# Reinforcement Games for Enhancing Thai High School Students' Performances on Basic Geometry

## Alisa Klieosinak, Nutjira Busadee*

*Faculty of Education, Chiang Mai University, Chiang Mai 50200, Thailand*

**Abstract**

In some Thai high school Mathematics classrooms, most students not only need the teachers who are more than the lecturers but they also need more meaningful and more enjoyable learning through the interesting games/activities. To enhance the students' mathematical interests and learning achievement on Basic Geometry lesson, 6 reinforcement games were used after finished each concept on Basic Geometry in order to give students' opportunities to review the concepts, to develop conceptual/formula understanding and to drill the practices come together with funny and meaningful activities. The reinforcement games included 1) Distances between Lovers 2) Midpoint Domino 3) Slope Bingo 4) Par or Per tossing (Parallel or perpendicular line) 5) Straight Line Riddles 6) Near or Far. The research study was conducted in 2015 to develop the reinforcement games for enhancing students' interests and students' learning achievement. The participants were 40 tenth grade students in the second semester of academic year 2015. The findings showed that 1) students' mathematical interests; attractiveness, enthusiasm, concentration and participation; improved from moderate level to high level 2) 82.50 percent of participants passed the achievement test. Moreover, the details of the reinforcement games were discussed.

*Keywords:* Reinforcement Games; Geometry; Mathematical Interest; Learning Achievement; High School Student; Mathematics Classroom

## 1. The Problems in Thai Mathematics Classrooms

The findings from many research studies (Bunreangnam, 2012; Klieosinak & Busadee, 2016; Leeyavanit, 2012; Saeratong, 2007; Sasarome, 2003) indicated the problems in Thai mathematics classrooms such as follow:
1) Most of mathematics instructional provision lack of interesting activities.
2) Many students had low mathematics achievements.
3) Some students cannot remember the mathematical formulas, cannot remember the meaning of the variables in the formula, and they did the mathematics exercise with meaningless.
4) During learn the new concept, most students are lack of the prior knowledge and they cannot apply the formula in the other mathematical concepts.
5) Most of mathematics activities were boring and did not appropriate to the students. It cannot challenge students to interest the lesson. The students lack of motivation in learning mathematics.
6) Some students were not interest in learning mathematics and in teachers' teaching.

---

\* Corresponding author.

7) Some students had the negative felling toward mathematics learning. They were unhappy to learn mathematics subject because this subject is difficult and complicate in their mind.
8) The students lack of drilling the practices/reviewing the content knowledge.
9) Many students preferred to play and learn along the way (entertaining together with mathematical understanding).
10) The students have less participate in Mathematics classrooms.

It means that most students not only need the teachers who are more than the lecturers but they also need more meaningful and more enjoyable learning through the interesting games/activities.

## 2. Effects of Games on Students Mathematical Performances

Mathematical games can be effective tools/approach for enhancing students' learning achievements and interest in learning Mathematics (Jonnavitula and Kinshuk, 2005; Perkins et al; 2005; Moursund, 2006). For many reasons as follow;
1) Games can create meaningful learning.
2) It spent less time to promote students' visual thinking.
3) The students will get better clearly conceptual understanding for solving challenging problems and accomplishing challenging task.
4) The students can link the knowledge in each concept and eliminate the gap of students' unknown.
5) The students have enjoyable learning and have more participate in Mathematics classrooms.
6) Games do a positive effect on motivation and retention of knowledge.
7) Games can reduce students' stress.
8) Games can develop students' thinking skill.

## 3. Six Reinforcement Games on Basic Geometry

Six reinforcements games were created to give students' opportunities to review the concepts, to develop conceptual/formula understanding and to drill the practices come together with funny and meaningful activities. They were used after finished each concept on Basic Geometry as shown in table 1 as follow.

Table 1 Six reinforcement games and mathematical concepts on Basic Geometry

| Games | Basic Geometry Concepts |
|---|---|
| 1. Distances between lovers | Distance between 2 points |
| 2. Midpoint Domino | Midpoint between 2 points/Midpoint of line segment |
| 3. Slope Bingo | Slope of line |
| 4. Par or Per Tossing | Parallel and perpendicular line |
| 5. Straight Line Riddles | Equation of straight line: Slope/x-intercept/y-intercept |
| 6. Near or Far | Distance of 2 parallel lines/ Distance of the point from the line segment |

The details of the reinforcement games were discussed below.

*3.1 Distances between Lovers*

Game rules:
1. Divide students into 4 groups. The 4 groups randomly arrange the order of play.

2. The first group selects the picture of 1 actor and 1 actress out of 10 actors and 10 actresses. It will show 2 points and a number behind 2 selected pictures. If the number is the distance between 2 points, the first group gets 1 score but if it is not, 2 selected pictures will turn back and the second group will play next (see figure 1).

3. Continue playing until all pictures were exposed.

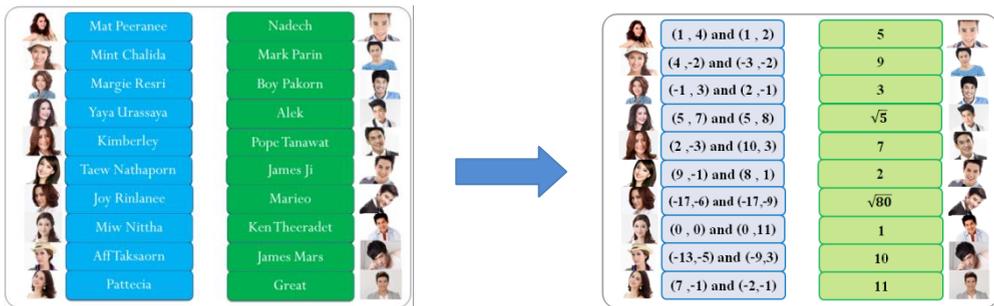4. The winner is the group who gets the greatest score in the game.



Figure 1.  *Distances between Lovers.*

*.2 Midpoint Domino*

Game rules:

1. Divide students into 5 groups.

2. Distribute each group with a set of 16 different cards (see figure 2).
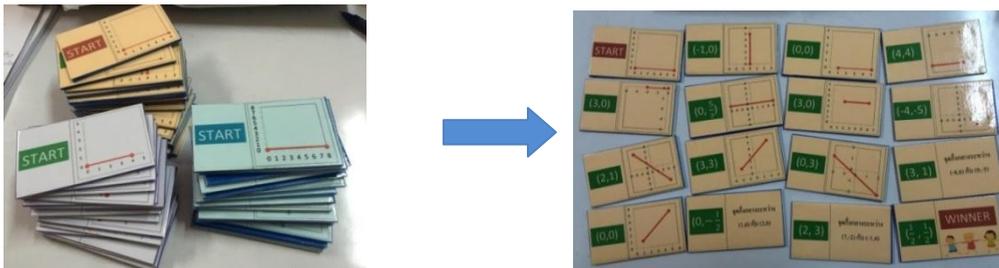


Figure 2. a set of 16 different cards.

3. Each group starts the game with the first card and find the midpoint between 2 points/midpoint of line segment for connecting the first card and the second card (see figure 3).
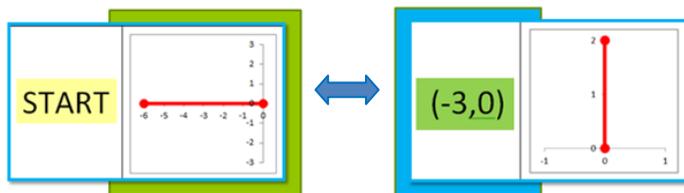


*Figure 3.*  Example of connecting the first card and the second card.

4. The winner is the fastest group who connects 16 cards correctly.

*Figure 4.* Midpoint Domino



Figure 5. *Students' behaviors during play "Midpoint Domino".*

### 3.3 Slope Bingo

Game rules:
1.    Each student receives a different 4x4 table of the Slope game (see figure 6).



| | | | |
|---|---|---|---|
| 0 | 6 | $\frac{2}{7}$ | $-\frac{3}{2}$ |
| $-\frac{3}{2}$ | $-\frac{3}{4}$ | $\frac{2}{5}$ | $\frac{3}{4}$ |
| $-\frac{7}{5}$ | $\frac{4}{5}$ | $-\frac{1}{3}$ | $-\frac{3}{5}$ |
| $\frac{1}{2}$ | 8 | -2 | $\frac{5}{4}$ |

*Figure 6.* Example of a 4x4 table.           *Figure 7.* Fruit pictures in Slope Bingo.

2. The students choosing a picture of fruit to open the direction such as a graph of the line segment or a slope problem (see figure 7).
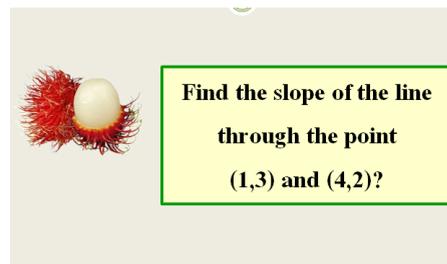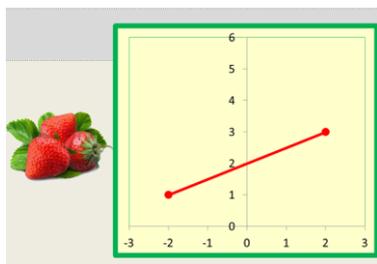


*Figure 8.* Some directions in Slope Bingo.

3. Each student marks in the slope value (according to the direction) on the bingo table.
4. The winner is a student(s) who can mark the slope values in a vertical line, horizontal line, diagonal line, inside corner, or outside corner.

### 3.4 Par or Per Tossing (Parallel or Perpendicular line)

Game rules:

1. Each student receives 4 cards. Each card shows the slope value.

2. In each round, the teacher randomly selects the slope of parallel line or slope of perpendicular line of the line joining 2 points.

3. Roll 2 point-dices to get 2 points

4. Find the slope of 2 points and turn back a card which is the slope of parallel line or slope of perpendicular line of the line joining 2 points.

5. The winner is a first student(s) who have no card.



*Figure 9.* Par or Per Tossing (Parallel or Perpendicular line).



Figure 10. *Students' behaviors during play "Par or Per Tossing".*

### 3.5 Straight Line Riddles

Game rules:

1. Divide students into groups of five.

2. The Teacher shows an equation of straight line and the representative of each group write the randomly answer (Slope/X-intercept/Y-intercept) on the blackboard in a minute. Each group will gets 1 score for the correct answer.

3. Continue playing until 16 equations of straight line are solved.

4. The winner is the group who has the highest score.

Figure 11. *Students' behaviors during play "Straight Line Riddles".*

*3.6 Near or Far*

Game rules:

1. Divide students into 4 groups. All groups randomly arrange the order of play.

2. Each group receives 20 questions to compute the distance of the point from the line for 10 minutes.

3. The first group selects a question and tells the distance of the point from the line. If the distance is the correct answer, the first group will gets the score which equal to the distance but if it is not, the first group has no score in this question and another group can select this question again. After that the second group will play next.

4. Continue playing until all questions were solved.

5. The winner is the group who has the highest summation score.



Figure 12. *Students' behaviors during play "Near or Far".*

## 4. From Klieosinak & Busadee (2016)

*Effects of Six Reinforcement Games*

Objectives of the research study were to develop mathematical interests and to develop learning achievement on Basic Geometry lesson of 40 tenth grade students by using reinforcement games. The findings showed that six reinforcement games were an appropriate and effective tool to develop high school students' performances. The results showed that 1) students' mathematical interests; attractiveness, enthusiasm, concentration and participation; improved from moderate level to high level and 2) 82.50 percent of participants passed the achievement test. Moreover, these games not only developed students' mathematical interests and students' learning achievement but also encouraged the students' conceptual understanding with meaningful, enjoyable and interesting learning through the games. Besides mathematics teachers can put them into practice.

## Acknowledgements

# References

Bunreangnam, A. (2012). Development of mathematics games to promote mathematics learning on addition and subtraction of Grade 3 students. Master of Arts' Thesis, Chiang Mai University.

Jonnavitula and Kinshuk. (2005), Making Math Children Will Love: Building Positive Attitudes to Improve Student Achievement in Mathematics. Retrieved September 9 , 2015, from https://www.edu.gov.on.ca/eng/literacynumeracy/inspire/research/WW_MakingMath.pdf.

Klieosinak, A. & Busadee, N. (2016). Development of Grade 10 Students' Mathematical Interests and Achievement by Using Reinforcement Games. The 8th National Science Research Conference, May 30-31, inpress.

Leeyavanit, R. (2012). Mathematics Teachers' Guide: Teaching Mathematics through Games. Bangkok: Chulalongkorn University Printing.

Moursund, D. (2006). Introduction to Using Games in Education: A Guide for Teachers and Parents. Retrieved July 28, 2016, from http://pages.uoregon.edu/moursund/Books/Games/Games.pdf

Perkins, K. K., Adams, W. K., Pollock, S. J., Finkelstein, N. D., & Wieman, C. E. (2005). Correlating Student Beliefs With Student Learning Using The Colorado Learning Attitudes about Science Survey. Retrieved September 12, 2015, from
https://phet.colorado.edu/publications/Perkins_PERC_revisedfinal.pdf

Saeratong, P. (2007). Use of games to develop mathematics achievement of students with learning disabilities. Master of Arts' Thesis, Chiang Mai University.

Sasarome, J. (2003). Use of games for supplementing mathematics learning of Grade 5 Students. Master of Arts' Thesis, Chiang Mai University.