Technology Acceptance Model and the Use of Digital Game-Based Learning (DGBL)

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Abstract - The globalization of information technology has been an agent of changes in almost every aspect of our life especially in the way we learn. The current generation as referred to by Prensky (2001), "digital native", has been fully influenced by the technology. This challenge created a pedagogic imbalance as the current learners becomes uncomfortable with the old traditional methods of teaching. As a result digital games were advocated. This research investigates the acceptance of DGBL among undergraduate students of Multimedia University of Malaysia. 171 questionnaires were collected and analyzed using descriptive statistics which covered perceived usefulness, perceived ease of use and attitudes towards use. The result indicated that, students with agreed and strongly agreed responses have higher mean and standard deviation. The research also verifies whether there exist any significant differences of the user demography (gender and age-group) and their attitude towards use. Mann Whitney U test and Kruskal Wallis H test were used for the analysis. The result showed that there were no statistically significant differences.

I. Introduction:

The participation and communication in the traditional classroom across various universities in the world has drastically changed due to the recent technology infusion [1]. DGBL is increasingly prevalent in the higher educational institution in order to create a medium for an effective teaching and learning. Effective teaching/learning is provided by an effective teaching atmosphere [2]. According to [3], effective teaching environment provides high intensity of interaction and feedback, established specific goals and procedures to meet them, be motivational, provides continual feeling of challenge to the learner, provide a sense of direct engagement on the task, provide appropriate tools that fit the task and avoid distractive and disruption that destroy the subjective experience. According to researchers such as [4] states that, all
of the above requirements for an effective teaching environment are included in games.

Games are considered as complex social phenomenon [5] which have become an integral part of our social and cultural environment [6]. Games have provided educationally potential learning environment that: 1) support multi-sensory, active, experiential, problem-based learning, 2) favour activation of prior knowledge which ascertain that players must use their previously learned information in order to advance, 3) provide immediate feedback enabling players to learn from their mistakes, 4) encompass opportunities for self-assessment through the mechanisms of scoring and reaching different levels, and 5) increasingly become social environments involving communities of players [6]. This research work focuses on online digital game-based learning (DGBL). Digital Game-Based Learning (DGBL), described games application on learning in digital platform.

II. Problem Statements:

The methods of teaching and learning in the higher institution have gradually been transformed especially with the integration of information and communication technology into education. The ICT has created an advanced changes in the educational sector, which includes development of content management software's (CMS), e-learning systems and distance learning which have over the years, gained acceptance in the educational sector [2]. The introduction of games into education has posed a new paradigm shift in the education sector. It revolutionized the entire methods of transmitting knowledge to learners. The emergence of games in education instigated a pedagogical imbalance, which in fact requires a serious re-adjustment in order to meet the need of the contemporary learners who have been considered as "digital natives" [7, 8] "net-generation" [9] "gamer-generation" [10]. These generation of learners have becomes technology addict, who virtually spends 80-90% of their time using one technology or the other. At a time is either they are found to be using their mobile phone surfing the internet, charting, or making calls, or using their digital computers doing assignment, watching movies or playing digital video games.
Game as a means of play was integrated into learning so that the so called digital natives, or gamer generation could be deceived to learn certain concept while they

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engaged into play. The game literature has revealed that, most of the researches conducted focuses their investigation into the learning effectiveness and motivational appeal [11], students learning outcome [12], skills development and motivation [13]: Most of the findings had been reported that players learn from games rather than considering whether the learners intrinsically accept the adoption of such technology within learning set up.

III. Theoretical Framework:

The researcher has reviewed several literatures in the information systems literature. After which technology acceptance model (TAM) was considered to be the appropriate model for the research. The model is regarded as the influential research model that is used frequently in the information system research, which is adopted based on the principle adapted from [14]. The model described two attitude construct: attitude toward the object and attitude towards the behaviour. The attitude towards the object is considered as the affective individual evaluation of specified attitude object, while, attitude toward the behaviour was viewed as an affective individual evaluation of specified behaviour involving the object. The attitude towards the behaviour is considered to be strongly related to the proposed research. The research therefore employ the use of the TAM construct; attitude towards the behaviour. The proposed TAM will explore attitude behaviour of the target system. Attitude towards using a system is defined as an evaluative affect that an individual associates with using a target system in his/her job. The TAM is composed of two distinct beliefs that trigger a system acceptance. These includes perceive ease of use and perceive usefulness. [14]. These two main TAM beliefs are more operative in the context of information technology user behaviour. They are empirically identified to be the most acceptable user acceptance criteria [15]. Perceived usefulness is defined as "the degree to which an individual believes that using a particular system will enhance his/her job performance." Perceived ease of use is defined as "the degree to which individual believes using a particular system would be free of physical and mental effort. The following is the proposed TAM for the research

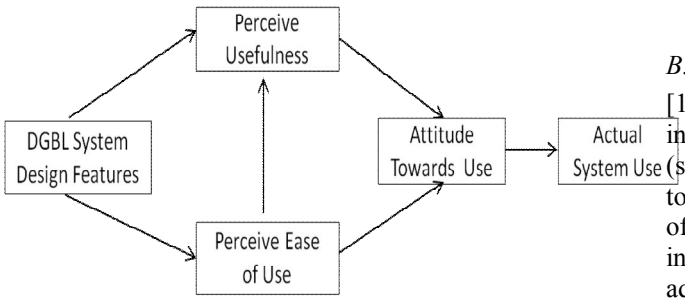


Figure 1: Technology Acceptance Model

Perceived ease of use significantly influences student's attitudes towards DGBL usage. That is, any system with simplified feature would influence attitude behaviour towards using the system. Perceive ease of use also influence user belief about the system to be useful. Usefulness also influences user attitude behaviour towards using. Perceived usefulness is entirely concern about the overall impact on the system (game). Meanwhile the features embedded in the game such as storylines, interactivity, interface, challenge and so on are considered as the external variables of which the system designer can manipulate during his/her design in making the game easier for use. [14], explained external stimuli as to influence person's attitudes towards behaviour, by directly influencing his/her salient belief about the consequences of performing the behavior. This research therefore considered system design features as the stimuli that influence ease of use and usefulness which were used as the basis for designing the instrument. Thus making visual interface clear, providing interested fantasy element, constructing easy understood story, assigning relevant rewards at each level and so on. This research is therefore limited to investigating the perceptions of usefulness and ease of using DGBL. It tries to find out whether the usefulness and ease of use mediate on students attitudes towards using, on which the following research questions were asked.

IV. Research Questions:

1. What are the student's perceptions on usefulness of online DGBL systems?
2. What are the student's perceptions on ease of use of online DGBL systems?
3. How does the students perceptions differ in using online DGBL Game?

V. Research Methodology:

A. Subject and Procedure:

The research was carried out on the student of Multimedia University Malaysia in the faculty of creative Multimedia. 171 questionnaires were collected from a total population of 711 students. The population comprises of undergraduate students from different majors (Departments) across the faculty which includes; 107 students of Media Innovation departments, 162 students of Advertising Design, 64 Media Art, 60 Digital Media, 99 Film and Animation, 92 Animation and video effect, 63 Virtual Reality, and 63 Interface Design students.

B. Research instruments

[16], explain survey research as a quantitative procedures in which researchers administer a survey to a portion (sample) or entire population of the respondents in order to describe opinion, attitudes, characteristics or behavior of the population [17] Questionnaire is chosen to be the instrument for this research. The questionnaire used was adapted and adopted from the related literature reviewed such as [15] "user acceptance of information technology", [1] "technology acceptance model and e-learning" [18] "extending the technology acceptance model to use Cabri Geometry". 5 point Likert scale format was used to design the questionnaire. 5 point Likert scale was used based on the recommendation that it is more appropriate and easier to use than other references scales [19].

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VI. RESULTS:

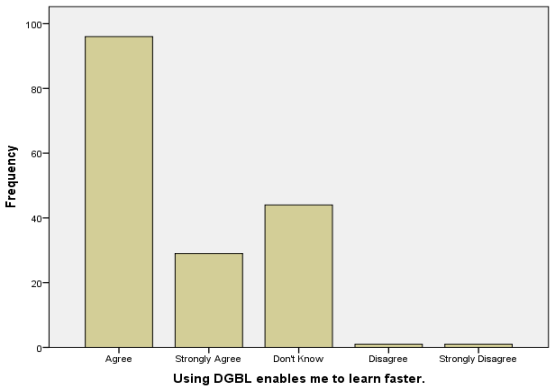
A. Research Question One:

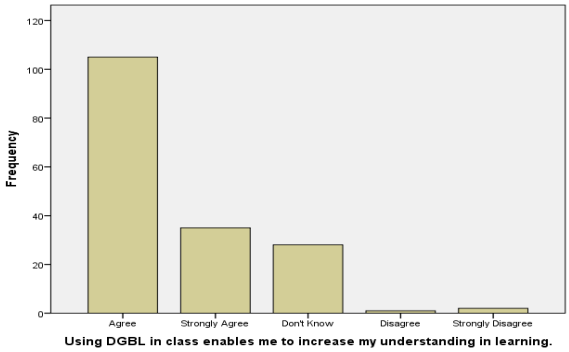
What are the student's Perceptions Usefulness online DGBL systems?

The question above ask the respondents to ranked their perceive usefulness (PU) of DGBL in accordance with their job performance. PU was defined by [15] as "the degree to which an individual believes that using a particular system will enhance his/her job performance." The survey contained three items that extracted opinions of the respondents on usefulness. The reliability of the items was tested, the Cronbach's Alpha was found to be 0.737 on DGBL usefulness. Which confirm that the reliability of the items were good. The table below shows the mean and standard deviation of the items.

Table 1: Mean and Standard deviation of perceived Usefulness

Items Number	Survey Items	Mean	SD
1	Using DGBL enables me to learn faster.	1.73	0.908
2	Using DGBL in class enables me to increase my understanding in learning.	1.60	0.865
3	Using DBGL enables me to improve my grades in learning.	1.93	0.968
	Cronbach's Alpha 0.737. N=171		





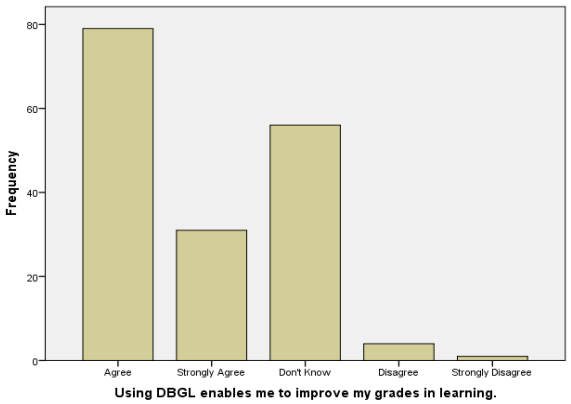


Figure 2: Graphical representation of Perceived Usefulness

The Figures above shows that the construct perceived ease of use fully mediate the acceptance of DGBL as learning tool with frequency of 96 agreed responses on the first item, 105 agreed responses on the second item and 79 agreed responses on the third item.

B. Research Question Two:

What are the student's perceptions on Perceive Ease of Use of online DGBL systems?

The question above ask the respondents to ranked their perceive ease of use (PEOU) of DGBL in relation to the online games experiences. The mean and standard deviation of the perception of student's on ease of using DGBL ranges from 1.65 to 1.89 and 0.832 to 0.970 respectively. The cronbach's Alpha reliability was computed to 0.686. Which indicated that the items used were reliable. The frequency and percentage of the responses according to the figure below show that majority of the respondents agreed with statements made on ease of using DGBL. On the first item 48.0% (N=82), second item have 55.6% (N=95) and the third item with 52.0% (N=89). Only 2.3% (N=4) to 4.7% (N=8) have disagreed.

Table 2: Mean and Standard Deviation of Student Perceived Ease of Using DGBL

Items Number	Survey Items	Mean	SD
1	My interaction with DGBL tools is always clear and understandable.	1.89	0.970
2	I find DGBL tools easier to interact with	1.65	0.832
2	I find the DGBL tools easy to use.	1.74	0.874
	Cronbach's Alpha = 0.684. N=171		

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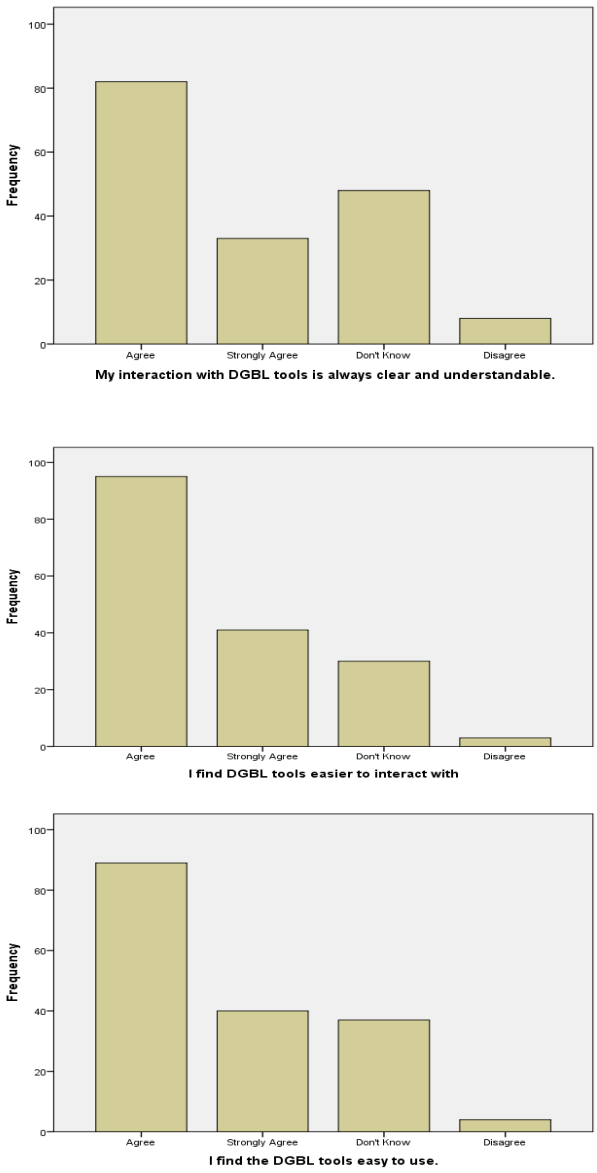


Figure 3: Graphical Representation of Perceived ease of use

Figure 4: Percentage of Students Responds on Ease of Using DGBL

C. Research Question three:

How the students do differs in their perception toward online DGBL usage?

The third research question was directed towards finding out whether demography influences any significance differences in the student's attitude towards using DGBL. The analysis compared perceived ease of use and perceives usefulness as the dependant variables and the demographic variables such as Gender, age, class level as the independent variable. Appropriate association test was used on each variable construct in order to identify whether there exist any significant relationship between them.

Perceive Usefulness, Perceive ease of Use and Gender of the respondent

Mann Whitney U test was used to test whether different student's gender resulted in a significant difference in their attitudes towards accepting DGBL. Mann Whitney U test is a test used to test difference between two independent groups on a continuous measure (e.g male and female). It is a non-parametric alternative to the t-test of independence samples that compares means of two groups. Mann Whitney test compare medians instead of comparing means. It usually converts the scores of the continuous variable to ranks across the groups and evaluate whether the ranks of the two groups differ significantly. The most important reason for using this test is that it does not concern about the distribution of the score in the groups [20].

From the tables below, the main important values to be considered are the **Z** value and the level of significant which is given as **Asymp. Sig (2-tailed).** To determine the level of significance, (Asymp. Sig (2-tailed)), the p-value should be less than or equal to 0.05 (p<=0.05) [21].

According to the result obtained from the analysis, the z value for perceived ease of use is -.59, perceive usefulness is -.25, respectively with a significance level value p=.56, 80, respectively. This shows that the P-value is not less than or equal 0.05 (p<>0.05). this therefore indicate that there is no significances between male and female in their attitude towards using DGBL. The Table below shows the Mann Whitney Rank and Test Statistics result

Table 3: Mann Whitney Rank test of Perceive Usefulness, Perceive ease of use and gender

Ranks

	Gender of the respondents	N	Mean Rank	Sum of Ranks
Perceived ease of use	Male	86	82.37	7084.00
	Female	82	86.73	7112.00
	Total	168		
Perceived Usefulness	Male	86	86.93	7476.00
	Female	85	85.06	7230.00
	Total	171		
Attitude towards use	Male	84	90.50	7602.00
	Female	84	78.50	6594.00
	Total	168		
Intention to use the system	Male	86	88.53	7614.00
	Female	85	83.44	7092.00
	Total	171		

Table 4: Mann Whitney Test Statistics of Perceive Usefulness, Perceive ease of use and gender

Test Statistics[a]

	Perceived ease of use	Perceived Usefulness	Attitude towards use	Intention to use the system
Mann-Whitney U	3343.000	3575.000	3024.000	3437.000
Wilcoxon W	7084.000	7230.000	6594.000	7092.000
Z	-.591	-.253	-1.635	-.704
Asymp. Sig. (2-tailed)	.555	.800	.102	.481

a. Grouping Variable: Gender of the respondents

Perceive Usefulness, Perceive ease of Use and Age-Group of the respondent

According to [20], Kruskal-Wallis test is employed when the assumption of normally (ANOVA) is not met. It is a nonparametric, distribution free test, which is used when comparing three or more variables.

The respondents had been grouped into 3 different groups based on their age levels: Group 1 (18-22 years old), Group 2 (23-26) and Group 3 (27-30).

From the above analysis, the most important values are the Chi-Square values, the degree of freedom (df) and the level of significance (Asymp. Sig.) as shown in (table 16) . The significance level of each constructs, perceived ease of use is 0.078; perceived usefulness was 0.501 respectively. The values are all not less than or equal to 0.05. this result can be used to deduced that there is no significant differences between the age-groups and the constructs 'perceive usefulness and perceive ease of use'.

Table 5: Kruskal-Wallis Rank test of Perceive Usefulness, Perceive ease of Use and Age-group

Ranks

	Ageof the respondents	N	Mean Rank
Perceived ease of use	18-22	146	81.27
	23-26	20	106.23
	27-30	2	103.25
	Total	168	
Perceived Usefulness	18-22	147	86.40
	23-26	22	80.11
	27-30	2	121.00
	Total	171	
Attitude towards use	18-22	146	82.59
	23-26	20	97.65
	27-30	2	92.25
	Total	168	
Intention to use the system	18-22	147	85.48
	23-26	22	91.93
	27-30	2	58.75
	Total	171	

Table 6: Kruskal-Wallis Test Statistics on Perceive Usefulness, Perceive ease of Use and Age-group

Test Statistics[a,b]

	Perceived ease of use	Perceived Usefulness	Attitude towards use	Intention to use the system
Chi-Square	5.103	1.383	1.816	1.025
Df		2	2	2
Asymp. Sig.	.078	.501	.403	.599

a. Kruskal Wallis Test
b. Grouping Variable: Age of the respondents

VII. Discussion

According to [22], DGBL is considered as one of the current trend in e-learning. It is design to alternatively support traditional method of teaching [23]. But these all new technologies that are introduced into the education sector, therefore their acceptance are a major determinant of their success. This research investigated the perceived usefulness and perceives ease of use of DGBL and how it influenced attitude toward using

In the previous research TAM was used by [1] on user acceptance of e-learning, the study revealed perceived usefulness as a significantly determinants for use and acceptance. [24] also revealed perceived usefulness to have a significant influence on consumer attitude perception on e-shopping. In line with the above findings, this study also found perceived usefulness to influence attitude towards using DGBL, based on the result presented in the research. Hence, usefulness has a positive influence on user acceptance of DGBL in line with the study of [1, 24].

The construct perceived ease of use as used in this research, is reported to influence user acceptance with extremely high agreed and strongly agreed responses. This is in line with previous research conducted by [15] using TAM to investigate the acceptance of electronic mail and text editor with emphasis on system design features reported that perceived ease of use have a significance influence on user acceptance. [23] in their research to investigate the effect of individual differences of learner's performance on 3D animation course through game-based learning, TAM was used with high teacher expectancy as external stimuli, students with high teacher expectancy demonstrated higher acceptance on perceived ease of use, perceive usefulness and perceived willingness to use the system.

The research also investigated whether gender and age-groups of the respondents influence any statistical differences on the user attitudes towards using DGBL. The TAM constructs were analysed using Mann Whitney U test and Kruskal-Wallis H test. Gender of the respondents was tested using Mann Whitney U test. The

level of significance revealed that there exist no statistically significance difference (p = Asyp. Sig) between male and female towards accepting DGBL. This is in line with the finding of [25] . Their finding revealed DGBL to be suitable for all gender with different experience.

Kruskal-Wallis H test was used to evaluate the age-group. TAM constructs were used and the result indicated that the significance level were found to be greater than the p-value (p<=0.05). which indicated that, there exist no statically significant differences between the age groups of the respondents. This is in line with research conducted by [12], who analysed the demographic variable, such gender, ethnicity and age of the respondents. The result revealed that there were no significance differences between the genders. [23] also revealed no significant difference among the genders in applying game-based learning approach to nutrition education.

VIII. Conclusion

The various researches conducted by prominent authors on digital games such as [11-13] had all indicated positive improvements in the learners outcome on using DGBL in their learning. In line with this study, it was found that, students generally have positive perceptions towards DGBL which therefore its acceptance. These positive attitudes of the respondents indicated that students willingly accept DGBL into their learning process

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