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Students' Devised Classroom Games-Simulations: An Innovative Tool on Mathematics Achievement and Motivation in Nursing Students

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Abstract. Mathematics is a difficult subject. Different techniques and strategies were used but improvements in the performance of students were slightly noticed. Mathematics should be enjoyable and interesting to the students for them to appreciate its relevance in their everyday lives. As a subject, it offers a challenge to teachers as to how to teach it effectively. True experimental method is used in this study. Only the experimental group received the treatment called students' devised games and simulations. The control group received the traditional way of teaching mathematics. Both experimental and control groups had 145 respondents. The pre-test and post-test were used to measure the achievement level of the respondents. A survey questionnaire was used to determine their motivation level. To maximize the use of the gathered data, SPSS 20 descriptive statistics, t-test paired and independent sample mean test were used for analysis. The results showed that there was a great improvement in the academic achievement and motivation of nursing students using the students' devised games and simulation.

Keywords: Students' Devised Games and Simulation, Traditional Teaching Method, Mathematics Achievement, Motivation.

1. Introduction

A reality check points out that the single most striking characteristic of our time is the speed by which change occurs. The advent of all these technological advancements has ushered in unimaginable changes in our lives, in society and certainty in the teaching and learning process. College students current generation tends to be experiential learners, they prefer to learn by doing, as divergent to learning by listening (Oblinger, 2004).

Today's students tend to be "always on". They are in communication with their friends constantly through a mixture of cell phones, instant messaging (IM), email, and social networking sites. In the face of these changes the educator must understand well the basic communication process, the means of communicating efficiently the developing world of information to the learners, and the ways to employ new educational communication tools. Failure to understand all these may result in such failure as student's disinterest, low levels of comprehension, and, in extreme cases, actual school dropout.

Many students do not like mathematics (Sedig, 2008). They often perceive mathematics as an unpleasant and difficult subject. It is a global issue as well as critical issue in developing nations the massive failure of mathematics course that resulted to mathematics anxiety and affecting all aspects of mathematics teaching and learning style (Mohameda & Tarmizi, 2010). The theoretical nature of mathematics is usually taught in ways that make the information monotonous, unsuitable and confusing to students' experiences that pave the way towards an ever- growing population of individuals with mathematical apprehension (Costu et.al. 2009).

These can be avoided to a large degree by improving medium of instruction. One beneficial instructional strategy is using educational games that promote group collaboration, commitment, involvement, and relevance to the course goals (von Wangenheim et al. 2012). This game playing is considered as problem solving and has a potential to stimulate the flow of experience (Kiili, 2005). According to Federation of American Scientists (2006) "People acquire new knowledge and complex skills from game play, suggesting gaming could help address one of the nation's most pressing needs – strengthening the system of education and preparing workers for 21st century jobs". Studies have shown that active learning specifically digital games and simulations are now being practiced by educators and proved to be effective (Low, 2010; Kumar

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& Lightner, 2007; Akinsola & Animasahun, 2007). Educational games provide demand for learning and stimulate interest that has the greatest impact on students' preference for games (Bourgonjon et.al. 2010).

The purpose of this study was to investigate the use of students' devised games-simulations as an educational tool in motivating and improving students' performance in mathematics. This study also utilized the difference between explanation and experience to appreciate the unique design opportunities of interactive educational multimedia to engage the students in designing simulation games.

2. Method

True experimental method was used in this study to establish a formal procedure for comparing the achievement level of the control and the experimental groups. The subjects were chosen using the cluster random sampling technique because the subjects were selected as classes not as individuals. The criteria of the subjects included are nursing students of University of Santo Tomas, First Year College, enrolled in the mathematics class, and ages 16 to 19 years old. Data gathering was conducted in University of Santo Tomas College of Nursing, specifically in the respective mathematics classes of the subjects to control any extraneous factors such as noise and heat. The study lasted for six weeks, which includes pre-test, treatment, post-test, and distribution and collection of motivational questionnaires. There were three experimental groups and three control groups. Three mathematics classes of the researcher were selected, as the experimental group while another three mathematics classes from the other math professors were designate as the control group. Both experimental and control groups had 145 respondents. The pre-test and post-test were used to measure their achievement level with Cronbach alpha 0.823 and 0.808. Pre-post survey questionnaires were used to determine their degree of motivation with Cronbach alpha 0.995 and 0.939.

The researcher obtained a written consent from the administration of the College of Nursing. On the first week, pre-test and pre-motivational survey was done. Pre-test and pre-motivational survey was administered in order to measure the base line achievement level of the subjects and the prior interest for the subject.

The experimental groups. After the pre-test, a brief discussion was given for the nature of the study, its objectives and significance, as well as the benefits and risks involved. Then each class was subdivided into 10 groups using stratified sampling technique. The students served as the developer and at the same time facilitator of the assigned topic for the games. The distribution of topic to the sub-groups was done by draw lots method. Guidelines were set for designing of games and simulation activities. These were the following: to develop their own mechanics; the mechanics of the games must be participative, creative and with originality; formulated their own problems; the activity was limited for 45 minutes; to facilitate the games inside the classroom; the use of props for the games was encouraged and there should be three winners and the winners received prizes (i.e. candies, chocolates, biscuits, etc.) from facilitators. Winners of the game were given corresponding additional grades, and facilitators' grades were based on criterion-reference. The games-simulation activity was given after every discussion of each topic. The researcher-teacher first discussed and explained the topic before the implementation of games.

The control groups. No brief discussion was given. After every discussion of each topic the usual practice exercises were given to the subjects.

On the sixth week. After the four-week activity (2^{nd} week to 5^{th} week), a post-test was given to both the experimental and the control groups. The pre-tests and post-tests consisted of different set of questionnaires, which were formulated by the mathematics professors, and an item-analysis of the two tests was done. The collections of examinations were done immediately. The post-motivational survey questionnaire was distributed to the experimental and control groups after the post-test. The pre-post motivational survey was adapted from Keller's Instructional Materials Motivation Scale (IMMS) (Keller, 2010) and was rephrased for the study based on Keller's guides for modifying the survey without altering the original source. Then collections of survey questionnaires were also done thereafter. After data collection, the test and survey questionnaires were collated and were subjected to the statistical analysis and interpretation.

3. Results and Discussion

3.1. Demographic Profile of the Respondents

Table 1 the demographic profile of the control group and experimental group.

Table 1: The gender and age distribution in the sample

		Control		Experimental	
		f	%	f	%
Gender	Male	52	35.86	50	34.48
	Female	93	64.14	95	65.52
	Total	145	100	145	100
Age	15	6	4.14	7	4.83
	16	68	46.89	67	46.20
	17	65	44.83	63	43.45
	18	5	3.45	7	4.83
	19	1	0.69	1	0.69
	Total	145	100	145	100

The table shows that 65.52% of the sample of the experimental group consists of female and the remaining 34.48% are male while 64.14% female and 35.86% male of the sample are of the control group. The age distribution of the sample for the experimental group are as follows: 46.20% of the participants are 16 years of age, 43.45% are 17 years of age, 4.83% each for the 15 and 18 years of age, and the remaining 0.69% is 19 years of age while in the control group, 46.89% for 17 years old, 44.83% for 16 years old, 4.14%, 3.45% and 0.69% for 15, 18 and 19 years old respectively.

3.2. Degree of Motivation

Table 2 T-test paired sample mean test between the pre-test and post-test of control group and experimental group on students' mathematical interest

Table 2: T-Test Paired Sample Mean Test

Degree of Motivation		Paired Differences		Paired Sample t-test	
		Mean	SD	t	P-value
Experimental	Pre - post	-0.67778	0.63596	-3.197	0.013*
Control	Pre - post	-0.12222	0.26352	-1.391	0.202

*Significant at $\alpha < 0.05$

The finding of the study shows that there is a significant difference on the motivational achievement before and after the treatment with the t-value -3.197 which is more than the critical value of -1.96 (p-value $0.013 < 0.05$ α). This means that students' devised games and simulations arouse the students' interest in mathematics. On the other hand, the t-value -1.391 is less than -1.96 critical value (p-value $0.202 > 0.05$ α). It shows that there is no significant difference between before and after the traditional method of teaching. This means that traditional method of teaching did not improve the motivation level of the students in studying mathematics.

Table 3 T-test independent sample mean test of the pre-test and post-test between experimental and control groups on the students' mathematical interest

Table 3: T-Test Independent Sample Mean Test

Degree of Motivation				t-test for Equality of Means	
		Mean	SD	t	P-value
PRE-TEST	Experimental	3.39	0.56224	0.087	0.932
	Control	3.37	0.5244		
POST-TEST	Experimental	4.07	0.18028	2.534	0.022*
	Control	3.62	0.49357		

*Significant at $\alpha < 0.05$

The finding shows that t-value 0.087 is less than the critical value of 1.96 (p-level $0.932 > 0.05$ α). It means that there is no significant difference between the pre-test of experimental and control groups. Thus,

the interest on mathematics of both groups is the same before the use of students' devised games and simulation and the traditional method.

In post-test the table shows that there is a significant difference between the post-test of experimental and control groups with the t-value 2.534 > 1.96 α (p-value 0.022 < 0.05) and the mean value shows that experimental groups post-test shows higher than the control groups. This means that students' devised games and simulation increase the motivation in mathematics of students.

3.3. Academic Achievement

Table 4 T-test for paired samples was used to show significant differences between the pre-test and post-test of experimental group and control group on students' mathematical scores

Table 4: T-Test Paired Sample Mean Test

Academic Achievement		Paired Differences		Paired Sample t-test	
		Mean	SD	t	P-value
Experimental	pre - post	-5.2931	5.66167	-11.258	0.000*
Control	pre - post	-4.47586	4.44126	-12.135	0.000*

*Significant at α < 0.05

In experimental table, the t-test value of -11.258 more than -1.96 α (p-value 0.000 < 0.05) shows there is a significant difference on the academic achievement between the pre-test and post-test. This means that students' devised games and simulation is effective in increasing the academic achievement of students. Interestingly, the mean also shows that there is greater improvement in the student's scores. In the control group, the table shows that t-test value is more than critical value (t-test -11.258 > -1.96 α; p-value 0.000 < 0.05). It means that there is a significant difference between the pre-test and post-test. Thus, traditional method is effective and the mean difference also shows there is an improvement in the students' score. But based on their mean differences, it was noticed that the mean increase in experimental group was higher than the control group. Thus, students with games-simulations had higher academic achievement than traditional method.

Table 5 Using T-test for independent samples significant differences of the pre-test and post-test scores of the experimental and control groups on the students were manifested.

Table 5: T-Test Independent Sample Mean Test

Academic Achievement				t-test for Equality of Means	
		Mean	SD	t	P-value
PRE-TEST	Experimental	84.7614	7.73674	1.912	0.057
	Control	83.2021	6.04841		
POST-TEST	Experimental	90.0545	6.29329	3.455	0.001*
	Control	87.6779	5.385		

*Significant at α < 0.05

The table shows that t-value 1.912 is less than the critical value 1.96 (p-value 0.057 > 0.05 α). It shows that there is no significant difference between the pre-test of both experimental and control groups. Thus, the pre-test scores of the students are the same on experimental and control groups. There is a significant difference between the post-test of experimental and control groups with a t-value 3.455 more than 1.96 critical value (p-value 0.001 < 0.05). This means that the post-test scores of students using students' devised games and simulations increase. Thus, the academic achievement of those students with games-simulations treatment is higher than using the traditional method.

4. Conclusion

Improving learners' knowledge, skills, attitudes and behaviours are potential factors through games. Games require transfer of learning from other venues like life, home, and school. In students' devised games

and simulations, the learners were challenged to participate and to develop their own games for them to implement problems and solutions in action. It promotes the development of interpersonal, analytical and creative skills of students into a higher level than the current traditional delivery system of education. In academics, it raises the level of performance to a point where students are more alert and attentive to class activities. Undeniably, most of the students are looking forward for their rounds to facilitate and to present their creativity and originality and were eager to win the games because of additional grades and the new concepts that they have experienced. The study showed that there was a great improvement in the motivation and academic achievement in mathematics of the students applying students' devised games and simulations. It is therefore concluded that learning through participative tool construction and playing made the students motivated and achieved more academically. It is also a way to prevent students from absenteeism, feeling bored and reluctant. Devised games and simulations teaching strategy also encourages the teachers the eagerness to teach mathematics. Thus, utilizing interactive teaching through students' devised games-simulation activities should be implemented in a classroom setting. Since different teachers (experimental groups and control groups) participated in the study, the researcher highly encourages further study of this topic using the same teachers to control the delivery of the topics and another study using other subjects and to include more participants. Future research studies also need to investigate the effect of different variables in the learning process.

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