Enhancing Student's Concept on Projectile Motion by Classroom and Outdoor Activities

Fuangladda Polthep and Udom Tipparach*

Department of Physics, Faculty of Science, Ubon Ratchathani University, Warin Chamrab, Ubon Ratchathani 34190 Thailand

**Corresponding Author. Email : udom.t@ubu.ac.th*

Abstract

We have designed and created learning activities in classroom and outdoor experiments in Physics on Projectile motion. The purpose of the experiments is to increase learning achievement. The activities are composted of classroom experiment to obtain the relation between vertical and horizontal motion on the dimensions of positions and times. The students were also provided video about projectile motion in action and predicted simulation. The outdoor activities consist of projectile motion in different situations such as throwing a ball at different angles and pitching an object vertically while moving horizontally. These activities can improve students' understanding the concept of projectile motion. The students' attitude towards learning physics is positive and the retention rate is increased.

Keywords: Projectile, learning activities, outdoor activities.

Introduction

It is generally believed that learners will learn more when taught less as the Minister of Education of Singapore embarked on "teach less, learn more"[1] in 2005. This means that learners learn more when they do experiments get trained or practiced by emphasizing on improving the quality of interaction between teachers and learners so that the learners can be more engaged in learning and better able to achieve desired outcomes of education. Many scientific and technological works are cooperative. The well-known learning pyramid by National Training Laboratories, Bethel, Maine, U.S.A., states that people will learn more and retain more their knowledge if the learning process involves doing, stimulating real experience and practicing [2]. In addition, to understand physics and do physics, learners should have both knowledge in Physics and scientific skills. Learners will gain better understand Physics if they learn knowledge and skills in doing physics with appropriate coaching. They also should have right-positive attitude towards learning Physics [3]. In this paper, we report the students' attitudes, expectations, and beliefs towards learning Physics compared to the experts in the field before taking the lesson. We describe the hands-on lessons so that the students can carry

out experiments through cooperative learning. We will probe the students' attitudes, expectations, and beliefs towards learning Physics after taking the lesson as well.

The Ministry of Education of Thailand has issued the policy "Teach less, Learn more" in 2015. To comply by this policy, we have designed learning activities focusing on students in order that the students learn and understand by constructing their knowledge. In this way, the students gain knowledge and build their scientific skills as well as social skills.

In this work, thus, we propose developing learning activities on projectile motion for grade 10 students to enhance understanding the concept of projectile so that the students can construct their own knowledge by doing learning activities such as experiments and hands-on experience. The activities consist of in-class activities and outdoor activities.

Materials and Methods

The design of the apparatus for projectile experiment is shown in Fig. 1.The real set up of the apparatus is shown in Fig. 2.

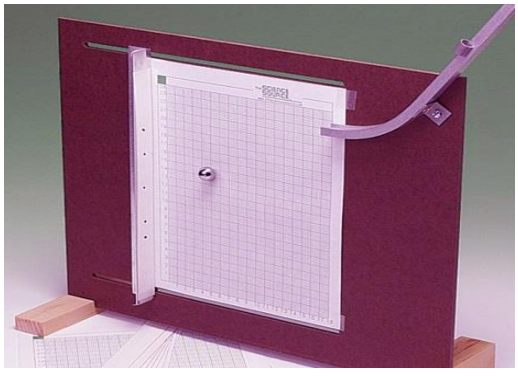

Figure 1. The designed apparatus for projectile experiment.

Figure 2. The real set up of the projectile experiment.

The purpose of the experiment is to construct students' concept of projectile. In this experiment, the students will carry out an experiment to verify that relation of positions of projectile in vertical (y) and horizontal (x) is parabola. The students are asked to plot a graph by plotting the positions of projectile in vertical (y) and the square of the horizontal (x^2) to prove that $y \propto x^2$ [4]

The students also explore the law of projectile motion in outdoor activities. The teacher asks the students questions. The questions are designed by the 5E inquiry method of teaching. The students perform a series of outdoor activities using 5E inquiry method of teaching. The examples of the questions include: which path of the projectile for a ball if the man is riding a bicycle with a certain velocity throw the ball into the air vertically.

Figure 4. A man throws a ball into the air vertically while riding a bicycle with a certain velocity.

Results and Discussion

The apparatus has been used in grade 10 Physics classroom of Khuemyai Wittaya School. The students were excited and happy to learn. They have a chance to work in a group of 5 students. They have learned Physics by doing experiments, develop scientific skills, e.g., measurement, collecting data, graphing, analyzing data, and drawing a conclusion. They also have gained social skills such as group discussion, working together, and communication. The activities can be used to promote learning physics as proposed by Popov [5] in 2006. The average score was increased with statistical significance at .05 levels as shown in table 1.

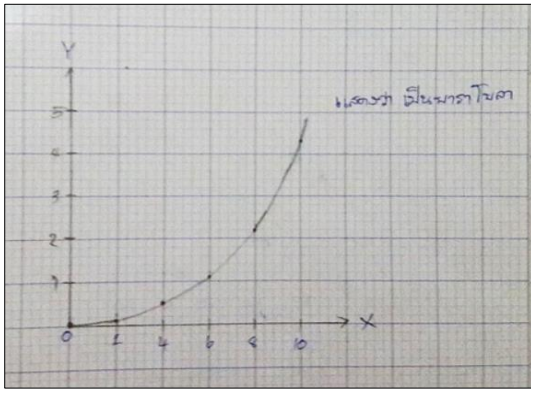

Figure 4. Student's work on relation of positions of projectile in vertical (y) and horizontal (x)

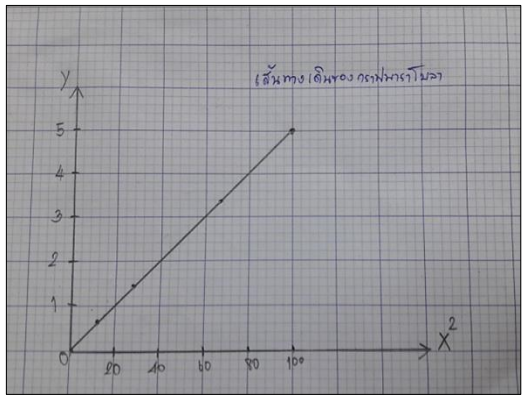

Figure 5.Student's work on relation of positions of projectile in vertical (y) and square of horizontal (x^2).

Figure 6. Outdoor activities about projectile (a)watering and (b)throwing a ball

Table 1: Mean score, average normalized gains, and t-statistics on the pre-test and post-test.

Score	Number of students	Full score 20		SD	t
		mean	percent		
pretest	34	7.38	21.7	0.99	45.74*
posttest	34	13.71	40.32	1.17	

*$t_{\alpha=.05,\ df=33}$=1.692

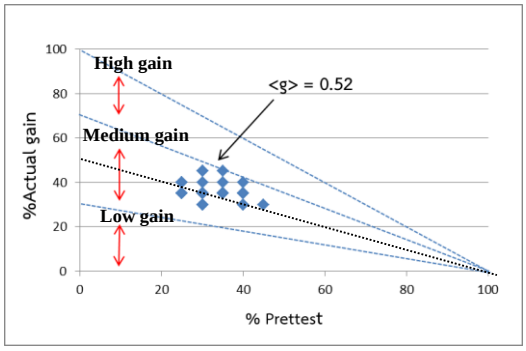

Figure 7. The relation between %pretest and %gain of the students.

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The normalized gain, <g>, a measure of the advancement of students' learning in scores between pre-test and post-test, was expressed as a fraction of the range of possible score increase and was also calculated by[4]

$$\langle g \rangle = \frac{(\%\,\text{Post-test}) - (\%\,\text{Pre-test})}{(100\%) - (\%\,\text{Pre-test})}$$

And $\langle g \rangle < 0.3$ is low gain,

$0.3 < \langle g \rangle < 0.7$ is medium gain,

$\langle g \rangle \geq 0.7$ is high gain.

The average normalized gains were 0.52 which is considered as medium gain. No student is in low gain and high gain. All students are in medium gain.

Conclusions

We have developed the apparatus for learning through inquiry and active learning methods. The learning activities helped to develop students' concepts of projectile motion. The activities also promote abilities of the student in analytical thinking on projectile motion. The students participated in Physics classroom and outdoor activities enthusiastically. They developed scientific skills and social skills at the same time.

Acknowledgments

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