

Development and Evaluation of a System to Increase Students' Participation in Class Using Gamification Techniques

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Abstract—Students' participation in class is paramount. The lack of participation by students or eagerness to participate in class creates a challenge to understand the learning content and topics being discussed. This study aims to improve explicit participation, such as students answering questions, asking question, and openly sharing ideas with their fellow classmates. In order to achieve this, a gamified web-based system has been developed applying a design science research approach. Application of this research approach uses prototyping of a gamified web-based platform to represent proof of solution development and problem solving. Through this application, an increase in students' participation in class has been improved, by transforming a classroom into an enjoyable environment using gaming mechanics and rules. This enables students to participate more in class knowing that they will earn points that will be used to contribute to a calculated percentage of their predicate mark. Gaming mechanics such as rewards, loss, status and reputation, and feedback are incorporated into the solution development and problem solving. This is because related studies have proved that gaming mechanics take advantage of the human psychological notion of winning, which is most likely to be in a gaming environment, in the scope of this study, to win is to participate in class.

Index Terms—Gamification, students' participation in class, web application, reward system

I. INTRODUCTION

According to [15] cited in [6], gamification is the “use of game design elements in non-game contexts”. Related studies prove that there has been a significant increase in applications of gamification. In this study, we apply gamification by developing a gamified web-based system with the objective of increasing student participation in class, using the design science research approach. Application of this research approach uses prototyping of a gamified oriented web-based platform to represent proof of solution development, problem solving, and implications of the research approach this study has followed.

Many educators and sociologists have observed that while the net generation (those born in 1980s and later) is happy to share thoughts in an electronic form online, they tend not to

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do so as freely in a large group, face to face settings such as traditional college class [5]. In addition these students “have grown up with entertaining media such as TV, video games, and Internet for education as well as amusement”. In comparison to these fast-paced, interactive media, traditional lecture classes are likely to be deemed dull and boring [5].

Students' participation in class is significantly paramount, the lack thereof makes learning and understanding in class a very challenging task for students. This study is thus aimed at increasing students' participation in class. As [18] state that increasing student participation is one of many strategies that might lead to improved student learning.

The application of gaming logic in this study, to develop a gamified web-based system that aims at improving students' participation in class has been important, because it is the basis of the solution design, the solution development, and the research problem solving. Nicholson [15] argues that: A frequently used model for gamification is to equate an activity in the non-game context with points and have external rewards for reaching specified point thresholds.

In this study, the reason why gamification is applied as part of the research approach, is because, gamification takes advantage of a human being's psychological notion of competing and winning. Meder et al. [12] indicates that “One of the core ideas of gamification in an enterprise setting is to engage employees, i.e., to motivate them to fulfill boring, but necessary tasks”.

Conventional approaches that aim to urge or enhance students to participate in class, such pointing out the student to answer the question, calling the student by name or surname and asking them to answer questions have proved to have a positive influence on the participation of students in a class, however they have partial influence in enhancing voluntary participation in class by students.

Our approach in this study has a significant influence in invoking voluntary participation also, through the use of gaming logic. It implies that students will voluntary participate knowing that there exists a potential of receiving rewards, and also knowing that there exists a potential of losing out rewards that are made available for participants only. Gaming mechanics such as rewards and loses are the underlying invokers of participation – not also forgetting the fun that comes with participating in a gaming environment.

In essence, this study aims at improving, increasing, and enhancing students' participation in class through designing, and developing a gamified web-based system that is implemented in a classroom environment. Using prototyping of a gamified web-based platform as proof of solution

development and research problem solving, the gamified web-based platform is intended to serve the purpose of the research approach.

More and more elements of distractions (social media platforms, IM's, and so forth) are increasingly becoming popular to students, making them less eager and less keen in participating in class, resulting in little to no understanding of the learning content presented by the lecturer. Yet, few studies have probed the lack of students' participation in class and how to increase it successfully. Insights gained from related studies would be imperative in solving the problem this study aims to solve.

This study aims to solve the problem of the lack of students' participation in class – and design a solution to solve that problem. The primary research question for this study is: How to develop a web-based system to increase students' participation in class using gaming techniques?

This research question is broken down into the following secondary research questions, namely:

1. How to design and develop gaming mechanics for a classroom environment ?
2. How to implement the integration of the designed and developed gaming mechanics with students in a class-room environment?

II. LITERATURE REVIEW

A. Introduction

According to [6], "Gamification" is an informal umbrella term for the use of video game elements in non-gaming systems to improve user experience (UX) and user engagement. The introduction of gamified applications to large audiences promises new additions to the existing rich and diverse research on the heuristics, design patterns and dynamics of games and game-based systems the positive UX they provide. Zichermann and Cunningham [21] argue that: Gamification may be a new term, but the idea of using game-thinking and game mechanics to solve problems and engage audiences isn't exactly new.

Huotari and Hamari [9] refer to gamification: a process of enhancing a service with affordances for gameful experiences in order to support user's overall value creation. At heart, gamification is a powerful tool for catalyzing attention, focus and investment. What parent ever resisted gamifying the process of getting a group of kids to the car by announcing that it was a race?

Gamification transfers the mode, value and incentive of game play to a separate experience like buying groceries, visiting web sites, or even learning. By borrowing the intrinsically rewarding elements of game play; rules, victory conditions, rewards, punishments, status, stakes and personally vested narrative other endeavours can find fresh appeal with stakeholders and increase the likelihood adoption [1].

B. Gamification in Education

While the concept of gamification may be simple, effectively gamifying a concept isn't. However, it can be simplified, by following a five-step process:

1. Understanding the Target Audience and the Context: A key factor that determines the success of an education

program, is a good understanding of who the student is. This combined with the context in which the program is being delivered, will help in designing a program that empowers the student achieve the objective of the program [8].

2. Defining Learning Objectives: Specific Learning Goals which could include the student understanding a concept, being able to perform a task after the training, or completing the learning program [8].

3. Structuring the Experience: Stages and milestones are powerful tools that enable instructors to sequence knowledge and quantify what the students need to learn and achieve by the end of each stage or milestone. These milestones work well for students as well, as it makes the ultimate objective seem more achievable and measurable, while ensuring that obstacles within and between each stage are easily identifiable [8].

4. Identifying Resources: Once the stages/milestones have been identified, the instructor can more easily judge which stages, if any, can be gamified, and how [8].

5. Applying gamification elements: The gamification process in education comes down to the elements that are being applied to the learning program [8].

Arnold [1] observes that "games create engagement – a necessity for any learning experience". Arnold [1] also states that: "Gamification is the process of adapting an experience like purchasing bread, mastering a handwriting recognition program or learning math with game-like elements".

The idea of using games for learning is not new. This is customary especially in the case of direct interaction between teacher and student [14].

Muntean [14] says "Gamification's main goal is to rise the engagement of users by using game-like techniques such as scoreboards and personalized fast feedback" Muntean [14] also says "making people feel more ownership and purpose when engaging with tasks". Muntean [14] argues that creating gamers for learning employ costly resources. A simpler yet still efficient approach is to use gamification in order to make the content more attractive and engage users. Muntean [14] further says "by using gamification in e-learning we wish to trigger a more efficient and engaging learning behavior". Muntean [14] again states that; "people respond to computers as if they were persons, especially when gaming". Muntean [14] argues that "in order to change or trigger a certain behavior students need to be motivated and at the same time have the ability to solve the challenges".

Gamification also implies a social game and interaction with other participants. Muntean [14] explains that when people perceive social presence, they naturally respond in social ways and have feelings like empathy or anger, or following social rules such as taking turns".

Simoes et al. [17] observe that: There is little research however regarding the usefulness of gamification in education. The authors start by explaining the meaning of gamification, what it is and how it can be used, while also pointing out the possible disadvantages in case of misuse. They define it as the use of game mechanics, dynamics and systems to promote desired behaviors. Returning also to the point made we can use gamification to determine certain behaviors or correct others and we can thus see the utility of using gamification in learning, and even more in e-learning. There might be possible dangers if the gamification design does not suit the purpose of motivating students to engage

and offer support to teachers and on the contrary for example it might teach students that they should learn only when provided by an extrinsic motivation. Authors notice a large increase in the gamification of learning and instruction. Due to the user of game elements like time, accuracy, point systems integrated into all types of training programs encourage users to achieve their desired goals.

Simoes et al. [17] argues: As video games, particularly, social games are growing in popularity and number of users, there has been an increasing interest in its potential as innovative teaching tools. Gamification is a new concept intending to use elements from video games in non-game applications. Education is an area with high potential for application of this concept since it seeks to promote people's motivation and engagement.

C. Effects of Gamification on Participation

Cechanowicz et al. [4] states that gamification has become an increasingly popular way to improve user engagement and motivation, but there is currently a lack of empirical research to demonstrate that increased gamification provides these benefits.

Deterding et al. [6] states that: We consider the collaborative study of the recent surge of 'gamified' information systems to be of immediate relevance to HCI researchers in all fields mentioned above (funology, persuasive technology, communities, motivational affordances, game UX, etc.). On the one hand, the

implementation of game design elements on a mass market scale potentially surfaces phenomena that wouldn't appear in laboratory prototypes. Gamified systems 'in the wild' provide new objects of inquiry in an unprecedented variety, data quality and scale. On the other hand, the focused integration of the many close but by-and-large decoupled research endeavors would greatly benefit each in turn. Although workshops in the past conferences have already addressed single issues, none of them has taken such an integrative approach. Therefore, at this point in time, such a synthesizing workshop on gamification would be of high interest to HCI researchers as well as researchers working on the increased blurring of (digital) life, work, and play in general.

D. Gamification in the Military

Zichermann et al. [21] argues that: The military has been using games and simulations for hundreds (if not thousands) of years, and the U.S military has been a pioneer in the use of video games across branches. Three hundred years ago, Scottish philosopher David Hume laid the groundwork for understanding player motivation with his views on the primacy of the irrational self. Since 1960s, authors have been writing books that explore the "gamey" side of life and psychology, while since at least the 1980s, Hollywood has been hot on the trail of gamification with movies like War games.

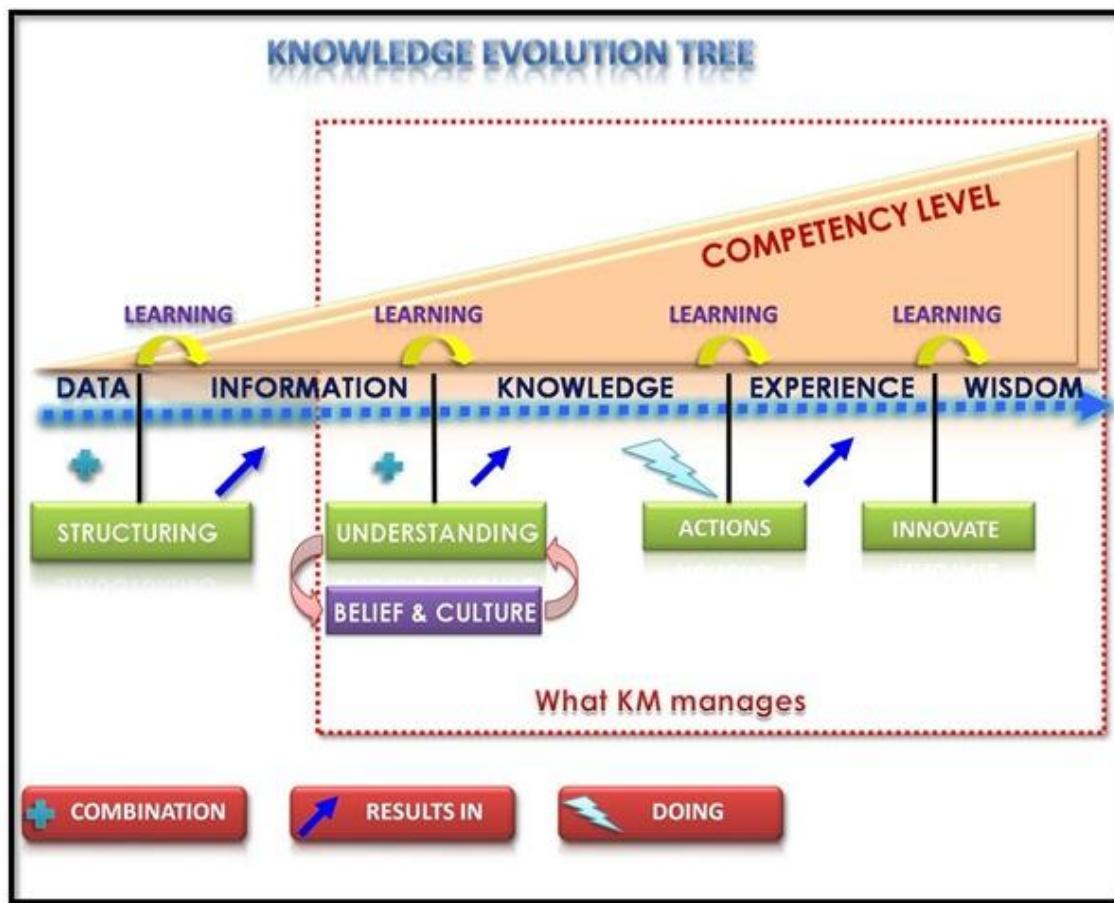


Fig. 1. Knowledge Evolution Tree

E. Gamification in Web 2.0

Liu et. al. [11] observe that: The nature of intelligent environments has transformed with the impact of Web 2.0 and social media over the past years. The conceptualization of the user has changed from being a cog in an organizational machine to a partner in system interaction and an ultimate consumer, and more recently to a content creator and a task performer. The shift in paradigm has been tremendous. Within this shift, a strong new focus is the user engagement through the system, which defines the phenomena of being captivated and motivated: not just about how a single interaction unfolds, but also about how and why people develop a relationship with a platform or service across multiple interactions.

F. Students' Participation in Class

Pateman [16] observed that: During the last few years of the 1960s the word 'participation' became part of the popular political vocabulary. This took place under the impetus of demands, notably from students, for new areas of participation to be opened up in class in the sphere of higher education – and of demands by various groups for the practical implementation of rights of participation that were their in theory.

Woods and Keeler [20] state that: The researchers, in the context of LEAD 713, a graduate-level online course at Regent University, consider whether the systematic use of instructor-initiated audio e-mails (as a supplement to regular textual forms of communication) will increase students' participation in group discussion and result in more favorable student perceptions of student/faculty relationships and quality of group discussion, a greater sense or feeling of online community, and a higher degree of satisfaction with the overall learning experience.

Carlson and Hastie [2] state that using a combination of fieldnotes, interview, and videotape data, four major themes emerged: a change in the way students socialized during class (with a particular emphasis on the development of teamwork and cooperation), a change in the opportunities for personal and social development (including leadership skills and cooperation), a change in the nature of competition (where winning became more important and led to greater student effort), and a change in how students viewed their learning within their physical education class. Turner and Patrick [19] state that participation in lessons facilitates learning. There are a number of ways that students can participate overtly, including offering their ideas and thoughts spontaneously, volunteering to answer questions, answering questions when called on, demonstrating at the chalkboard, talking to peers or the teacher about tasks, and completing written work. Students may also participate without these behavioural indicators of involvement by watching, listening, and thinking. In the current study we focus on participation that is explicit and observable.

Turner and Patrick [19] continue to state that; Participation in learning activities is a valuable work habit for several reasons. It provides students with opportunities to learn and practice new knowledge and strategies, to explain their reasoning, and to examine their thinking processes and recognize the need to revise thinking. It also

allows teachers a window into student thinking processes and learning, allows them to diagnose learning problems or evaluate student progress, and provides teachers an opportunity to provide cognitive and affective supports for students' understanding. Despite these benefits, participation varies among students, and for some opportunities to learn do not arise. Important factors regarding whether students participate include students' motivation to learn and the kinds of environments and supports for participation offered through classroom instruction.

Moore and Taylor [13] indicated that based on structured classroom observation, interviews, and surveys with students and teachers, they examine 1) how a CMC pattern of discourse differs from a face-to-face pattern of discussion in a class setting; 2) whether students participating in a CMC activity produce a discourse that reflects the level of thinking and sharing of ideas desired by the instructor; and 3) how the computer-based interface facilitates and/or inhibits communication between students. The CMC discourse encourages experimentation, sharing of early ideas, increased and more distributed participation, and collaborative thinking. However, for some students the CMC activities are confusing and inhibiting because of the lack of social cues and multiple threads of simultaneous topics— the same features that appeal to other students. Successful use of CMC activities requires a classroom social environment that encourages peer interaction.

Camp [3] states that: Using the High School and Beyond sophomore cohort data set, they examined that implied causal relationship between level of student participation in extracurricular/co-curricular activities and academic achievement. The model examined accounts for the effects of gender, family background, academic ability, and other competing time-use habits. The findings suggest that academic achievement is enhanced by student participation and raise questions about the rationale behind rules excluding academically marginal students from participation in extracurricular and co-curricular activities.

III. RESEARCH METHODOLOGY

The research project follows a positivist research design model but will involve some elements of interpretive participatory research. The positivist research design employed involves methodologies like prototyping used in the development phase.

A. Prototyping

A prototype is a sample system built to test and learn about the processes that it can perform. It is mostly designed to test a newly designed product to increase the quality of usability, and it acts as a specification of a running system instead of a theoretical one. Prototyping's main idea is to build and understand the requirements before a design or coding can proceed. By doing that, one gets the actual feel of the system before it is developed based on the requirements of the desired system.

In terms of an information system, prototypes are employed to help system designers build an information system that is easy to manipulate for end users. It is an iterative process that is part of the analysis phase of the

systems development life cycle (SDLC). Prototyping refers to building web application prototypes which display the functionality of the product under development but may not actually hold the exact logic of the original application.

A trial web-based communication is built for the Department so that users or employees can interact with it to experience the feel of the future platform. Prototyping helps users to have a version of a complete and working product or application instead of a brief description of how the system will look like in the future.

System development life cycle provides a system used to build and monitor application software. SDLC is a complete process for developing information systems and oversees all the steps and activities involved in the development of a new system. Employee involvement and the right implementation methodology when developing software are critical to the success of the organization.

(iii) Design Phase: The design phase determines how the system will operate or work (in terms of software, hardware, and network infrastructure), the user interface, and the specific programs, databases, and files that will be required. The algorithm is as follows:

```
Lecture asks a question
If Student raises hand
Then
    ~ Lecturer asks student to provide answer
End If

If Student provides a correct answer
Then
    ~ Student won
    ~ Student's Points = Current Student's Points +
        Student's Won Points
Else
    ~ Student lost
    ~ Student's Points = Current Student's Points
End If
```

Basic gaming mechanics are incorporated to achieve this research objective. The incorporated basic gaming mechanics are; rewards, loss, and winnings. The lecturer asks a question to the class and a student voluntarily raised their hand as indication of willingness to answer the lecturer's question – the lecturer then affords the student with the opportunity to answer the question. If the student answers the question correctly, it is a win for the student.

The lecturer then rewards the student with the appropriate point(s). However, if the students provide an incorrect answer to the question it is a loss for the student. Consequent to that other student are now allowed to raise their hands and attempt to gain points by providing the lecturer with a correct answer to the question put forth.

Three layers have been designed to integrate the designed and developed for the construction of the gamified web-based system to increase student's participation in class. This section focuses on the design and development of the User Interface layer. Through the user Interface of the web-based system, a lecturer can be able to assign a point to a student and student's can be able to see instant results of their points gained through participating.

The implementation of the integration is however not designed in this section, meaning that the design of this

section only focuses on what the end-user(lecturer and students) sees, and not what is implemented in the back-end for them to see what they see.

Usage of a web interface development language; HTML (Hyper-Text Markup Language) is used to build the interface that integrates the gaming mechanic with students in the class, not forgetting the lecturer. From the buttons the lecturer presses to assigning points to students, to the list-boxes where the student's points are presented to the student – all this is developed using HTML.

Implementing the integration of the designed gaming mechanics with the students in class is achieved through adding the database layer to the already existing layers; the application layer, and the interface layer. This layer helps store students' points gained through the interface layer.

B. Interpretive Case Study for the Evaluation

The population that is used to evaluate the prototype is; lecturers, and students that the lecturers teach in a classroom environment. The lecturers and the students are the subjects of the simple random sampling evaluation method used in the evaluation of this study.

In this phase this study applies the simple random sampling method, for probability sampling and evaluation of the prototype developed in the Development phase of this study mentioned. Probability sampling is used in this study to conduct the evaluation – affording each subjects an equal chance to be selected as a sample.

Simple random sampling: in this method each element has the equal probability to be selected as a sample. It is bias free. Here an element cannot come twice as sample (Haque,2013).

A Self-Administered Survey data collection tool is used in this study, the survey is presented as a web-based form, developed.

IV. SYSTEM DEVELOPMENT RESULTS

The system has been successfully designed and developed using HTML5 for the front-end, PHP for the back-end, and MySQL for storage of the survey answers to increase students' participation in class using applying gamification, and using prototyping for proof of solution development and problem solving.

Students are successfully introduced to the system, they know the implications of participating in class, and aim to score points to be rewarded at the end of the semester for participating in class. More and more students are now voluntarily participating in class.

The web application will also have other pages such as:

- Photo gallery page where employees share pictures of events
- About page provides background about the functions of the unit
- Marketing mix page allow employees to share strategic documents
- Resource centre page enables colleagues to share information about registered events and project reports
- Events calendar list all current and upcoming events
- Contact us page provides contact details of marketing team.

V. Case Study Results

We use qualitative methods to obtain as much data and information as possible for the evaluation of the system in this study. In this study, focus is partly on the perceptions and practices of the employees regarding knowledge management within the department.

Responses from the population through the self-administered survey were solicited. The respondents from selected through the simple random sampling method used are ten (10) in number, seven (7) are Males and the remaining three (3) are Females. Ninety percent (90%) of the respondents suggest that the web-based system is user-friendly. Hundred percent (100%) of the respondents agree that the system increases students' participation in class. In terms of the capabilities and options that the system provides to the users, forty percent (40%) of the respondents are satisfied with the options provided to them, and sixty percent (60%) are not satisfied with the options. Seventy percent (70%) of the respondents access the system only when they are in class, and thirty percent (30%) access the system, outside the class too. Of the 30%, ten percent (10%) access it once a day, twelve percent (12%) access it twice a day, and the other eight percent (8%) access it more than twice a day outside of the classroom.

VI. CONCLUSION

Students are now keen on participating more in class, with the primary objective of earning points. Through participation, students are being corrected when their answers are incorrect and this makes it feasible and convenient for students to understand the learning content better, including the topics discussed in class.

This resulted in making students becoming more keen on competing with each other, which is only through participation. They all want to earn maximum points, or as many points as they can through the system, they all want to be the leaders of the pack, when the scores are presented to

the entire class, the drive is there, the energy is there, and participation or lack thereof is increased.

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Fig. 2. Home Page for the System