HEAT AND MONSTER BINGO: AN INSTRUCTIONAL BOARD GAME TO LEARN TEMPERATURE AND HEAT

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Abstract

Physics is a subject that plays an important role in our daily life. It is a basic for the development of advanced technology. Even though it is an important subject, some high school students are not interested in learning physics. The low motivation to learn physics are caused by several reasons such as difficult material, boring classes, dislike for the teachers, and so on. Low motivation in learning physics cause negative attitude while learning physics and thus students cannot get optimal learning achievements. In this study, we developed a board game called "Heat and Monster Bingo" to make students to be interested in learning physics. The instructional game "Heat and Monster Bingo" covers topics of temperature and heat. We developed the board games in Indonesian and English so that students can learn physics in bilingual way. The broad game has gone through expert appraisal and has been tested to a group of students consisting of 27 high school students. The data were gathered through questionnaire filled by the students. According to the questionnaire data, 88.47% of the students agree that the physics learning medium in the form of board games is interesting and able to help them in studying temperature and heat.

Keywords: instructional game, high school physics, temperature and heat

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1. Introduction

Physics is an important subject that is the basic for current technology development. Physics is introduced in high school so that students have basic knowledge about essential physics concept which may be used in daily life. Other than that, through learning physics in high school, students are stimulated to develop their inquiry towards nature and their creativity to create something within nature principles and law. However, unfortunately a lot of students think that physics is not interesting. There are several reasons such as the perception that physics is a difficult subject, that there is no benefit from learning physics, and that there is only limited future employment related to physics [1]. Some students also feel that learning physics in class is boring.

To generate interest toward physics, innovation in instruction or learning strategy is required. Making learning process become more fun and enjoyable can boost students' mood and motivation in learning physics. However, the instruction strategy still has to provide students with opportunity to practice skills and knowledge. Inserting games in learning process may be one of instructional strategy to make learning process more fun.

Some researches about instructional games have been done in the past [2,3]. Instructional games have some benefits such as providing motivating and fun atmosphere during learning process, facilitating individualization of assessment and instruction, and making the abstract concrete [4]. As consequence of these benefits of instructional games, there are some positive impacts such as increased students' participation higher interest level, and more varieopportunities for practice and review. [4].

To achieve the positive impacts of using instructional games, several things must be considered. Since instructional games are made for instructional purpose, instructional games must have written instructional objectives. In order to attract students' interest, the game must be appealing, colorful, active, and relevant. Moreover, the instruction of the game must

be clear, simple, and easy to be understood by all who play. A game will be more challenging if there are different levels of complexity. However, the weakness and the strengths of students who play the game must be considered. Age and attention span need to be considered to determine the duration and the pace of the game. The game also must be adjusted so that every child has the same opportunity to win. Monitoring and evaluating the effectiveness of the developed instructional games is definitely required. [4]

Instructional games should be used as supplement in instruction and not as substitute for it [5]. Teacher may use any kinds of method (even the traditional one) in the instruction, while instructional games can be used for rehearsal and practice.

Considering the potential of instructional games as complimentary tool in instruction to attract students' motivation, in this study, we try to develop a board games called "Heat and Monster Bingo". This game is intended to help students in learning temperature and heat. This game is mainly used for practicing problem solving. "Heat and Monster Bingo" aims to increase students' interest and motivation during practicing problem solving.

2. Method

This study is a research and development study. After doing need and concept analysis, we design the prototype of "Heat and Monster Bingo" games. The prototype of the game is validated by experts. By taking the experts advice as consideration, we revise the game several times. After revision, the game is tested to a group of senior high school students. There were 27 students involved in this "preliminary" field testing. We investigated the improvement of students' learning motivation through questionnaire. We also gathered the students' appraisal about the quality of the "Heat and Monster Bingo" games through questionnaires as well.

The questionnaire consists of some statements. In each statement, students have to fill “strongly agree”, “agree”, “disagree”, and “strongly disagree”. The students’ responses are converted into a numerical data such as given in Table 1. After being converted to numerical data, we find the average score of each statement and interpret it to qualitative description, such as shown in Table 2.

Table 1: Conversion of questionnaire responds to numerical data

Responds	Score	
	Positive Statement	Negative Statement
Strongly agree	4	1
Agree	3	2
Disagree	2	3
Strongly disagree	1	4

Table 2: Conversion of score to qualitative description [6]

Interval	Description
$\overline{X} > \overline{X}i + 1.8\ S$	Very Good
$\overline{X}i + 0.6\ S \ < \overline{X} \leq \overline{X}i + 1.8\ S$	Good
$\overline{X}i - 0.6\ S \ < \overline{X} \leq \overline{X}i + 1.8\ S$	Fair
$\overline{X}i - 0.6\ S \ < \overline{X} \leq \overline{X}i - 1.8\ S$	Poor
$\overline{X} \leq \overline{X}i - 1.8\ S$	Very Poor

$\overline{X}$: Actual Score

$\overline{X}i$: ½ (ideal maximum score + ideal minimum score)

S : ⅙ (ideal maximum score – ideal minimum score)

3. Results and Discussions

3.1. Product

The output of this study is a set of instructional board games called “Heat and Monster Bingo” (see Figure 1). “Heat and Monster Bingo”

consists of a board in which bingo box called “Bingorian” lies; a set of problem cards called “monster”, an answer key book called “antimonster”, a set of “angle” cards, 12 elixirs, and a guide book. The language used in Heat and Monster Bingo games is Indonesian and English.

The design of the board actually resembles an old castle that had been left by people for long time. Monster cards which contains problems about heat and temperature are put into the “ancient box”. If the problem has been done, the monster cards are put in the the “Dark Forest”. There are 32 problems distributed to 32 monster cards.

This games involves two teams and one judge. Each team can consist of up to 3 students. The basic rule is that one team must take one “monster card” from the opponent’s “Ancient” then give an answer to the problem given in the “monster card”. Whenever a team takes one “monster card”, they have to mention the code. The judge will check the answer by looking at the “antimonster book”, which is a book that contains the solution to solve the problems. If the team can give a correct answer in less than 4 minutes, then they can get one elixir and place the elixir in the “Bingorian box”. The winner is the one who can make Bingo pattern in the “Bingorian box” fastest. The complete rule of the games is explained in the guide book.

The excitement of this games is generated by adding “angel cards”. In total, there are six Angel’s cards. There are 5 types of angel’s cards, i.e. “freeze card” (2 cards), “NomNom card” (1 card), “glory card” (1 card), “victory card” (1 card), and “alive card” (1 card). “Freeze card” is used to make rivals losing their turns to play. “NomNom card” is a card that can be used by a player to take “monster card” two times directly. “Glory card” is a card which is used to take “Bingorian box” from the rival after the player can answer problem in monster card correctly. “Victory card” is a card that allows a player to win one elixir without answering the “monster card”. “Alive card” is a card that can be used to take back “monster card” from “dark forest” and re-answer the problem. If the answer

is correct, then the player can get one elixir and place it in the "Bingorian box".

(a)

Components of Heat and Monster Bingo Games
A. Monster Card: Problem card
B. Antimonster book: answer book
C. Angel card: help card
D. Bingorian: bingo box
E. Elixir: marker coin for the Bingorian
F. Ancient: zone to place the monster card
G. Dark forest: zone to place the monster card that has opened

(b)

Fig 1: (a) A set of "Heat and Monster Bingo" games (b) Components of "Heat and Monster Bingo" games

3.2. Developmental Testing

This learning medium has gone through a developmental testing. The developmental testing consists of expert appraisal and field testing. Expert appraisal aims to make sure that the quality of problems, solutions, language, layout, and instructional aspect are good enough. After being validated by expert, we do field testing to a group of high school students. There are 45 students involved in this research.

After the teacher teaches the students about heat and temperature, they are asked to play the games. Thus, this game is actually designed as complimentary to the instructions. To be specific, it aims to help students in the problem solving practice. After students try to play the game, we give them questionnaire to gather the data about students' opinion and appraisal about the "Heat and Monster Bingo" instructional board games.

Table 3: Summary of Students' Respond after Trying "Heat and Monster Bingo" Games

No.	Statements	Average score (in scale 4)	Average (in %)	Criteria
1.	"Heat and Monster Bingo" is interesting and boost my motivation in learning physics	3.82	95.5%	Very good
2.	The instruction of the games is easy to be understood	3.48	87%	Very good
3.	Figures in the media is clear and proportional	3.78	94.5%	Very good
4.	The text can be read clearly and comfortably	3.74	93.5%	Very good
5.	The problems in the card can be understood well	3.37	84.25%	Good

No.	Statements	Average score (in scale 4)	Average (in %)	Criteria
6.	The solution is explained well in the answer book, "Antimonster"	3.48	87%	Very good
7.	This learning media helps me to understand temperature and heat concepts.	3.37	84.25%	Good
8.	I got a new knowledge about physics application in daily life.	3.37	84.25%	Good
9.	This learning media can be used for independent learning (outside classroom).	3.59	89.75%	Very good
10.	Bilingual feature is useful.	3.67	91.75%	Very good
11.	This learning media make me confuse. (negative statement)	3.26	81.5%	Good
	Overall	3.54	88.47%	Very good

The result of the field testing is summarized in Table 3. Overall, students who have tried "Heat and Monster Bingo" games agree that that the game has a very good quality. The game can attract students' interest

and motivation in learning physics. The game can be played easily because the instruction, figures and text are very clear. Moreover, according to students' statement, problems can be understood easily and the answer is explained very well in the answer book. Students also state that the game is helpful for them to learn physics and give them new knowledge about physics' application in daily life. This media is presented in bilingual (Indonesian and English) format, and the students say that this feature is also helpful.

This study still only involves "preliminary" field testing. The data were gathered only though questionnaire, so that the improvement data are somewhat subjective opinion from students. We suggest that in the future study, the students' performance after inserting this game in the instruction also should be investigated

4. Conclusion

In summary, in this study we have developed an instructional board games called "Heat and Monster Bingo". The game covers material of heat and temperature. According to the preliminary field testing, students agree that this game improves their interest and motivation in learning physics. However, this study still needs more comprehensive investigation as to the game's impacts in the physics' learning. In this study, we only gather the information from students' responses through questionnaire. The improvement in students' performance is also necessary to be investigated in the future.

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