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The Use of Interactive Simulation in Teaching Science 9: Projectile Motion

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This study discovers the use of simulations in teaching science concepts on projectile motion. This aims to highlight the use of simulation in teaching a perceived difficult science concept. The researchers subjected all the students who underwent the program to a pre-test prior to integration or use of simulation to teach the science concept. Result of the pre-test shows the need for good instruction in teaching projectile motion. Simulation as an instructional material is being used to highlight whether the use of this instructional material is effective or not. The simulation program used in this study is from the website for science and mathematics concept simulation on http://phet.colorado.edu. The duration of the program took three classroom days or equivalent to three classroom contact hours with the students. During the program they had activity sheets to follow to explore and use the simulation. Results in the post-test reveal an increased score compared to the result in the pre-test. Thus, simulation of science concepts in teaching science may be further studied or explored to realize the help of interactive simulation in teaching abstract and difficult science concept in physics.

Keywords: simulation games; simulation in physics; projectile motion sims

Introduction

People are living in the information age, taking part in the information society. Through this age, technology has been both the generator and the transmitter of information, thus making the permeation of technology in education. As the result of technological advancement, they have developed instructional methods using technology in education to cope with these changes in the ever-changing world. One of the possible novelties in instructional methods of teachers is the use of games. It may be wrong to call games as a novelty in education since children in their early years learn through games and plays as cited by Rieber in 1996.

Educational games and simulations are activities that help the learners to visualize and realize the concept of the lesson in a virtual world. There they apply or learn knowledge, skills, and strategies in executing the assigned roles (Gredler, 2004). Using games and simulations in education may be traced in the 1600s, wherein war games were used to improve the strategic planning of both armies and navies. Using simulations has become essential in both the business and medical education fields in the late 1950s (McGuire, Solomon, & Bashook, 1975). According to Sorensen (2011), simulations are highly effective as a learning tool and instructional method for higher academic education purposes. They consider simulation games to be an effective teaching tool to boost the practical knowledge and skill of the student. They referred simulations as an abstraction or simplification of some real-life phenomena and an attempt to emulate a real or virtual environment and system.

Teachers can use simulation games as an instructional method in teaching in what-if analyzes, experimentation and instruction (de Jong, 2004). The simulation games in online resources are a wide

range in science education subjects (e.g., the PhET Sims at http://www.phet.colorado.edu, 2011). In the study of Rutten and his colleagues, simulation of science concepts enhanced traditional instruction and the notable development in the science process skills of the students engaged in simulating of the concept. In the same studies on the use of simulation in teaching science, it shows that the use of simulation helps the student understand difficult science concept (Plass et al., 2012). Simulation as a method in teaching science helps the teacher to increase the engagement of the students in learning activities (Davies, 2002). It also helps the teacher make students visualize science phenomena which are hard to depict (Chang, Quintana & Krajcok, 2010) making simulation as a doorway to a more accessible and visible acquisition of abstract science phenomena understanding (Ryoo & Linn, 2012).

To rack it up, science education researches have shown that application or the use of simulation in teaching science is a need to cope with the helpful use of technology in teaching. This simulation as a method of teaching is used in teaching chemistry and physics which is effective to learn difficult science concept in physics (Shaw, 2014).

Methodology

Each student took a pre-test on projectile motion whose scores were compared with that of the post-test scores after the students learned the concept using the computer simulation available for online resources. The simulation used is from the website http://www.phet.colorado.edu. This is available online but may also be downloaded as software. Some simulation games available in this site also are also in html5 format and can be used not only in computers and laptops but also in cellular phones.

Twenty-one Grade 9 students from Christ the King Catholic School were selected to take part in the program. A pre-test was given to the participants to measure the level of students' conceptual understanding of projectile motion based on their schema wherein the concept was introduced when they were in Grade 8. After the pretest was given, the resulting scores were accumulated and recorded. Students were then grouped into three with seven members each. Each group was assigned to bring at least one laptop and two cellular phones. The institution restricted the students from bringing cellular phones or any other gadgets; therefore, the researchers asked permission from the school head who positively responded on the matter the research purposes only. The activity was held for three class days, which was equivalent to three hours of classroom contact with students.

Participants explored the simulation games using their laptops and phones with no Internet connection needed. With the help of the teacher concerned, students' difficulty in using the simulation was unlocked. On the second day, the researchers gave the students activity sheets to follow. These activity sheets contained the procedures to follow which helped the students explore and understand the concept of projectile motion competency.

The data collected – (1) pre-test scores and (2) post-test scores – were the main basis of the results in this study. The researchers also conducted random interviews with students who did the simulation activity.

Results and Discussion

Force and motion are two of the four strands of science that are used in a spiral progression in the current curriculum of Philippine education which is known as the K-12 curriculum. Force and motion are a scope of science that can be categorized under the branch of physics. This subject was seen as difficult for the students as they reached their 9th grade. Though the concepts relating to force and motion are taught during their later years, they still consider some concepts to be difficult based on a random interview done during the execution of this study.

Table 1. Result of the Pre-Test-Post Test

Student	Pre-Test Score	Post Test Score
1	3	9
2	5	11
3	6	10
4	7	11
5	7	13
6	2	9
7	9	14
8	10	12
9	7	13
10	11	13
11	4	9
12	3	9
13	5	13
14	6	14
15	8	11
16	9	13
17	12	15
18	2	8
19	4	8
20	4	11
21	5	12
Mean	**6.14**	**11.33**

Table 1 shows that the results of the pre-test given to students reflect that the majority get low scores before integrating simulation in their learning was done. During their exploration and use of simulation in learning projectile motion, students were noted to taking part in the learning activity since they could use technology while learning. The researchers also observed students enjoying the use or manipulating the simulation as they put a bet whether the cannoned object could or could not reach the target. Students' engagement to learning activity was clear which attests to the result of the study of Davies (2002). On the first day of the simulation use, the researchers gave the whole time for the students to explore the computer simulation with the help of the teacher in unlocking their difficulty in using simulation. On the second day, the researchers gave the students an activity sheet to follow. As they were accomplishing the sheets, the teacher conducted a random interview asking why the topic was perceived as difficult. Most of their answers stated that they saw the topic as an abstract and difficult subject since they could imagine what the concept is about but they could not explain and understand the real

application of the concept. They could only give examples that follow to the concept such as basketball, volleyball, and soccer ball games.

The result of the post-test revealed an increase in the scores of the students. Compared to pre-test scores, these scores were much higher. The lowest score gained in the pre-test was 2 out of 15, but after integrating the simulation in teaching the concept, the lowest score became 8 out of 15. This lowest score gained the passing fifty percent score.

Table 2. Paired t – test for Significant Difference in the Scores in the Pretest-Post test

Pair	N	Mean	SD	*t*-value	df	*P* value
Pretest Scores	22	6.14	2.816	-13.813	21	.000
Posttest Scores	22	11.33	2.054			

*p = < .05

Table 2 shows the paired t-test for a significant difference in the scores of the students' pre-test and post-test. As seen, there is a significant difference in the scores of the students' pre-test (M=6.14; SD 2.816) and post-test (M=11.33; SD=2.054) since t (21) = -13.813, p = .000. This only means that there is a drastic change in the scores before and after the simulation integration in their learning.

Conclusion

Based on the foregoing results of the study, the researchers concluded that there is a substantial and enough evidence that the use of simulation in the students' learning on projectile motion is effective. Based on the scores of the pre-test and post-test, there is a drastic change in the scores. This is further confirmed by the paired *t*-test that also provided a significant finding to prove that the use of simulation is effective in the learning of the students.

Recommendation

Because of the listed accounts above, the use of simulation in teaching abstract concept in science may be further studied to improve the teaching method of science teachers. Using technology is very appealing to students as it catches the students' interest more making students to interact/engage to the learning activity. It is highly recommended for the teachers in science to use this technique or strategy to further motivate their students in learning.

References

1. *Chang, H. Y., Quintana, C., &Krajcik, J. S. (2010). The impact of designing and evaluating molecular animations on how well middle school students understand the particulate nature of matter. Science Education, 94, 73-94.*
2. *Davies, C. H. J. (2002). Student engagement with simulations: A case study. Computers & Education, 39, 271-282.*
3. *De Jong, T. (2004). Learning and instruction with computer simulations. University of Amsterdam, Department of Social Science Informatics, the Netherlands: Science Direct*
4. *Gredler, M. E. (2004), Games and Simulations and their relationships to learning. University of South Carolina: Semantics Scholar*
5. *McGuire, C., Solomon, L. M., & Bashook, P. G. (1975). Construction and use of written simulations. Houston, TX: The Psychological Foundation*
6. *Plass, J. L., Milne, C., Homer, B. D., Schwartz, R. N., Hayward, E. O., Jordan, T., Barrientos, J. (2012). Investigating the effectiveness of computer simulations for chemistry learning. Journal of Research in Science Teaching. 49(3), 394-419.*
7. *Rieber, L. P. (1996), Seriously Considering Play: Designing interactive learning environments based on the blending of microworlds, simulations, and games. University of Georgia: LRieber Website*
8. *Rutten, Nico., van Joolingen, W. R., van der Veen, J. T., (2012). The Learning Effects of computer simulations in science education., ELAN Institute For teacher Education, University of Twente, The Netherlands: Elsevier Journal*
9. *Ryoo, K., & Linn, M. C. (2012). Can dynamic visualizations improve middle school students' understanding of energy in photosynthesis? Journal of Research in Science Teaching*
10. *Shaw, K. C. (2014). Use of Computer Simulation in Physics: Comparison of Simulation implementation as introductory or reinforcement tools. Montana State University: Scholar Works*
11. *Sorensen, M. (2011). Learning with simulation games. Copenhagen Business School: Springer*