

QUANTIFYING USER EXPERIENCE IN USING LEARNING GAMIFICATION WEBSITE

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ABSTRACT

User experience is all about the user (which is why personas are important) because it deals with our users' needs such as learn programming languages course. Currently, all new students always suffering to learn programming languages course in computer science departments. The preliminary investigation has showed that students have experienced ineffective learning, lack of interest towards this course and lack of motivation. In order to encourage user to interact with a learning website, adding game elements such as a challenge. Gamification has to be implemented well and has to be adequate for good user experiences. Previous studies have shown that applying Gamification elements in websites engages users. Gamification refers to the use of game elements in a non-game context to increase engagement between human and computer. Gamification Website was designed based on the gamification framework that has been constructed. This paper is discussing on quantifying user experience in term of usability and motivation in using the learning gamification website. The result of evaluation have shown that the gamification website has good (mean > 4.00) for all usability elements. On the other hand has a positive motivation in students' performance. Finally, the finding of evaluation suggested that gamification website can be used as a motivation tool to promote students learning programming language subject.

Keywords: *Gamification, Game elements, Game Mechanic, Motivation, Programming Language*

1. INTRODUCTION

User Experience refers to a person's emotions and attitudes about using a particular product, system or service [1]. It includes the practical, experiential, affective, meaningful and valuable aspects of human-computer interaction. Additionally, it includes a person's perceptions of system aspects such as utility, ease of use and efficiency.

User experience is a broad term that encompasses many methodologies that generate quantifiable outcomes including such as user acceptance, user satisfaction, usability, and user motivation [1]. Good user interface design plays an important role in increasing user experience [23].

Gamification is an informal umbrella term for the use of video game elements in non-gaming systems to improve user experience and user engagement to solve problems effectively [2, 3, 4, 5, 6, 7, 8, 22, 24, 25, 26]. Zichermann and Cunningham [9] defined Gamification as a process

of game thinking and game mechanics that engages users and solves problems. Kapp [10] argues that Gamification can be thought of as using pieces of games to motivate learners, but the real definition of Gamification involves using game-based mechanics, aesthetics, and game thinking to engage people, motivate action, promote learning, and solve problems. Gartner [11] predicted that by 2015, more than 50% of organizations that manage innovation processes will gamify those processes.

According to Laskaris [12], gamification can turn the entire learning process into a game. The concept takes game mechanics and gameplay elements and applies them to existing learning courses and content to better motivate and engage learners. Examples of these mechanics include achievement badges, points, leaderboards, progress bars, and levels/quests. In theory, you can gamify any activity, not just learning ones. Indeed, everything from fitness apps to profile pages on LinkedIn can be, and has been, gamified to increase user participation and engagement.

Additionally, more than 80% of learners say that they would be more productive if their university/institution or work was more game-like [2]. Andriotis [13] found that over 60% of learners would be motivated by leaderboards and increased competition between students. Andriotis [13] also discovered that 89% would be more engaged to win an e-learning application if it had a points system.

In order to make learning more effective, certain elements must be considered, such as game mechanics (Simões, et al. [14], Mohd and Dalbir [21], Bunchball [15]); points, levels, badge achievement, virtual goods, leaderboards, and virtual gifts; rewards, status, achievement, self-expression, competition, and altruism, and game techniques; and progressing to different levels, scores, avatars, and virtual currencies. The expected results for the effective uses of gamification in learning would increase student's motivation to continuously using the learning material, due there are several methods that lead to improve user experience such as some of game like element (Gamification).. Therefore, in this paper user experience in using the gamification learning website in term of its usability and students motivation are discussed.

2. RELATID WORK

The term gamification was coined in 2002 [4-5] and made its first appearance in education technology literature [6] in 2008. From 2010, the term started gaining more popularity [7].

[8] discuss that gamification can be thought of as using pieces of games to motivate learners, after that the definition of gamification involves using game-based mechanics, aesthetics, and game thinking to engage people, motivate action, promote learning, and solve problems. Then Zichermann and [6] define gamification as a process of game thinking and game mechanics that engages users and solves problems. Lastly, Gamification refers to the use of game elements (game design, game thinking) in a non-game context to improve user experience and user engagement in non-game services and applications [5].

In the past few years, gamification has emerged as a trend within marketing sectors, and has recently gained the attention of academics, educators, and practitioners from a variety of

domains [4]. Even so, gamification is not a new concept, having roots in marketing endeavours, such as points cards and rewards memberships, and educational structures: most notably scholastic levels, grades, and degrees, and workplace productivity [5]. The subsequent section describes the conceptualisation of gamification based on an extensive literature review in order to distinguish between the concepts of related ideas.

Gamification is considered easier to define than it is to conceptualise [5]. While no standard yet exists, most sources agree that gamification is generally defined as the use of game elements and mechanics in non-game contexts [5]. However, a more in-depth view of gamification including theoretical foundations, overarching purposes, and standards for practice require further development.

[4] and [5] sought to conceptualise gamification based on the work of industry practitioners, academics, and current researchers. Besides the varied landscape of theoretical trends and taxonomical options, the authors observed that not all examples of gamefulness outside of games could be placed under these headings or along these research paths, despite outwardly forming an increasingly cohesive whole. Therefore, the authors acknowledged gamification as the accepted term for a distinct concept they defined as the use of game design elements in non-game contexts [5].

[5] suggested that gamification involves applying elements of gamefulness, gameful interaction, and gameful design with a specific intention in mind. Here, gamefulness refers to the lived experience, gameful interaction refers to the objects, tools, and contexts that bring about the experience of gamefulness, and gameful design refers to the practice of crafting a gameful experience. Even though gamification may or may not call for a serious context, it does require the end system to not be a fully-fledged game.

Several researchers have pointed out the parts of gamification definition in terms of: (1) games: firstly, gamification relates to games, not play (playfulness), where play can be conceived as a broader, looser category, containing game elements but is different from games [6]; (2) game elements: perceived to also be a matter of role, whether it be designer or user, such as the

Mechanics Dynamics Aesthetics model suggested by [7] to create aesthetics, whereas players experience aesthetics, and in so doing, infer knowledge about mechanics; (3) design: [24] found five levels of abstract design elements in games and the gamification concept based on a literature review. The authors described the level of game design such as Badge, Leaderboard and Level for the level of game interface design pattern and for level game models such as Mechanics Dynamics Aesthetics and Core Elements of the Gaming Experience as conceptual models of game components.

Gamification is an integral part of an application because it can ensure the effectiveness of its usage, as demonstrated in the results within learning environment, the benefits of Gamification elements cannot be ignored because the main goal is to increase user effectiveness and understanding within a fun and enjoyable learning thereby yielding high user performance. Based on the results of Thom, et al. [16], this research tries to solve the problem through a Gamification approach to verify the effectiveness of applying a Gamification approach to students especially in difficult subjects such as Programming Language courses (ie. HTML, CSS, SQL, Visual Basics, C++/Java and Machine Language).

Several researches have been done on how to make computer programming fun, students motivated and increase students' performance. In 2010 [17] mentioned that reducing the difficulties of students in understanding the concepts and rules of a programming language can enhance their motivation and competency to learn the course. The most popular problems that students faced in learning programming languages are (1) Memorizing reserved words in code writing is the most common difficulty faced by old and novice students. Text with unfamiliar grammar rules and syntax written in a language foreign to students. Writing the syntax code of programming languages can be frustrating for students who are new to the course; (2) Learning basic algorithms; (3) Particularly in introducing formal programming; (4) Students do not focus on their lessons, that is, they focus on trivial things instead of concentrating on the essential ones; (5) Many teaching materials used by teachers and lecturers at the university discount the essential issues of programming courses. This circumstance has led to bad coding habits that have caused students to unintentionally write poor code from the beginning; (6) Difficulty

in understanding how to debug problems; and (7) Insufficient time for learning and lack of motivation.

Usability defined as the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency, and satisfaction in a specified context of use. Although there are no specific guidelines on how to measure effectiveness, efficiency, and satisfaction, a large survey of almost 100 summative usability tests [1]. In general, there are two types of usability tests: finding and fixing usability problems (formative tests) and describing the usability of an application using metrics (summative tests). The terms formative and summative come from education (formative: providing immediate feedback to improve learning, versus summative: evaluating what was learned).

Regarding to the motivation issue, the ARCS model of motivational design was by Keller 1990, which presumes that people are motivated to learn if there is value in the knowledge presented and if there is an optimistic expectation of success. The model consists of four main areas: attention, relevance, confidence, and satisfaction. Attention and relevance, according to ARCS motivational theory, are essential to learning and are the key components for motivating learners. Confidence and satisfaction can be considered the backbone of the ARCS theory, where the attention and relevance components rely upon the former.

Attention component mentioned in this theory refers to the interest displayed by learners in the concepts/ideas being taught. This component is split into three categories: perceptual arousal, using surprise or uncertain situations; inquiry arousal, offering challenging questions and/or problems to answer/solve; and variability, using a variety of resources and methods of teaching. Within each of these categories, John Keller provided further subdivisions of types of stimuli to capture the attention of learners.

According to Keller, relevance must be established using language and examples that the learners are familiar with. The three major strategies Keller presents are goal oriented, motive matching, and familiarity. Similar to the attention category, Keller divided the three major strategies into subcategories, which provide examples of how to make a lesson plan relevant to learners.

The confidence aspect of the ARCS model focuses on establishing positive expectations for achieving success among learners. The confidence level of learners is often correlated with motivation and the amount of effort put forth in reaching a performance objective. For this reason, it is important that the learning design provides learners with a method for estimating their probability of success.

Finally, learners must obtain some type of satisfaction or reward from a learning experience. This satisfaction can be obtained from a sense of achievement, praise from higher-up, or mere entertainment. Feedback and reinforcement are important elements and when learners appreciate the results, they will be motivated to learn. Satisfaction is based upon motivation, which can be intrinsic or extrinsic.

This research proposes the use of a Gamification approach to solve the problems in Programming Language learning. Therefore, gamification based learning was developed and tested to the real users. There are two types of evaluation namely usability and motivation.

3. METHOD

The usability and motivation evaluation of gamification website was conducted with 60 students from UKM - FTSM (new students registration in September intake 1(2015/2016). The students were assigned to one group of 30 students; experimental group (Eg).

Nine usability constructs, which are 48 items such as (Perceived enjoyment, Perceived usefulness, Interface, Content, Feedback, Immersion, Learning opportunity and Perceived intention to use) are measured.

The usability evaluation of the gamification website was evaluated by 30 new intake students for session 2015-2016. Usability instrument was adapted [18] as shown in Table 1. Five pars Likert-like scale arrange from very bad to very good was used.

Table 1: The usability evaluation items

Construct	Usability items
Perceived Ease of use	I can quickly access the information I need on gamification website
	My interaction with this gamification website is clear and understandable
	I can quickly find the information I need on this gamification website
	Users would know how to handle gamification in the computer lab.
	It would be easy for users to use gamification in the computer lab.
	Users interaction with gamification in the computer lab would be clear and understandable
Perceived enjoyment	During the navigation process, I felt excitement with the gamification website
	While navigating on this website, I felt a sense of adventure
	This website it entertains me with the game elements
	I enjoyed with the serious learning application and with the game elements
Perceived usefulness	This website provides good quality information to student learning
	This website is useful for selecting the best questions for assessment
	Information displaying is useful through explanation and assessments
Interface	The gamification website interacts closely with the user.
	The gamification screen is clear and easy to understand.
	The process of the gamification is easy to learn.
	The design of the gamification screen is attractive
	The important information is presented

	clearly.		Users temporarily forget worries about everyday life while using the gamification website.	
Content	The descriptions in the gamification website short and easy to understand.	Learning opportunity	This gamification offer opportunities to experiment with knowledge.	
	The content is presented in a conceptual order.		This gamification offer opportunities to take control over the learning process.	
	The MCQ assessment in the gamification are related to the learning materials.		This gamification offer opportunities to experience things users learn about.	
	The learning goals are documented in the gamification.		This gamification offer opportunities to interact with other users through top 10 and leaderboard.	
	The information in the gamification is accurate.		This gamification offer opportunities to think critically.	
	The content of the gamification is interesting.		This gamification offer opportunities to motivate users.	
	Gamification website covered many examples and exercises of programming language course. content		Students will find ease to do the exercises of programming language course through gamification website.	
	Gamification website make student more focus on the concepts of programming language used and make it as an essential notes. content		Students, after using gamification website can adapt with other programming language such as C language.	
	Gamification make student find easy to memorize and understanding the reserved word (more practice). content		Perceived intention to use	I would be willing to use this gamification website
	Gamification website make student to distinguish between (Compilation error, logical error and case sensitive error). content			I intend to use this gamification website in the future as well
	Gamification website makes the syllabus of programming language more clear and specific for learning programming language concepts. content			I'm likely to recommend this gamification website to my friends
				Awards such as (points and Badges) increases my involvement in the gamification website
	Feedback		Users receive feedback on their progress in the gamification.	
Users receive information on their success (or failure) of goals.				
Immersion	Users forgot about time passing while using the gamification website.			
	Users become unaware of their surroundings while playing the gamification.			

The sample of students was used to measure students change in motivation who using the Gamification website. ARCS motivation model used as shown in Table 2, the method of motivation evaluation was divided into three stages: pre-test, treatment session, and post-test. In the first stage, a pre-test was administered to the experimental group. The experimental group sample had to undergo the pre-test to ascertain their motivation for learning programming language. The objective of this stage is to accumulate and gauge the

motivation scores of students. The second stage involved the treatment session, where the experimental group continued learning using the gamification website with the conventional method. After that, in the third stage, the experimental group sample was given the post-tests. The objective of this post-test is to measure the motivation score obtained by the students after the treatment session.

Table 2: The motivatin evaluation items

ARCS	Motivation items
Attention	1- There are something interesting at the beginning of this course that got my attention.
	2- The manner in which the programming learning concepts are presented helps me focus my attention.
	3- I can concentrate on the learning programming language concepts.
	4- The way the information is arranged on the pages helped keep my attention.
	5- The themes of the programming learning concepts draw my attention.
	6- I learned some things that are surprising or unexpected.
	7- The variety of reading passages, exercises, illustrations, etc., helped keep my attention on the course.
Relevance	1- The ‘Understanding of programming language concepts’ activities in this course are very helpful to me.
	2- Completing this course successfully is important to me.
	3- The content of this material is relevant to my interests.
	4- There are explanations or examples of how people use the knowledge in this course.
	5- The content of this course is

	valuable and worth learning.
	6- I can link the content of this course to knowledge with which I am already familiar.
	7- The content of this course will be useful to me.
Confidence	1- When I first look at this course, I have the impression that it will be easy for me.
	2- After reading the introductory information, I feel confident that I know what I suppose to learn from this course.
	3- As I work on this course, I will be confident that I can learn the content.
	4- After working on this course for a while, I will be confident that I will be able to pass a test.
	5- The good organization of the content helped me be confident that I will learn this material.
	6- The progressive method of the conventional learning activities meets my expectations.
	7- I am confident that I can accomplish all the conventional learning activities.
Satisfaction	1- Completing the exercises in this course gave me a satisfying feeling of accomplishment.
	2- I enjoy this course so much that I would like to know more about this topic.
	3- I really enjoyed studying the course of programming language.
	4- The wording of feedback after the exercises, or of other comments in this course, helped me feel rewarded for my effort.
	5- It felt good to successfully complete this course.
	6- It was a pleasure to work on such

	a well-designed course.
	7- I am satisfied with my learning achievement in the ‘Understanding programming language concepts’.

4. RESULT AND DISCUSSION

In order to solidify the final results, this research used a pilot study before the final evaluation. The internal consistency test was used to determine the Cronbach’s Alpha Coefficient of these subscales. The Cronbach’s Alpha values for the 46 and 28 questions in this study were found to be greater than 0.7. Hence, it is reliable to use these usability and motivation evaluations. On the other hand, a pilot test to determine the validity of the instrument was carried out with five IT teachers. The Content Validity Ratio (CVR) for the instrument is +1.00. CVR is a method used to test the content validity of the instrument using the formula $CVR = (2ng / N) - 1$; ng = number of experts who have given positive or great grading for instrument items and N = total of experts who have given a grading for the instrument items of 46 and 28 questions. The subsequent section will discuss the findings regarding to usability and motivation evaluation as below.

4.1 Usability Findings

Table 3, shows results for the usability evaluation. The mean score are all above 4.00, the least is 4.07, meaning that the gamification website has good usability from the aspects of Perceived Ease of use, Perceived enjoyment, Perceived usefulness, Interface, Content, Feedback, Immersion, Learning opportunity and Perceived intention to use.

Table 3: The result of usability evaluation

Construct	Item code	Mean	S.D	General Mean
Perceived Ease of use	E1	4.27	.740	4.33
	E2	4.13	.730	
	E3	4.40	.724	

	E4	4.33	.606	
	E5	4.47	.681	
	E6	4.40	.724	
Perceived enjoyment	En1	4.57	.626	4.42
	En2	4.57	.626	
	En3	4.40	.621	
	En4	4.17	.648	
Perceived usefulness	U1	4.23	.626	4.28
	U2	4.20	.610	
	U3	4.43	.626	
Interface	I1	4.37	.615	4.36
	I2	4.50	.630	
	I3	4.30	.596	
	I4	4.40	.563	
	I5	4.27	.640	
Content	C1	4.50	.630	4.35
	C2	4.33	.606	
	C3	4.37	.718	
	C4	4.17	.699	
	C5	4.33	.711	
	C6	4.43	.626	
	C7	4.23	.626	
	C8	4.30	.596	
	C9	4.23	.679	
	C10	4.63	.669	
	C11	4.37	.718	

Feedback	F1	4.17	.592	4.27
	F2	4.37	.556	
Immersion	Im1	4.20	.664	4.38
	Im2	4.63	.615	
	Im3	4.33	.711	
Learning opportunity	L1	4.27	.640	4.24
	L2	4.07	.640	
	L3	4.20	.714	
	L4	4.00	.587	
	L5	4.47	.681	
	L6	4.23	.728	
	L7	4.43	.626	
	L8	4.30	.750	
Perceived intention to use	In1	4.43	.626	4.41
	In2	4.40	.621	
	In3	4.67	.606	
	In4	4.17	.699	

The results show that gamification website scored in the Perceived Ease of use with mean score of 4.33, that is mean this criteria has more than good in ease to use the gamification website. Perceived enjoyment with mean score of 4.42, that is meant student feel good excitement with gamification website. Perceived usefulness with mean score of 4.28, that is meant website provides good quality information to student learning as well as the website is useful for selecting questions for assessment. Interface with mean score of 4.36, that is meant The gamification website interacts closely with the user, easy to learn, easy to understand, attractive and The information is presented clearly. Content with mean score of 4.35, that is meant the information in the gamification is good accurate, interesting as well as covered many examples and exercises of programming language course. Feedback with mean score of 4.27, Immersion with

mean score of 4.38, Learning opportunity with mean score of 4.24 that is meant the gamification website offer a good opportunities to experiment with knowledge, then to take control over the learning process and to interact with other users through top 10 and leaderboard finally students will find ease to do the exercises of programming language course through this website. Perceived intention to use with mean score of 4.41, that is meant good score from students would be willing to use this gamification website presently and in future.

4.2 Motivation Findings

The result of motivation evaluation by using paired t-test. The purpose of the paired t-test is to see whether there is a significant difference between two scores of motivation (pre-test and post-test), as shown in Tables 4 and 5.

Table 4: Motivation mean score

	Experiment group	Mean	Std. Deviation
Eg	Pre-test	1.49	.45
	Post-test	4.60	.44

Table 5: Result of paired t-test on motivation scores of Eg

Pre-test	Mean	Std. Deviation	t	df	Sig. (2-tailed)
Eg	-3.11	.66	-25.65	29	.000

The paired-t test shows that there is a significant difference in the scores for pre-test (Eg) (Mean=1.49, SD=.45) and post-test (Eg) (Mean=4.60, SD=.44) conditions: $t(29)=-25.65$, $p < 0.0001$ for experimental group. This means that there is a significant change in motivational gain for the experimental group, which used conventional teaching method and the Gamification application.

4.3 The relationship between usability and motivation

In order to measure the level of motivation toward the usability of gamification website based on students perspective. This study used correlation coefficient bivariate by Pearson analysis as shown in Table 6.

There is a positive relationship between learning motivation and usability, as seen in Table 6. According to [19], motivation theorists have long argued that those who are more interested and engaged in the process of education will learn better and achieve more. The results of this research indicate that intrinsic motivation can change learning achievement based on the game elements. When learning activities arouse students' curiosity and interest, and students are satisfied with the system's function in an educational environment, and these students can reach a greater level of learning motivation and attain a higher learning achievement. Similarly, [20] found that learning motivation has a strong positive effect on learning outcomes.

5. CONCLUSION AND FUTURE WORK

This study mainly focused on how to measure user experience in using gamification technique in programming language course. The usability and motivation evaluation was conducted in gamification website.

Gamification prototype was designed in order to improve user experience such as students in the subject of programming language as a learner, particularly using for self-learning and assessment of their level of knowledge. The experiment group answers questions of usability and motivation evaluation. The findings shown there is positive motivation level toward the usability of gamification website based on students aspect.

On the other hand, gamification prototype could be used for other subjects such as database, chemistry and mathematics by uploading the content or learning material of particular subjects.

Table 6 The correlation coefficient between Usability and motivation evaluation

	E	En	U	I	Co	F	Im	L	In	A	R	C	S
E	1	.593	.829	.708	.662	.498	.621	.542	.504	.688	.487	.369	.498
En	.593	1	.775	.662	.586	.386	.537	.413	.432	.641	.503	.867	.238
U	.829	.775	1	.727	.683	.510	.633	.426	.472	.706	.535	.535	.723
I	.708	.662	.727	1	.636	.480	.641	.489	.497	.703	.571	.668	.921
Co	.662	.586	.683	.636	1	.825	.805	.737	.738	.900	.813	.735	.513
F	.498	.386	.510	.480	.825	1	.644	.527	.550	.715	.617	.789	.359
Im	.621	.537	.633	.641	.805	.644	1	.782	.782	.836	.874	.583	.689
L	.542	.413	.426	.489	.737	.527	.782	1	.925	.792	.903	.683	.639
In	.504	.432	.472	.497	.738	.550	.782	.925	1	.807	.938	.722	.599
A	.688	.641	.706	.703	.900	.715	.836	.792	.807	1	.878	.947	.719
R	.487	.503	.482	.571	.813	.617	.874	.903	.938	.878	1	.678	.978
C	.369	.867	.535	.668	.735	.789	.583	.683	.722	.947	.678	1	.985
S	.498	.238	.723	.921	.513	.359	.689	.639	.599	.719	.978	.985	1

Note : E = Ease of use, En = Perceived enjoyment, U = Perceived usefulness, I = Interface, Co = Content, F = Feedback, Im = Immersion, L = Learning opportunity and In = Perceived intention to use in usability evaluation constructions. The motivation evaluation constructions such as A = Attention, R = Relevance, C = Confidence and S = Satisfaction in motivation evaluation constructions

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