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Bernard Nino Q. Membrebe, Ryan R. Tiu

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'Scimazing Game' As an Outdoor Teaching-Learning Strategy in High School Science

Bernard Nino Q. Membrebe

College of Education, Eastern Visayas State University, Tacloban City, Leyte, Philippines

Email: bernard.membrebe@gmail.com

Ryan R. Tiu

Science Department, Eastern Samar National Comprehensive High School, Borongan City, Eastern Samar, Philippines

Abstract

The idea of an active and experiencing learner in an environment where knowledge is not transmitted to the learner rather constructed through activity like games is an approach to constructivist learning. Game-based learning (GBL) is a strategy that engages students in the topic, makes learning fun and motivates learning inside or outside of the classroom. 'Scimazing Game', an outdoor game-based teaching-learning strategy was developed for a high school Science class to determine the outcome of the achievement of the students, and allow the learners to have fun while gaining knowledge and skills at the same time. Using the 'Scimazing Game' strategy, results showed an increase in the test results of the students. Pre- and post-test scores of the students were also subjected to paired t-test and showed significant difference. Likewise, the three variables on the profile of the students, namely: its sex, age, and general weighted average showed no significant association on the academic achievement of the students. This result supports the increasing attention of utilizing game-based teaching-learning strategy and management as a powerful medium for teaching and learning. 'Scimazing Game' provides a varied strategy and innovative resource that would help increase the students' academic achievement in Science.

Keywords: Science, Game-Based Learning, 'Scimazing Game', Achievement

Introduction

To be successful in the learning process, the facilitator or the teacher may use the exploratory approach to learning. With such approach, learners construct their own understanding and knowledge of the world, through experiencing things and reflecting on those experiences. By experiencing and reflecting on some things, the learner can create and construct its own knowledge and understanding on the real world. Learning from a constructivist point of view can be done through various activities in teaching like experiments, problem solving and

other exploratory activities that would create in depth knowledge to the learner, letting the learner reflect and discuss their activity, and validating how their understanding changed, progressed and evolved. It is on the elements that facilitate learning does constructivism is focused on. According to Pivec et al (2003) learners are active participants in knowledge acquisition, and engaged in restructuring, manipulating, re-inventing, and experimenting with knowledge to make it meaningful, organized, and permanent in the constructivists approach, therefore, knowledge is made from experience with complex tasks and challenges.

Game-based learning (GBL) is an educational method that can be utilized in the process of learning. Good games can be a tool for deep and meaningful transformative learning that includes complex competencies, while the player is involved in an iterative cycle of goal-based, interactive problem solving (Shute & Ke, 2012). As more learners become interested in gaming, it can now be a medium in learning using an exploratory approach and interaction among the students. By playing different roles and giving responsibilities during the conduct of the game, students learn and acquire the basic knowledge and experience, and lifelong skills that are needed in the real world applications. Game concept that is developed can be a template for different teachers and facilitators in introducing various knowledge and contexts for their topics and specific learning objectives (Pivec et al., 2003). Games that are well-designed can be an excellent type of learning environment, since it can facilitate learning of academic content and 21st century competencies within complex and meaningful environments, and can induce intrinsic motivation (Shute & Ke, 2012).

Based on Garris et al (2002) model on game-based learning, the main attribute of an educational game is that instructional content is hidden and blurred with game characteristics. It was further explained that game should be motivating to encourage learners to repeat specific cycles within the game context; hence, the learner could exhibit desirable behaviors based on emotional or cognitive reactions as a result from interaction and feedback from playing the game. Likewise, debriefing process should be given consideration between the game cycle and the achievement of the learning outcomes since debriefing linked simulation and the real world, thus, connecting game experience and learning of the students (Pivec et al., 2003). The learners should be the focus and the center point of any organized game-based learning activity. From the learner's point of view, aside from a more compelling, rich, and exciting experience, games also allowed a more individualized experience and efficient learning (Epper, 2012).

There had been various literatures that were reported why games can be used as an educational tool, like: games contain elements that foster intrinsic motivation (Dickey, 2007; Bisso & Luckner, 1996); games relevant in all of the four learning phases of experiential learning (Dieleman & Huisinigh, 2006); the presence of pedagogic principles in game design (Becker, 2007); games enable extensive and multiple types of cognitive learning strategies (Shute & Ke, 2012); the access to shared social practices for the construction of knowledge (Gee, 2007; Steinkhueller, 2008 as cited by Fabricatore & Lopez, 2012); and games providing key conditions in fostering sustainability learning (Fabricatore & Lopez, 2012).

On the other hand, sustainable education requires strategies, approaches and environment that promotes and facilitate systems thinking development and learning complex things (Fabricatore & Lopez, 2012). Nowadays, educators are given means of addressing the sustainable education theory, however, no definite or very limited tools and approaches were

provided to assist in the implementation of the said theory. There is an immediate need therefore for these tools and approaches that would promote systems thinking and facilitating learning for complexity (Tilbury & Wortman, 2004). In this manner, game-based learning can then be used to support sustainable education since it supports knowledge and skills learning through enjoyment, in situated and meaningful contexts; allowing the players or learners to deal with ill-structured problems, unpredictability, emerging systemic properties and behaviors, and non-linear development of events; and also support remote interactions across large numbers of players, requiring collective engagement in achieving common goals (Fabricatore & Lopez, 2011).

Game-based learning had been used in various courses taught in school. The complex topics in science can utilize this teaching-learning strategy in developing the learners' valuable skills like problem solving and creativity. Sung & Hwang (2013) developed a collaborative game-based learning environment for a science class that allow the learners to share and organize on their learning upon playing the game. Aside from promoting students' learning attitudes and motivation, collaborative educational game also improves students' learning achievement and self-efficacy (Sung & Hwang, 2013). Likewise, the Arizona State University (ASU) has launched an initiative for the use of games and simulations in the teaching of Environmental Sciences with the aim of promoting the participation of students. Game based courses were developed wherein both the learner and the facilitator have instruments to measure the quality of learning (Gamelearn, 2015).

In this study, the 'Scimazing Game' was utilized as an outdoor teaching-learning strategy in science (Physics) class of fourth year high school students. This study therefore, sought to determine the level of academic achievement as a measure of students' learning after using the aforementioned game, to compare the differences on the pre- and post-test scores of the students; and to look if there is a relationship of the academic achievement of fourth year high school students and their corresponding profile (sex, age, and general weighted average).

Methodology

Subject and Profile of the Study. The use of 'Scimazing Game' on a topic in Science (Physics) was made to a heterogeneous fourth year high school class last February 2015 in Eastern Samar National Comprehensive High School, Borongan City, Eastern Samar. There were forty-five (45) students in the class that participated in the game. 'Scimazing Game' was repeated five times but with different subtopics in focus and different challenges to do, in order that all groups in the class would take turns in the facilitator group's responsibility and be able to play the game. For the profile, the sex, age, and general weighted average (GWA) for Science subject were obtained from the Department of Education (DepEd) Form 137 of each student. Categories on the GWA were based also on the scale stipulated on DepEd Order No. 8, s. 2015.

Game Mechanics. The game was inspired and adapted from the famous reality television game show CBS's *The Amazing Race* (CBS, 2015) with modifications and was designed towards learning concepts in Science (Physics), thus, the name is *scimazing game* (science and amazing combined). The class was divided into five groups, where one group served as facilitator and the others as contestants or players. The subtopics in focus were given to the class two weeks before the conduct of the game. This was done to give time for preparations for both facilitating and playing groups. Pre-planning discussion with the facilitating group and the teacher was done

before the game, and the proceedings of the game were agreed. The group contestants were briefed on the game's objectives, instructions, and needed materials. Health measures were taken into consideration among the participants. Orientation was done at least a day before the conduct of the game, and a re-orientation was made before the start of the game. Each team was required to visit several posts (one for each team) at the same time and finish all posts' challenges and tasks. The number of posts considered the allotted time; number of materials available; and the number of competencies needed to achieve for a subtopic. The teams were required to solve riddles that lead them to different posts around the school campus where they were given challenges or tasks to complete. Posts' challenges are mini-games like solving puzzles, message relay, quiz bee, etc.; all of which provides concepts of the Physics topic for the day.

The competing teams were assembled at an outdoor area of the school. The facilitating group discussed the objectives and rules of the game. Teams were then given riddles to where they are going. To set a course for each team, the teams started out at different destinations. Every team was required to visit every post, where a set of course was provided by the facilitating group. Each post facilitator was assigned to give the team's riddle-clues to the next post and a ticket. The teams were required to have the ticket from all posts before they were allowed to move to the last stop. Upon acquiring all tickets, the team then moved to the area assigned as the final stop and presented the tickets to be considered finished. The first group to arrive was declared the winner, and the succeeding ones as the next in ranks. The members of the facilitating group were the only persons who knew the order of their route ahead of time. In the case that two or more teams arrived at one post, a first come first serve and time-bounded basis rule was followed.

Science Academic Achievement (Pre- and post-test). A pre-test was given to the class on the topic focused by the race. This was done the day before the game. During the game proper, a formative assessment was done to the performance of the group on the different challenges of the race. A researcher-designed rubric, enriched and approved by the class, was used as a tool for the formative assessment. Post-test was given to the class a week after the game. Academic achievement on this study refers to the pre- and post-test scores of the students. Scores were categorized based on the scale used by the Department of Education as per Order No. 8, s. 2015.

Data Analyses. Descriptive statistics (frequency and percentage) were used to present the profile of the students and academic achievement of the students. A two-tailed paired t-test was used to determine the significant difference of the students' academic achievement based on the pre-test and post test scores. Likewise, a Pearson product-moment correlation was used to test the relationship of the academic achievement (post-test) to the profile of the students. All data obtained were entered into Microsoft Excel and imported into the IBM SPSS software package version 17 (Statistical Package for the Social Sciences, SPSS Inc., IBM Corporation) for analyses.

Results and Discussion

Profile of the Students. The profile of the students was obtained from their Form 137. The general weighted average (GWA) was based on the first three grading periods of the student during their fourth year at the secondary level. Table 1 presented the detailed profile of the students who were the research respondents of this study.

Table 1

Profile of the 4th Year High School Students (n=45)

Profile	Frequency (f)	Percent (%)
Sex		
Male	10	22.22
Female	35	77.78
Age		
16	35	77.78
17	10	22.22
Graded Weighted Average (GWA)		
Very Satisfactory (85-89)	39	86.67
Outstanding (90-100)	6	13.33

The class was dominated by females (77.78%), while the males comprised only of about a quarter of the entire class (22.22%). With regards to age, the highest frequency is on the 16 years of age (77.78%) as compared to the 17 years of age having only 22.22%. The standard age for the fourth year high school students in Philippine educational system is 16 years old; however, the study was conducted in February 2014 where the academic year is about to end (March), thus there were students already reaching and about to reach the age of 17 years. The general weighted average, on the other hand, corresponds only to the GWA of the science subject from the first grading up to the third grading period. Majority of the students had a GWA categorized as very satisfactory (86.67%), while only six of the students or 13.33% meet at the outstanding level.

Academic Achievement of the Students. The academic achievement corresponds to the pre- and post-test scores of the students during the achievement test conducted by the researcher. At the pre-test level, result showed that 29 students (64.44%) of their achievement are categorized as 'satisfactory' having scores ranging from 80 to 84. Whereas, about 35.56% or 16 students got scores ranging from 85 to 89 that is classified as 'very satisfactory'. Upon using the 'Scimazing Game' in the class, there was a noticeable change on the academic achievement of the students. Post-test scores shows that 100% or all of the students obtained scores at the outstanding level (100%). This shows that the use of the outdoor teaching-learning strategy designed for the topic in Physics is an effective tool to increase the academic achievement of the students.

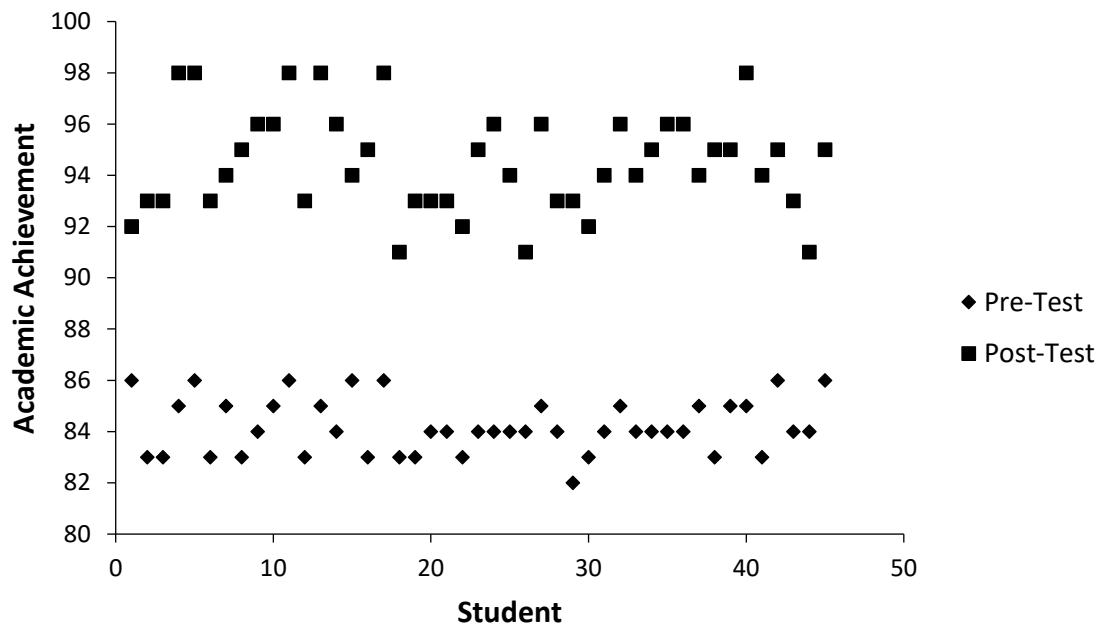


Figure 2. Academic achievement (pre- and post-test scores) of fourth year high school students using the Scimazing game as a game based teaching-learning strategy.

As shown on the scatter plot on Figure 2, there is a clear increase of the academic achievement (pre- and post-test scores) upon using the 'Scimazing Game'. The effectiveness of the game-based learning strategy was clearly observed. It had been noted that games can activate prior knowledge; provide immediate feedback and assessment of progress; require transfer of knowledge from other venues; naturally experiential; and are considered social environment with communities of practice around the game, thus, making the game a potentially powerful learning environment (Oblinger, 2004). Likewise, games have been shown to foster development of critical thinking and problem-solving skills to the learners (McFarlane et al., 2002).

Furthermore, Table 2 shows that there is a significant difference on the pre- and post-test scores or the academic achievement of the fourth year high school students when the game ('Scimazing') was used in the class at 5% level of significance. This implies that there is a positive increase of the academic achievement of the students in Physics when they used the outdoor teaching-learning strategy for a heterogeneous class in high school.

Table 2

Paired t-test on the academic achievement (pre- and post-test scores) of fourth year high school students using Scimazing game in learning the topic in Science (Physics).

	Paired Differences					t	df	Sig.
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
Academic Achievement of 4 th Year High School Students in Physics (pre- and post-test scores)	-10.311	1.690	0.252	-10.819	-9.803	-40.932	44	0.000*

*significant at 5% level of significance

In this study, it is evident that the use of GBL strategy will improve the academic achievement of the students. Similarly, the study of Ku, Chen, Wu, Lao, & Chan (2013) demonstrated that the use of GBL approach yielded better outcomes than the paper-based setting in both students' confidence and students' performance. The students with high and low levels of ability in the GBL group gained a significant improvement on the confidence toward mathematics. Additionally, low-ability students in the GBL group have better performance in mathematics than those in the paper-based setting. The strategy addresses the problem on the students having low confidence in learning mathematics that may eventually affect the learner and will hinder them in the practice of additional and complex mathematics knowledge (Ku et al., 2013).

Relationship of Academic Achievement and Profile of the Students. To check whether the profile of the students may have an association or relationship to the academic achievement (post-test) of the students, correlation analysis was done. Results then were presented in Table 3. Sex, age, and the general weighted average of the fourth students comprising the profile of the students utilized in the study showed no significant association to the academic achievement of the fourth year students after the outdoor teaching-learning strategy was used. This signifies that no trend can be made by the profile of the students to the academic achievement of the learner.

Table 3

Pearson product-moment correlation coefficient of the profile of the 4th year students to their academic achievement (post-test).

	r_{xy}	Sig.
Sex and Academic Achievement ^{ns}	0.079	0.607
Age and Academic Achievement ^{ns}	0.282	0.060
General Weighted Average and Academic Achievement ^{ns}	0.123	0.420

^{ns}not significant at 5% level of significance

Results of this study showing no relationship on academic achievement and profile of the students have similar results obtained also by Blunt (2007) wherein the students in classes using the game scored significantly higher means than classes that did not. There were no significant differences between genders, yet both genders scored significantly higher with game play and there were also no significant differences between ethnicities, yet all ethnic groups scored significantly higher with game play (Blunt, 2007).

Conclusion

This study supports to some literatures that claimed the effectiveness of game-based learning strategy as a potential powerful learning environment. It is evident that there is an increase on the academic achievement of the students upon using this outdoor-based teaching-learning strategy. The 'Scimazing Game' could be implemented on the other classes or year levels; and not only Science but also with other subjects offered in school. This could also be used in providing activities for the students in the formation of concepts and competencies; and in the review of topics that were discussed. However, there is also a need to look into the appropriateness of the game for a specific topic and the desired knowledge and skills to be transferred unto the learner. There is a need for the teachers to recognize and map the relationships between activities in the games and the associated learning before they can embed the use of the game within the wider learning context (McFarlane et al., 2002). Likewise, understanding the game and how it works will help the teachers create and design GBL strategy for future learning environments. On the other hand, digital games and technology based games should be explored with its use in the learning environment especially on the basic educational system of the Philippines particularly in public sector. The need to catch-up with the technological advancement in education is necessary to be competitive. Possible local GBL researches are encouraged like using and modifying traditional games that will suit to the learning needs of the students in such a way that there is appreciation on the culture and its integration in the various disciplines being studied.

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Corresponding Author

Bernard Niño Q. Membrebe

College of Education, Eastern Visayas State University, Tacloban City, Leyte, Philippines

Email: bernard.membrebe@gmail.com

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