Chapter 41

Double Trouble (Mathematics)

Melinda Yunos, Nani Ilyana Shafie, Baderisang Mohamed, Shaira Ismail & Mohd Sukor Md Yusoff

Universiti Teknologi MARA Cawangan Pulau Pinang

melinda2907@uitm.edu.my

ABSTRACT

Science, Technology, Engineering and Mathematics (STEM) has been the national agenda for the past several decades. The Ministry of Education Malaysia is concerned over a declining trend in students opting for Science, Technology, Engineering and Mathematics (STEM) subjects in schools and higher education institutions (IPT). One of the factors is due to the approaches used in teaching and learning are teacher-centred and students lack sufficient opportunities to be critical, creative and innovative. The purpose of this paper is to introduce an idea to develop a board game to raise student outcomes and interest toward mathematics subject through a new learning approach.

Key Words: teaching mathematics, learning mathematics, mathematical games.

1. INTRODUCTION

Science, Technology, Engineering and Mathematics (STEM) has been the national agenda for the past several decades. The Ministry of Education Malaysia is concerned over a declining trend in students opting for Science, Technology, Engineering and Mathematics (STEM) subjects in schools and higher education institutions (IPT). According to Minister Dr Mazlee Malik, in 2018, only 44 per cent of students in schools chose STEM streams compared to 48 per cent in 2012 (Mustafa, 2019). The number of students at the IPTs who enrolled in fields related to Science, Maths, Computers, Engineering, Manufacturing and Construction in 2017 totalled 334,742. This was much lower when compared to the 570,858 students majoring in Arts and Humanities, Education, Social Sciences, Business and Law. This gradual drop will eventually lead to a lack of talent absorbed into STEM-related industries.
One of the major factors underlying the declining enrolment and quality of student outcomes in STEM is inconsistent quality of teaching and learning (Malaysia Education Blueprint 2013-2015, 2013). Teaching and learning approaches are teacher-centred and students lack sufficient opportunities to be critical, creative and innovative. In addition, some teachers invest heavily in preparing their students for examinations, at the expense of the practical elements of the curriculum. According to a survey by the Energy, Science, Technology, Environment and Climate Change Ministry, nearly 70 percent of students said they had low interest in STEM subjects because the teaching was too theoretical (Ministry; Waning STEM, 2019).

The purpose of this paper is to introduce an idea to develop a board game to raise student outcomes and interest toward mathematics subject through a new learning approach. The term "student outcomes" typically refers to either (1) the desired learning objectives or standards that schools and teachers want students to achieve, or (2) the educational, societal, and life effects that result from students being educated. This educational board game idea is introduced with the intention to achieve both student outcomes.

2. DOUBLE TROUBLE (MATHEMATICS) BOARD GAME

The idea to develop Double Trouble (Mathematics) board game is based on the principles of educationally rich mathematical games by Russo, Russo and Bragg (2018):

**Principle 1: Students are engaged**

*Mathematical games should be engaging, enjoyable and generate mathematical discussion.*

Double Trouble (Mathematics) provides opportunities for social interaction and meaningful mathematical dialogue to increase enjoyment and engagement with mathematics. Students are divided into groups of 5 to 10 people. Each group should consist of students with different performance in mathematics: weaker, average, and excellent. Each of them will take turn to roll a dice and choose a score mark. When the player gets the question, he or she should try to answer the question first. If the player is unable to solve the mathematical problem, other group members can discuss among themselves and give suggestion to the player on how to solve the problem. This will create positive learning environments, enhancing student motivation and generating mathematical discussion.

**Principle 2: Skill vs luck**

*Mathematical games should appropriately balance skill and luck.*

Double Trouble (Mathematics) provides a balance between skill and luck to sustain the interest and engagement. The board game consists of six different topics that the
students have learned previously, and each topic has five different questions with different score numbers: 20, 40, 60, 80, and 100. Lower score numbers are for questions with lower cognitive levels, while higher score numbers are for questions with higher cognitive levels. Students need to throw a dice (luck) to get a topic (number 1 until 6), and then they choose the score number they want for the question (skill).

**Principle 3: Mathematics is central**
*Exploring important mathematical concepts and practising important skills should be central to game strategy and gameplay.*

Double Trouble (Mathematics) requires students to focus on the underlying mathematical concepts as an integral component of game strategy. With different score numbers for different cognitive level questions, this game can allow students to operate at different levels of thinking and to learn from each other. This board game can be used both to provide opportunities for practising skills and concepts or exploring new mathematical ideas.

**Principle 4: Flexibility for learning and teaching**
*Mathematical games should be easily differentiated to cater for a variety of learners, and modifiable to cater to a variety of concepts.*

Double Trouble (Mathematics) can be modified to be optimally challenging for students, and, ideally, lend themselves to seamless differentiation. The slots for each topics and questions are modifiable. Teachers can choose any six topics from the syllabus with respective questions for each game session. This flexibility allows teachers to choose suitable topics based on current lesson plan.

**Principle 5: Home-school connections**
*Mathematical games should provide opportunities for fostering home-school connections.*

Double Trouble (Mathematics) can also be played at home with carer as moderator. Playing games may allow adults and children to explore mathematical ideas together in a positive context.

Figure 1 shows the prototype of the board game was used in a STEM Grooming Camp as a pilot program for developing the game idea. The name of the board game was Double Jeopardy but later it was changed to Double Trouble (Mathematics) for commercialization purpose.
Double Trouble (Mathematics) is an idea to develop a new learning approach using board game to raise student outcomes and interest toward mathematics subject. The term “student outcomes” typically refers to either (1) the desired learning objectives or standards that schools and teachers want students to achieve, or (2) the educational, societal, and life effects that result from students being educated. This educational board game idea is introduced with the intention to achieve both student outcomes. The concept of the game is based on the principles of educationally rich mathematical games: (1) students are engaged (2) skill vs. luck (3) mathematics is central (4) flexibility for learning and teaching (5) home-school connections.

The game concept is designed to encourage student’s engagement and generate mathematical discussion. The balance between the element of luck and skill creates excitement and motivation. The mathematical problems enable students to explore important mathematical concepts and practice important skills. This game allows students to solve mathematical problems at different levels of thinking and learn from each other. In a group of students playing this board game, one student might be encountering a mathematical concept for the first time, another may be developing his/her understanding of the concept, a third integrating previously learned concepts. In comparison to more formal classroom activities, greater learning can occur through this game due to the increased interaction among students, opportunities to test intuitive ideas, problem solving and winning strategies. Double Trouble (Mathematics) provides opportunities for building self-concept and developing positive attitudes towards mathematics, through reducing the fear of failure and error.

With all the fun and excitement in the game, this learning approach could increase student outcomes and interest toward mathematics. When they start to enjoy learning the subject, it is hoped that they will include mathematics as one of their favourite subjects.
and lead them to build their future professional careers in science and technology to fulfil the need of a developing nation.

This board game is in the stage of development. The prototype has been tested during the STEM GROOMING BOOTCAMP which involved 120 Form One and Form Two students from 32 secondary schools around Perak, Pulau Pinang, Kedah, and Perlis. They were divided into groups of 10 students, in which each group consisted of students from different schools and levels. Even though they just got to know each other, they were able to communicate well among themselves, develop teamwork and problem-solving skills in order to win. Therefore, when this product idea is converted to a commercialized product, it has a high potential to penetrate secondary school market all over Malaysia.

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REFERENCES


