Needs Analysis for Online Game Development for Form 2 Mathematics in the District of Bagan Datuk, Perak

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ABSTRACT

This study was conducted to investigate the topic that the students perceived as the most difficult topic in Form 2 Mathematics, students' perceptions on online games as well as identify user-friendly, interactive and design-appropriate features for online game development for Form 2 Mathematics. A study was conducted among 500 students from 8 schools under the administration of the Bagan Datuk District Education Office (PPD). The data were collected using the questionnaire form. SPSS (Statistical Package for the Social Science) version 26.0 was used as a tool to analyze descriptive data with mean (M) and standard deviation (SP). Based on the findings from the analysis using frequency, the students chose the topic, Probability. Statistical descriptive analysis of students' perceptions of online games showed a moderate level (M = 3.38, SP = 0.75). Features such as user-friendly showed high levels (M = 3.58, SP = 0.97). From this study, researchers were able to use Probability as a topic to develop online game and make use of user-friendly, interactive and design-friendly features in developing online games to help students in their learning.

Key Words: Perception, Mathematics, Probability, Online Game, Interactic

INTRODUCTION

The Malaysian government has embarked on a continuous effort to prepare youngsters to face the Industrial Revolution 4.0 through the implementation of Malaysian Higher Education Blueprint 2015-2025 (Amirah Mohd Jasmy, Siti Adilah, Noraina & Norkamaliah, 2018). Even so, education without proper and sufficient teaching aids prohibits teachers to deliver quality education to their students in rural areas and the improvement in education shall not happen (Wan Afizi, Shaharuddin & Noraziah, 2014).

The new era in the teaching field encourages students to not only learn the skills and knowledge, but also the sources of the skills and knowledge being taught (Fisk, 2017). Furthermore, the learning process has no physical boundary that the students can learn from any part of the world (Hussin, 2018). Therefore, a new approach that can be incorporated in the learning process which supports the transformation in education field is online games (Hairol, Ahmad, Azli, Muizz, &Intan, 2014). Online learning refers to the act of conducting teaching and learning activities on an online platform according to the available curriculum (Muhammad Nidzam, 2017). Previous studies have shown that digital games in learning process can elevate critical thinking and problem solving skills (Shute, Venture, & Ke, 2015; Hwang, Hung, & Chen, 2014), improve creativity (Hsiao, Chang, Lin, & Hu, 2014), motivation (Hwang et al., 2014; Eservel, Law, Ifenthaler, Ge & Miller, 2014), and students'

achievements (Hwang et al., 2014; Yang, 2012). Thus, online games have started to be incorporated in every level of learning process. Acknowledging this, the Ministry of Education (MOE) has prepared sufficient infrastructures such as computers to allow more subjects to be taught using interactive technology and learning process via websites (Zainuddin, Ibrahim, Ali & Sukor, 2008).

PROBLEM STATEMENT

Learning process should benefit students to allow them fully maximize their potentials (Nesusin, Intrarakhamhaeng, Supadol, Piengkes & Poonpipathana, 2014). Students possess negative perception of Mathematics which focuses on the learning of calculation and formula, and it is limited to practices (Ismail & Zaidan, 2009). Traditional teaching method makes the teaching of Mathematics more difficult due to limited time and a larger amount of students present in a class which results in the teacher's poor classroom management (Rahman, 2010).

Malaysia participated in *Trends in Mathematics and Science Study* (TIMSS) to assess the school students' performance in Science and Mathematics in comparison to other participating countries (Mohd Erfy & Mohd Ali, 2016). Our country has participated in *Trends in International Mathematics and Science Study* (TIMSS) for five times in the year of 1999, 2003, 2007, 2011, and 2015, but only involving Form 2 students who were selected randomly from 150 schools. The main issue being glaringly highlighted and spoken until today is pertaining the TIMSS test score which significantly dropped since 1999 until 2011 (Ministry of Education [KPM], 2013). Therefore, it is crucial for scholars to conduct research on Form 2 students' performance and ability in mathematics to overcome the downward trend.

The presence of technology especially electronics such as calculators and computers have changed the function of teaching and learning process of Mathematics because it provides a platform to vary and improve the activities and presentation (Noraini, 2005). Incorporation of technology opens space and opportunity for the students to explore the real world or simulation in the application. Moreover, the presence of Internet allows students to engage in online interaction with friends which eventually makes the learning process to become more interactive (Hsiao et al., 2014). Introducing digital games in learning is one of the ways to aid students to improve their creativity and non-routine problems (Nurfazliah, Jamalludin, Shaharuddin, & Aman, 2015). Incorporation of online games can reduce boredom and weariness in solving Mathematical problems (Nurfazliah et al., 2015).

RESEARCH OBJECTIVES

The objectives of this research are:

1) Identify the topic in Form 2 Mathematics which students find to be the most difficult topic to develop an online game.
2) Investigate students' perception of online game.
3) Identify appropriate features to develop an online game for Form 2 students.

METHODOLOGY

The research was conducted using survey method in order to collect information and data from a large pool of respondents or a bigger population. This survey based research included a set of questionnaires to collect data for analysis purpose.

Samples were chosen through random sampling. The study was conducted in a population of Form 2 students in the district of Bagan Datuk, Perak. 8 out of 10 schools chosen in this study were located in

the Bagan Datuk district, which was 80% of the population. The district was chosen to allow the researcher to control the defects in collecting a huge amount of data. Random sampling was used to select 500 respondents among the Form 2 students in Bagan Datuk district. Each school were distributed with 65 sets of questionnaires at random to Form 2 students to obtain a total of 500 sets of data.

Based on the tables to determine the size of sampling proposed by Krejcie and Morgan (1970), for a population of 870 people, the appropriate size of sample is 265. However, the researcher collected 500 responses among the respondents which was more than the one suggested by Krejcie and Morgan (1970). According to Talib (2013), collecting samples more than the target number is crucial to meet the goals of survey in a survey based study.

The research instrument used in this study was a questionnaire which was adapted from Normilawati and Azliza (2014). Johari (2003) proposed that this method is frequently used by researchers to collect data. In Gay, Mills and Airasian (2011), questionnaire can represent the actual population if the sampling is done accurately and appropriately. In this study, the questionnaire was divided into four sections (refer to Table 1) and a Likert scale was used to allow the respondents complete the questionnaire (refer to Table 2).

Table 1: Questionnaire's Sections

Section	Item
A	Gender and Race of the Respondents
B	Respondents′ Perceptions on the Difficulty Level of Topic in Mathematics
C	Respondents′ Perceptions on Online Games
D	Suggestion of Features to Develop Online Games i) User Friendly ii) Interactivity and Design.

Table 2: Likert Scale

Level	Acronmy	Score
Strongly Disagree	SD	1
Disagree	D	2
Not Sure	NT	3
Agree	A	4
Strongly Agree	SA	5

The collected data were analyzed using SPSS software (Stastiscal Package for the Social Science) version 26.0. Descriptive Statistics was used to analyze the respondents' demography. The descriptive statistics used in this study include frequency, percentile, min, and standard deviation. The level of interpretation was based on Tschannen-Moran and Gareis (2004), and it is presented below (refer to Table 3):

Table 3: Min Score's Interpretation Level

Min Score	Interpretation Level
1.00 until 1.80	Very Low
1.81 until 2.60	Low
2.61 until 3.40	Average
3.41 until 4.20	High
4.21 until 5.00	Very High

Source: Tschannen-Moran & Gareis(2004)

PILOT STUDY

Prior to conducting the actual study, a pilot study was conducted to determine the reliability value of the instrument being employed in this study. The pilot study was conducted using the same questionnaire on 30 respondents who were selected randomly among the population. This pilot study examined the reliability based on Cronbach's Alpha values.

Table 4: Cronbach's Alpha vales for Questionnaires

Section		No. of Item	Value of Cronbach's Alpha
C	Students' Perception on Online Games	8	0.764
D	Suggestion of Features to Develop Online Games for the Learning of Mathematics		
	A. User Friendly	3	0.655
	B. Interactivity and Design	8	0.890
	Total		0.770

The findings indicated that the reliability value was higher than 0.60, that was 0.770 which signified that the instrument adopted was effective and can be used in the actual study (Darusalam & Hussin, 2016). The findings of the survey conducted for the items in the questionnaire were reported in Table 4.

FINDINGS AND DISCUSSIONS

Analysis on the Respondents' Demography

The analysis in Table 5 below is pertaining respondents' demography including gender and race:

Table 5: Respondents' Demography

Item	Category	Frequency	Percentage (%)
Gender	Male	269	53.8
	Female	231	46.2
	Total	500	100.0
Race	Malay	384	76.8
	Chinese	64	12.8
	Indian	46	9.2
	Others	6	1.2
	Total	500	100.0

The distribution of the genders was almost balance with 53.8% of males and 46.2% of females based on Table 5. As for the race, the Malay respondents recorded the highest percentage of 76.8% as compared to others.

Analysis on the Most Difficult Topic in Mathematics

In this section, there were 13 topics for the respondents to choose from. Respondents were required to evaluate the topics based on the order of number one (most difficult), number two (moderately difficult) and number three (difficult). Based on the analysis, the respondents' data were recorded in Table 6:

Table 6: Frequency of the Most Difficult Topic in Mathematics

No.	Topic	Frequency (%)
1	Simple Probability	20.4
2	Circle	13.8
3	Factorisation and Algebraic Fractions	12.0
4	Patterns and Sequences	10.6
5	Isometric Transformation	8.6
6	Coordinates	6.8
7	Graphs of Functions	6.0
8	Speed and Acceleration	5.0
9	Three-Dimensional Geometrical Shapes	3.8
10	Polygon	3.8
11	Measures of Central Tendencies	3.8
12	Gradient of a Straight Line	3.2
13	Algebraic Formulae	2.2

The top three topics perceived as the most difficult ones were recorded in Table 7 below.

Table 7: Topics' Ranking based on Students' Perceptions.

Ranking	Topic	Percentage (%)
1	Simple Probability	20.4%
2	Circle	13.8%
3	Factorisation and Algebraic Fractions	12.0%

Normality Test

A normality test was conducted to determine if the distribution of data were normal or abnormal.

Table 8: Normality Test Results

Variable	Values of Normality Test	
	Skewness	Kurtosis
Students' Perception on Online Gaming	0.126	0.503
Suggestion of Features to Develop Online Games for the Learning of Mathematics		
A. User Friendly	-0.038	0.007
B. Interactivity and Design	-0.034	-0.029

Based on Table 8, all the data collected in this study achieved normal distribution. This was supported by the value of skewness and kurtosis, which was in between -2.00 and 2.00 (Tabachnick & Fidell, 2001).

Students' Perceptions on Online Games

There were 8 items constructed to determine students' perceptions on online games. Table 9 displays the results of descriptive statistics of 500 students and their perceptions on online games.

Table 9: Students' Perceptions on Online Games

Item Code		Min	SD	Interpretation
C1	I wish to learn Mathematics through online games.	3.33	1.33	Average
C2	I spend a lot of time playing online games using mobile phones.	3.50	2.14	High
C3	I like to play online games because it is fun.	3.46	1.13	High
C4	I like to learn Mathematics online.	3.23	1.14	Average
C5	I like to do Mathematics practices online.	3.11	1.11	Average
C6	I like to learn Mathematics casually.	3.83	1.12	High
C7	I feel excited when I get to learn Mathematics online.	3.32	1.05	Average
C8	I feel excited when I get to do practices for Mathematics online.	3.27	1.11	Average
	Overall	3.38	0.75	Average

The findings revealed that the value of overall min score was 3.382 (SD = 0.747), which was on the average level. Analyzing each item, there were five items recording average min score. The items include C1 (Min = 3.33 & SD = 1.33), C4 (Min = 3.23 & SD = 1.14) C5 (Min = 3.11 & SD 1.11), C7 (Min = 3.22 & SD = 1.05) and C8 (Min = 3.46 & SD = 1.13). The remaining three items recorded high min scores, including C2 (Min = 3.50 & SD = 2.14), C3 (Min = 3.46 & SD = 1.13) and C6 (Min = 3.83 & SD = 1.12). Based on this, it can be concluded that the students spend more time playing online games, likes to play online games and learn in a relaxed manner. This is supported by Norashikin (2010), in which she stated that the students spent more time online. Some of the items showed an average level which could be due to the lack of exposure to online games among students (Sumarni & Zamri, 2018). Besides, another finding of a research reported that the students' interest in the subject had positive correlation on their performance in Mathematics' subject (Rellensmann & Schukajlow, 2017; Rafiee Jamian & Hafsah Taha, 2020). Therefore, it can be concluded that the students are more likely to learn Mathematics better if they have interest in it, which can be shaped by using online games.

Analysis on the Suggestions of Features to Develop Online Game

Table 10 shows the results of descriptive statistics for the features of user friendliness to develop online game. The analysis indicated that the min score of that particular feature was 3.50 (SD = 0.89). Based on the interpretation table by Tschannen-Moran and Gareis (2004), the user friendliness feature recorded a high level. This revealed that the feature must be strongly considered in developing an online game for Mathematics. In fact, each item below recorded high min scores. Item D1 achieved a min score of 3.8 (SD = 1.06), D2 with 3.51 (SD = 1.11) and D3 with 3.41 (SD = 1.06).

Table 10: Suggestions of Feature to Develop Online Game

Item Code		Min	Standard Deviation	Interpretation
D1	Full screen view for online game allows me to look at the contents easily.	3.58	1.06	High
D2	Online game should be easily accessed through mobile phones.	3.51	1.11	High
D3	Navigation menu helps me to easily use the online game.	3.41	1.06	High
	Overall	3.50	0.89	High

Table 11 below depicts the results of descriptive statistics for two features; interactivity and design to develop an online game for Mathematics. The finding shows that the min score of interactivity and design was 3.70 (SD = 0.86), which was on the high level (Tschannen-Moran & Gareis, 2004). All the items in the features recorded high min scores D4 (Min = 3.48 & SD = 1.09), D5 (Min = 3.59 & SD = 1.02), D6 (Min = 3.59 & SD = 1.10), D7 (Min = 3.87 & SD = 1.72), D8 (Min = 3.80 & SD 1.06), D9 (Min = 3.78 & SD = 1.05), D10 (Min = 3.73 & SD = 1.10) and D11 (Min = 3.37 & SD = 1.07).

Table 11: Suggestion of Interactive and Design Feature to Develop Online Game

Item Code		Min	Standard Deviation	Interpretation
D4	The elements and icons in the online game must be interactive to make me feel interested in learning Mathematics.	3.48	1.09	High
D5	The options available in the online game must be well-functioning to make the learning process more structured and systematic.	3.59	1.02	High
D6	The links given to browse other websites should function well.	3.59	1.10	High
D7	Graphic visuals and animations of online games should be suitable and attractive to create a fun learning environment.	3.87	1.72	High
D8	Font size used in the online game should be clearly visible.	3.80	1.06	High
D9	Font type used in the online game should be clearly visible.	3.78	1.05	High
D10	Online game that has different levels should be easy for me to remember the learnt content.	3.73	1.10	High
D11	Teaching notes in the form of multimedia and exercises in the online game should meet the learning objectives.	3.73	1.07	High
	Overall	3.70	0.86	High

The findings revealed that all the items were at the high level of interpretation. This shows that the students have high interest towards interactivity and design features in developing an online game for the learning of Mathematics. The analysis pertaining the interactivity and design of online game indicated that each item in Table 11 is important in developing online game. For instance, the specific feature of the online game should be user friendly so the students will feel attracted to use the application. Besides, it should be able to help them achieve the learning objectives and provide positive outcome.

CONCLUSION

The development of an online game for the learning of Mathematics provides an opportunity for the students to better acquire the knowledge of Mathematics. Based on the findings in this study, the topic in Form 2 Mathematics perceived to be the hardest among the students was probability. In conclusion, there is a need to develop online game for the learning of Mathematics as a subject. This is in favour of the needs' analysis which indicated that the students' perceptions towards online game was on an average level. Acknowledging this, there are a few measures to be considered prior to developing the online game. One of the measures to be taken is to increase the teachers' knowledge and skills and their appropriate ways to achieve learning objectives based on their students' needs. Moreover, this also helps the teachers to plan and conduct a more successful teaching and learning session for

Mathematics. Besides, the findings also indicated that the level of students' perceptions on online game was on an average level. Therefore, it can be regarded that the students were hoping for the development of the online game to be more user friendly and possess the elements of interactivity and attractive design.

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