Nutrition-Related Computer Game Use Resulted to Improved Health Literacy among Preschoolers in the Philippines

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Abstract

Health education aided with technology has been recently examined by experts as a new approach in extending universal efforts to achieve health-for-all. However, despite its outstanding potentials, sensible evaluations for health games has been given little consideration. Health Hunt (the researcher-made computer game) was developed to benefit preschool children tin understanding the concept of nutrition, specifically, the different food groups. Using one-group pretest-posttest design (n=30), the present undertaking aimed to test the effectiveness of the health game in attaining its expected goal. Data revealed significant improvement in the cognitive valuation scores (t= -6.50; α=0.05) from the participants' pretest scores ($\bar{x}$=7.40; SD=2.14) to their posttest scores ($\bar{x}$=10.93; SD=2.23). This indicates substantial evidence the game's effectiveness and is envisioned to contribute to the innovations in the gaming, education and health industries.

Keywords: Nutrition, Literacy, Game for Health, Preschool, Causal Research, One-group Pretest-posttest Design, Before-after Design

1.0 Introduction

Despite the advancements in the medical industry, there are still unresolved gaps that needs to be bridged, specifically on malnutrition and health literacy among children. The latest conducted by the Food and Nutrition Research Institute (FNRI) of the Department of Science and Technology (DOST) in 2008 has revealed that there is increasing occurrence of malnutrition among children in the Philippines. Several nutrition agendas and plans were delivered to eradicate malnutrition, but the problem still subsists. Studies have shown that the decline in health literacy is considered the real cause of the problem (Azim, Shafi, Qureshi, Sheikh, Azim, & Hayat, 2005). Therefore, experts started searching for new ways to provide health information to children.

Researches have been looking for the potentials of computer gaming as a way to provide health information to children. With the immense community of gamers existing Entertainment Software Association (2011), utilizing games as a method of health teaching must really be taken into consideration. A number of serious health games, or games intended to educate, produced positive results in providing health knowledge on children. One example is the eBug project that incorporated elements of a platform game in order to raise awareness of children on antibiotic resistance and respiratory hygiene (Kostkova, Farell, de Quincey, Weinburg, Lecky & McNulty, 2010). In line with this fact and the various improvements in the methods of learning, the present study argues that computer gaming can be a potential tool to provide health information to the younger population and later help solve the issue on malnutrition.

This paper intended to determine the effectiveness of a researcher-made computer game in providing health information to preschoolers in a selected preschool institution. The health game is entitled “Health Hunt”, a point-and-click adventure game that provides children information about the basic food groups. Such undertaking would be beneficial in providing a guiding light for the utilization of games in the academic environment that will directly affect didactic knowledge, as well as providing empirical evidence that would help researchers in their future undertakings.

2.0 Background

2.1 Theoretical Framework

This study propelled to contribute to the interesting phenomenon of health literacy, gaming and sustainable health among the preschoolers. This study aimed to test the effectiveness of a researcher-made health game in providing the value of nutrition among preschool children. This research, was inclined to the Relevance, Embedding, Translation, Adaptation, Immersion & Naturalisation (RETAIN) Model (Gunter, Kenny & Vick, 2007) and the Experiential Learning Theory by David Kolb (1984).

According to Gunter and her co-researchers (2007), gaming experience has three levels: (1) interacting, (2) engaged and (3) immersed. Interaction simply happens when there is information exchange between the player and the game (Salen & Zimmerman, 2004, cited in Gunter et al, 2007). At a higher level, the player decides to involve himself emotionally, intellectually or psychologically to the game (Salen & Zimmerman, 2004, cited in Gunter et al, 2007), and this is where engagement occurs. At this time, the player is willing to "play along" because there is a feeling that the elements the player is interacting with could be real (Laurel, 1993 cited in Gunter et al, 2007). Immersion, being the highest level refers to the interplay of both interaction and engagement (Gunter, et al, 2007). Such intense experiences, later on, can be transformed into learning.

David Kolb (1984) believed that experiential learning is a product of the person's reflection of his experience. It is indicated by this process: [1] prehension wherein the person perceived the experience, and [2] transformation which is initiated by "reflective observation" where the person makes sense of the experience and then by "active experimentation" where the reflection is converted according to the likeness of the person. The quality of the experience and reflection is essential to the value of learning.

Translating this fact into the experience of the gamer, it would be necessary to provide the player a game that is enough to extract good experience and stimulate quality reflection. According to Fowler (2008), the quality of experience depends on

the degree the person is involved and the relevance of the subject matter, whereas the quality of reflection depends on what tool to aid the person's reflection and the person's behavior.

2.2 State of Nutrition and Malnutrition among Preschoolers in the Philippines

Nutrition has always been a primary concern not only among developed countries but especially among the developing countries. Basically, nutrition is a human right (United Nations International Children Emergency Fund, 2012) and is important to the continuity of life and the prospering of children (DevPulse, 2008). Malnutrition, on the other hand, is the absence of the essential nutrients that a healthy body must own (World Health Organization, 2011). Malnutrition still persists to exist especially in developing countries like the Philippines, leading UNICEF (2003) to coin malnutrition as an "invisible emergency"

A number of data to support the severity of the situation were presented by local and international groups combined. Roughly 2.9 million families have subjectively expressed unintentional hunger, and about 760,000 families expressed severe hunger (Social Weather Station, 2008 cited in DevPulse, 2008). Objective surveys reported that as of the year 2008, 26.2% of children 0-5 years of age were underweight (FNRI-DOST, 2008) and as of 2009, 20.7% of the children were underweight (World Health Organization, 2011). Also according to the 7th National Nutrition Survey (2008), 6.1% and 27.9% of children 0-5 years old were known to be wasted and stunted respectively. Objective data were gathered through measurement of anthropometry, or body sizes such as weight and height and observation of clinical signs such as visible bipedal pitting edema (Walton & Allen, 2011). This does not end to such data, however, because malnutrition unseals a lot more subsequent complications to children.

A lot of impediments is surprisingly associated to malnutrition. In fact, childhood underweight is the leading reason why the world experiences most diseases imaginable (Caulfield, de Ontis, Blossner & Black, 2004). Vitamin A deficiency, which is one characterization of malnutrition (DOH, 2012), generates about 350, 000 additional occurrence of blindness and partial blindness to children every year, while

iodine deficiency still persists to cause preventive mental retardation worldwide (Jukes, 2007). Child mortality as result of many diseases has been also associated with malnutrition. Specifically, 60.7%, 52.3%, 44.8% and 57.3% of deaths due to diarrhea, pneumonia, measles and malaria respectively were linked to malnutrition (Caulfield et al, 2004). Lastly, though surely not least, is the fact that children experiencing malnutrition have higher chances of being deprived from schooling. Studies have shown that undernourished children were more likely to be absent from school or worst, not enrolling at school. Specifically, stunted children have found out to enroll later in school than other children (Jukes, 2007). Problems with schooling can lead to even more problems such as deprivation of information regarding health and nutrition.

2.3 Health Literacy among Preschoolers

A few literatures link the lack of access to health information to malnutrition, but this deficiency might be the primal origin of malnutrition and why it does not cease to exist. According to Gopalan (2000), although poverty is known to be the main cause of malnutrition, the lack of adequate nutrition should also be pinpointed to ignorance, rather more on poverty. Poverty by itself does not cause malnutrition (Azim et al, 2005). Ignorance is also as significant, if not directly responsible, and must be addressed the way poverty is addressed.

The children's continuous existence has always been the goal of the government (Jukes, 2007). Thus, various initiatives were done to address the problem on malnutrition. With the commencement of the Medium-term Philippine Plan of Action for Nutrition 2008 – 2010 that intended a decrease of prevalence of underweight children, 0-5 years to 21.6% (National Nutrition Council, 2012), several health and nutrition programs emerged such as the Food Fortification Program (DevPulse, 2008). International initiatives were also developed such as the Operation Timbang (translated: Weighing Program) of the World Health Organization (2011), in association with the Department of Health (DOH). After such effort, malnutrition was still in high rates.

A heap of articles suggest that parent health literacy outcomes the health of children significantly. However, a few articles explain health literacy among children, especially the importance of improving their knowledge and self-efficacy (Abrams, Klass & Dreyer, 2009). What is known about children development as relate to literacy is that early exposure to graphics and health development programs significantly increases literacy among children, especially in developing countries wherein educational graphics are found first mostly at school (Puchner, 1993).

2.4 Gaming Definition and Demographics

Education aided with technological advancements has started to get to the senses of the people as a new method for all levels of education; but among these technological advancements, it is computer games that are central in educating children and teenagers alike (Kostkova, Farell, de Quincey, Weinburg, Lecky & McNulty, 2010). Game, as defined by Schell (2008) is a "problem-solving activity approached with a playful attitude." Such entertainment draws people into playing computer games. However, gaming as a method of educating has been given little attention (Kostokova et al, 2010), quite indirectly proportional to the expanse of gamers around the world.

There has been an immense community of players currently existing. In the US alone, 72 out of 100 American household play computer games, 18% of these gamers are below 18 years (ESA, 2011).

2.5 Effect of Computer Game Participation to Health Literacy

Computer games have a lot of potentials, as it can be used in a broad area of fields, specifically the medical field. After being solely an immersive diversion a few decades ago (MobiHealth News Research, 2011), it's becoming possible to use games not only for entertainment, but also for improvement of health, and education. In fact, gaming as an approach can be a simple yet effective way of conveying information and messages regarding health (Noble, Best, Sidwell & Strang, 2000). To stimulate this hype even more, the Health Games Research national program, which offers resources for a diverse group of individuals like the health care industry, the media, the game industry and the educators, awarded a total of $4 million in 2008 and 2009

to fund researches on health games (Parker, 2012). Because of this, it can be stated that there is a "lively academic health games community" (Parker, 2012) that utilizes and researching about the subject matter.

Since games were originally intended for fun and gaming, computer games that have a primary purpose of educating were given its own name. Serious games, like commercial games, are also entertaining but they are designed predominantly with education as its intention, through the implementation of pedagogy.

With coherence on the discussions above, this research examines the effectiveness of computer games in teaching children about nutrition. Thus the following questions were raised:

Research Question 1: *Is there an improvement in the cognitive valuation scores of the respondents before and after the gaming sessions?*

Research Question 2: *To what extent and polarity is the effect of gaming to the cognitive and valuation scores of the respondents?*

Likewise, the study argues that:

H_1(+): *There is an improvement in the cognitive valuation scores of the respondents before and after the gaming session.*

Along with the presentation of the variables, the following figure is created:

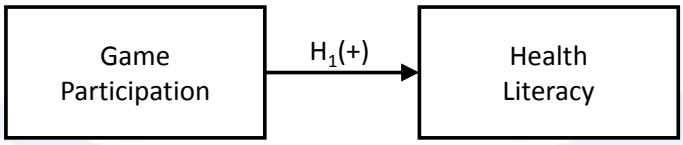

Figure 1: Hypothesized relationship between system participation in gaming and health literacy valuation scores

3.0 Methods

3.1 Research Design

Because of the far-reaching extent of utilization of the gaming industry to health education, the researcher used a quantitative approach in this study, were data are collected in numerical figures (Harrison III, 2012). Being a causal research, this paper also applied one-group pretest-posttest design to determine the effectiveness of the researcher-created game in teaching preschool respondents the basic food groups. One-group pretest-posttest design is also known as before-after design, wherein data are collected from the subjects before and after applying an intervention, usually used to measure changes or difference within a single group (Polit & Beck, 2003).

3.2 Study Subjects and Locale

To test the effects of a researcher-made computer game to health literacy, a total of 30 preschoolers from a selected preschool facility in Valenzuela City were employed to play a Health Hunt, researcher-made computer game. Purposive sampling was utilized in order to gather the respondents. The researcher followed this set of criteria: (1) must be a preschool student of the selected facility regardless of age, (2) has a computer at home which can play the researcher-made game with minimum requirements or higher, (3) must be willing to participate in the study, and (4) has consent of a parent or a guardian to participate in the study. Likewise, the researcher was guided by the following criteria for the selection of preschool facility: (1) must be conducting normal preschool education in case the facility is also providing special education, and (2) must have given the researcher permission to conduct the study in its premise.

3.3 Study Tools

3.3.1 Basic Information Sheet

A basic information sheet was prepared to obtain the basic demographic information from the respondents. It includes information such as the respondent's name, address,

age, and gender. It also includes the name of the institution and the parent or guardian's name. More importantly, it asks whether the participant has a working computer at home. This form is initially given to ensure that the respondent is qualified to participate in the study.

3.3.2 Health Hunt

The researcher-made computer game is entitled "Health Hunt", a point-and-click type of adventure game intended to teach preschool age children the difference between energy-giving, bodybuilding and body-regulating groups of food, and the foods that belong to each group. For each stage, the player will be given a list of foods that belong to a specific food group. Different foods will fall down the screen and the player must click on the foods that are listed for the given time limit. Clicking foods from a different group will cause the timer to go down further. No penalty is given if the player clicks a food that is not in the list but is included in the food group. The game characters' expressions also changes depending on the standing of the player. For example, the character will be sleepy and tired when the player does not get the correct energy-giving food. Stars will be awarded at each stage depending on how fast the player finishes the stage. Three stages are given for each food group for a total of nine stages. Afterwards, the player wins the game and can decide to repeat the game to get used to the different food groups and get more stars per stage.

The game was prepared as a single executive file for Microsoft Windows operating system. It followed the game development process as presented by Moreno-Ger, Sierra, Martinez-Ortiz & Fernandez-Manjon (2007), consisting of the following phases: [1] Production of the storyboard, [2] Markup of the storyboard, [3] Production of art assets, and [4] Production of the videogame. The researcher utilized Game Maker 8.1 Lite software as the interface for programming language and game engine. Since the engine is incorporated with the software, the fourth phase of the game development process was done simultaneously with other phases.

3.3.3 Nutrition Quiz

The nutrition quiz measures the understanding of the respondents of the different food groups and the foods that belong to them. The form is a 15-item quiz for children, consisting of 9 matching type and 6 multiple choices questions. In the matching type test, 9 different foods are drawn and the respondents need to match the foods to the correct food group. For the multiple choices, 3 questions ask what will happen if the person lacked a particular food group, and 3 ask what food to give at a certain scenario. All the items are in graphical form, and the same form was given as pretest and posttest.

3.4 Data Gathering Procedure and Data Analysis

The testing spanned for 5 days total. During the 1st day, the respondents were first given an overview food groups for 15 minutes. Afterwards, they were given the nutrition quiz to provide the baseline analysis. For the 2nd up to the 4th day, the 30 respondents are given the chance to play the researcher-created computer game at their respective houses for 20 minutes in 3 days, or for a total of 1 hour playing. They must gather with the researcher on the 5th day to be given another set of nutrition quiz.

The first and second nutrition quiz were checked and the scores were transcribed using a spreadsheet software. Frequency and percentage were used to present the scores of the respondents and paired t-test were utilized to determine the changes between the two tests. The statistical analysis was done automatically using SPSS v21 software. SPSS, or Statistical Package for Social Sciences, is a Microsoft Windows package program (Arbuckle, 2006 cited in Schreiber, 2008) that calculates data from various multivariate statistical methods with more accuracy (IBM, 2012).

4.0 Results and Discussion

Table 1

Cognitive Valuation Scores of Respondents

SCORE	PRETEST		POSTTEST	
	f	%	f	%
3	1	3		
4	2	7		
5	3	10		
6	3	10	1	3
7	5	17	2	7
8	9	30	2	7
9	3	10	4	13
10	2	7	2	7
11			3	10
12	2	7	5	20
13			9	30
14			1	3
X	7.40		10.93	
SD	2.14		2.23	
T-Test	-6.50*			
Tcrit (1 tail)	-1.70			

**Significant at 0.05*

Table 1 explicates the cognitive valuation scores of the respondents in terms of percentage. As shown on the table, 30% of the respondents got a score of 8 over 15 in their pretest and 30% got a score of 13 out of 15 in their posttest. The pretest scores of the respondents got an average grade of 7.40 while the posttest have an average score of 10.93.

The table also presents the t-test scores for the pretest and posttest. At 0.05 level of significance, the T statistics (t-value = -6.50) is greater than the critical value of -1.70

(lower tailed). Deliberating on the results as compared to the research simulacrum, the undertaking has come up with the following figure:

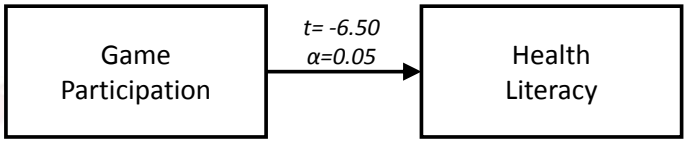

Figure 2: Resulted relationship between system participation in gaming and health literacy valuation scores

The data suggests that there is an improvement in the knowledge of the participants after the game exposure. The initial baseline of the preschool students yielded then an average score of 7.40 out of 15 items. But after the 3 days of undergoing exposure to Health Hunt, the students got a higher average of 10.93 out of 15 items. The paired t-test score indicates that this increase in cognition scores is of significance.

The data revealed in the undertaking directs that Health Hunt was successful in improving the knowledge of preschool children in terms of the different food groups, specifically the energy-giving, body-building and body-regulating foods. It also indicates understanding of the different foods that belong to each food groups and the effects of the absence of such foods to the human body.

The researcher-made computer game was successful in its intention of providing health information to the younger population. This adds up to the present researches and endeavors that believe in the potentials of computer gaming in improving health among the population, especially to the children, who are more affected by the penetrating issues in nutrition.

Conclusion

Health Hunt is one of the first games in the Philippines set to provide educational support to its target consumers besides its typical entertainment purpose. In this undertaking, the researcher tested the effectiveness of this game for health in teaching preschool children the value of nutrition through the basic food groups. The data

provides evidence that the cognitive improvement among the participants is substantial.

This paper did not focus on separate items in the nutrition quiz, it did however, approached the scores in a general sense. This opens further researches to provide specific testing for health games to check the integrity its stages or levels. Also it would provide evidence more empirically if future researches are done with a higher number of respondents.

Another thing that needs to be addressed in this paper is the environment. This paper opted to let the children play the game at their most convenient hours to ensure optimal experience given that they play the game for a total of an hour. However, questions regarding internal validity are left hanging. The undertaking suggests to consider similar researches on a more structured and systematic environment, or even consider comparing structured and unstructured environments when dealing with health games.

Notwithstanding its limitations, the researcher is confident that the study goal was met. This paper is envisioned as one catalyst in establishing pragmatic solutions in health and new approaches and innovations in technology enhanced education.

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