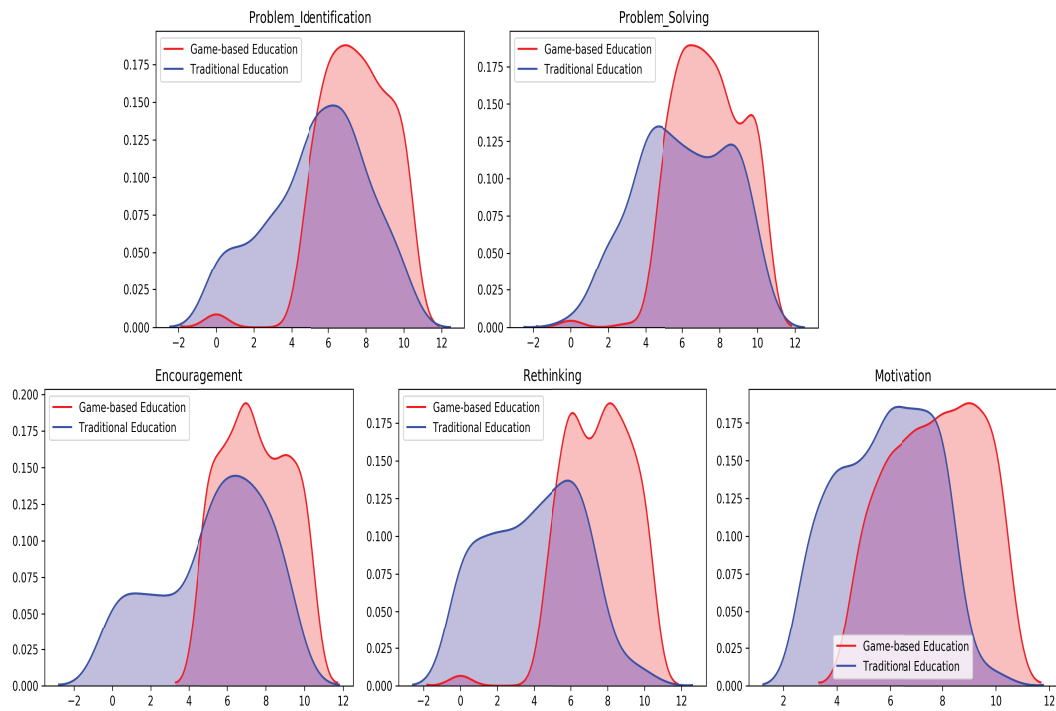


Figure 4.5: Student's performance shows in Kernel Density Plot

a significant difference in both learning environment. The analytical result is given in Table 4.3.

4.4.3 Student's Experience

We also analyze the student's experience from student's experience. Data taken from survey questionnaires. That helps us to find more about the differences in both learning environment. We find that students enjoyed both lectures. We got 92.3% of student who likes a gaming educational environment. 84.10 % of the student stated that their learning progress improved after experiencing the gaming environment. Students viewpoint on gaming environment is given in Table 4.4.

From Table 4.5, it can be said that student generally prefers both of the lectures and

Table 4.3: Statistical Analysis for Encouragement, Motivation, and Rethinking

	T-Test	F-Test	p-Value
Encouragement	11.78	138.83	5.8×10^{-29}
Motivation	13.30	176.71	1.6×10^{-35}
Rethinking	19.18	368	2.8×10^{-64}

Table 4.4: Student's experience on different criteria in the gaming environment of education

(measure in a scale of 1-5)	Mean	SD
An appropriate story-line with each puzzle	3.82	0.72
Sustained engagement with strategic storytelling	3.92	0.80
The puzzle makes you curious, and you find the motivation to solve that problem	4.48	0.68
The assessment create challenges with other motivators	3.87	1.00
Appropriate difficulty level for each problem	3.97	0.81
Interaction with the instructors was encouraging	4.17	0.91

SD = Standard Deviation

their experience is almost similar in the different learning environment.

4.4.4 Faculty Interviews

Instructor's viewpoint is one of the most important fact for comparing learning environment and their interest to adapt new environment. We took interviews of several faculty members. We have got different viewpoints from the faculties. A total three faculty think that the idea of implementing gaming environment in classroom could bring a positive outcome from the students. One of them strongly supported the gaming environment method for learning process, he stated that "I always prefer a enjoyable classroom so that

Table 4.5: Student's opinion analysis in both gaming and traditional environment

Attributes (Evaluate on a scale of 1-5)	Environment	Mean	SD	P value
For the amount of time, I invested in this course, I am happy with what I learned	Game-based	3.95	1.05	0.66
	Traditional	3.84	1.01	
I found what I learned in this course personally fulfilling	Game-based	3.95	0.82	0.19
	Traditional	3.66	1.05	
I felt encouraged to rethink my understanding of some aspects of the subject	Game-based	4.07	0.87	0.62
	Traditional	3.97	0.95	
I find more engaging teamwork participation	Game-based	4.25	0.84	0.17
	Traditional	3.94	1.09	

SD = Standard Deviation

my students can learn anything easily and comfortably. Applying gaming environment in classroom slightly different from my viewpoint. But recently the development of technology inspires me to adapt this system.” Though many faculty give positive feedback, some faculty shows concern about the implementation of gaming environment. One of them stated that ”The content for implementing gaming environment in higher education is not sufficient. More sometimes gaming environment requires additional time to implement”. From their viewpoints we can assume that if we can remove the barriers of implementation of gaming environment in classroom, there are possibilities for the instructors to adapt this system in their classroom.

Chapter 5

Conclusion and Future Work

5.1 Introduction

Different methods have been applying for years in the learning process to make it more easy and enjoyable for the students. In our case study we investigated the impacts of gaming environment in terms of student's learning rate. For that we used both traditional environment and gaming environment. According to our finding we have found a noticeable improvement in applying gaming environment in classroom. However we also found out some limitations and drawbacks of implementing gaming environment in education specially in classroom environment.

5.2 Future Work

Our future work is to focus on the limitations of gaming environments and trying to find solutions to remove the barriers for implementing gaming environment in classroom and in education. We also have plan to analysis teacher's perspective to offer an improvement of education in higher education.

5.3 Conclusion

Our proposed hypothesis will improve the classroom environment and make learning process in the classroom more enjoyable and fruitful. This will help the students to

improve their cognitive skills and help them to engage to the topic more frequently than before. It will also help them to have a better understanding in any topic. Which will enhance their desire for learning.

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Appendix A

List of Publications

International Conference Papers

1. Md Ataur Rahman Bhuiyan, Quazi Mahabubul Hasan, Amit Kumar Das, and Rasel Ahmmed, “*Play and Learn: Impact of Gamification and Game-based Environment in Education,*” The 22nd ACM Conference on Computer-Supported Cooperative Work and Social Computing, Austin, Texas, U.S.A. November 9th-13th 2019 (1st Round Review).