



## IMPLEMENTATION OF SERIOUS GAMES INSPIRED BY BALURAN NATIONAL PARK TO IMPROVE STUDENTS' CRITICAL THINKING ABILITY

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### ABSTRACT

The purpose of this study is to implement Baluran National Park-based Serious Game to enhance the students' creative thinking skill and motivation to learn. The subject of the study were 60 students of SMP Negeri 1 Asem-bagus, Situbondo regency. The sample was divided into three groups. Two groups were chosen as experimental classes and the other group as the control class. Both of the experimental groups were given treatment using serious game based on Baluran National Park. The instruments used were observation sheet, pre-test, and post-test. Baluran National Parks-based serious game was effective in improving the students' creative thinking skill and motivation to learn science subjects.

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**Keywords:** Baluran National Park, Creative Thinking Skill, Serious Game.

### INTRODUCTION

Upon entering the 21st century, there is a huge paradigm shift in the education process in Indonesia since there is an urgent need to balance our education quality toward international education level. One of the changes was the integration between the learning processes with digital service. The emergence of various types of learning technologies has encouraged educators, researchers, teachers and other practitioners to utilize this particular tool (Santally, 2005). Many believed that the use of digital media can improve student learning, increase student engagement and more effective management in learning (Perrotta, 2013). Forms of digital media include television, movies, games, music and internet (Padilla et al., 2012). Based on the aforementioned medias, the digital media which gives integrated factors of playing activities, challenges, and education is game. Nowadays, people are stimulated by the use of games for entertainment and

playing facility (Girard et al., 2013). It was generally agreed that a very important reason why game have a positive effect on learning is because games provide live experience of user involvement (Cheng et al., 2015).

Game is an electronic media with the three key attributes that displays visual content, interactive, and entertainment. It also has various formats, applications and design. A digital game is divided into several types including traditional play (game watch), computer games, and web-based games (online) (Cheng et al., 2016). With main focus of educational purposes, a game will be called as a serious game to educate the players through pleasant experience (Chiu et al., 2015; Mortara et al., 2014). Serious game is a form of new topology designed for education and training (Arnab et al., 2015). There are five characteristics in games such as: (1) Game is freedom; (2) The game play has no risk in real life; (3) The location and time is different with real life; (4) Playing game needs something ideal; (5) Playing a game has nothing to do with the material or profits.

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Based on the genre, serious game is divided into adventure, simulation, quiz, strategy, action and fighting games.

Dindar & Akbulut (2015) stated that the high anxiety level when playing games will reduce the motivation to use the game. While doing the research, it is necessary to review the serious game related with the genre and the cost so that the players feel comfortable in playing the game. For the convenience, the things need to be developed in a serious game is the dynamics and the environment. We assumed that the components (avatars, levels, unlocking content, leader boards, achievements, virtual view, point, team and badges) should be adapted to the environment and needs to be specified (Kocadere & Caglar, 2015).

Natural Science is a study that is based on the construction of knowledge through scientific activities and evaluation of empirical evidence (Decristan et al., 2015). It is more commonly known by the student that science has a symbol that represents an idea or concept (e.g. force, energy, chemical bonds) and has an analogy in the form of formulas, diagrams, graphics and simulations (Tang et al., 2014). In its development, science undergoes various changes in the teaching and learning process. Many kinds of methods had been proposed and applied to provide a good concept understanding for the students. Teachers and researchers had conducted mammoth experiments to teach science as effectively as possible. Many of those people had changed the teaching methods with the investigation, used a great deal of learning media, or even used the computer network such as the simulation to teach science. But various models are often polished with the overstatement of the effects on the students' learning process while ignoring social skills, emotional and motivational shifts (Rutten et al., 2012). For example, the use of games in learning does not do good in learning activities (Dobrowolski et al., 2015; Shalom et al., 2015).

In the east part of Java island, there are three National Parks that provide rich forms of biodiversity. One of them is Baluran National Park, an area located in the border of Situbondo and Banyuwangi regencies, which inhabited by a lot of animals and plants endemic. Baluran National Park is often used as learning reference, especially in recognizing living and inanimate objects. This park is located in a very spacious area, divided into four major areas such as evergreen, savannah, mangroves and Bama beach becomes an obstacle in the learning process. To investigate the whole area will require a lot of time and expense, thus teachers often ignore the learning

process based on the real world. Therefore, we need to develop a learning material in the form of Baluran National Park-based game to improve creative thinking skills and student motivation.

## METHOD

The study was first started by selecting the control class and experimental class using cluster random sampling. The purpose of this study was to determine the impact of the use of Baluran National Park-based serious games on creative thinking skills of students and students' motivation. The main subject applied into the game is object classification and their biotic and abiotic environment. Sixty junior high school students participated in this research with an average age of 12.53 years (SD = 1.49 years). Experimental classes are divided into two groups: the first group was taught using Baluran National Park-based game and was complemented with manual modules of Baluran National Park while the other experimental class was solely given the Baluran National Park-based game. The control class learned without the use of both serious game and manual modules.

The main instrument in this research is the serious games that had been developed based on Baluran National Park. To find out the data of students' motivation, a questionnaire was constructed using Likert scale with value of 1-5 (1 = disagree, 5 = strongly agree) depended on their choice. We also developed evaluation sheets for the pre-test and post-test that described the students' creative thinking skill level. Creative thinking skill indicators are developed by (Ku, 2015) in which it includes validity, flexibility, novelty and originality. Creativity is not just ideas, products and knowledge but also the involvement in the process of creative thinking. The instrument had been tested for 60 other students for the limited preliminary test. The reliability of instruments is shown in Table 1.

The serious game was developed based on the real ecosystem in Baluran National Park. There were 4 different levels as the miniature of the real things: evergreen, savannah, mangrove and Bama beach. Each level target could be completed by students after solving the existing problems. After the development process, the validity test was conducted by two experts in science and learning media. The results of the expert validation are shown in Table 2.

Prior to the learning activity, all participants took part in the pre-test for 50 minutes. Pre-test was used to measure students' creative thin-

**Table 1.** Cronbach Alpha value of the instruments

Intrument	Number of question	Cronbach alpha	Description
Motivation	20	0.901	High
Validity	5	0.922	High
Flexibility	5	0.830	High
Novelty	5	0.730	Acceptable
Originality	5	0.780	Acceptable

**Table 2** The expert validation of SGs

Aspect	Value	Criteria and Judgment
<b>Display</b>		
Layout		
Icon use	3.5	good
Image proportion	3.0	reasonable
Sound effect	3.5	good
Language	3.0	reasonable
Characters	3.0	reasonable
Contrast	3.0	reasonable
<b>Content</b>		
Contextual Problem		
Information	3.0	reasonable
Not causing misconceptions	4.0	good
Conformity of the story	3.5	good
	3.0	reasonable
<b>Access</b>		
Games format		
Facility	4.0	good
Network	3.5	good
	2.0	medium
Average value	3.21	Good

king skill before the treatment was given. Pre-test sheet contained questions about creative thinking skills and motivation to learn science. Learning was held for 3 weeks consisted of two meetings per week with the duration of 100 minutes. The topics taught were: differences in living and non-living objects; solid, liquid and gas; elements and compounds. Each week the experimental classes were given the chance to play the serious game in the time span of 30 minutes. At the end of the activities, we carried out a post-test for 50 minutes.

## RESULT AND DISCUSSION

Before the implementation of the game based on Baluran National Park, the researchers first examined students' learning outcomes obtained in SMP Negeri 1 Asembagus. After that, we did field studies to copy the setting and to record various activities in Baluran National Park. The essence of this activity is to make the minia-

ture version of the ecosystem as the game input.

Baluran National Park-based game is a side scrolling platform game with simple game play. Players need to take a particular item and avoid certain items, and they will go through four levels of Savannah, Evergreen, Beach, and Mangrove. Player will act as a Forest Ranger Hero who protects Baluran National Park plagued by Animal Treasure Hunter. At the end of each level, the player must beat the boss hunter to win the game. This game belongs to the "Serious Game: Game-based learning" which has the objective to provide knowledge and information through visualization within the game about animals, plants and abiotic environment in Baluran National Park. Additionally, the Banna game also provides a learning process to preserve Baluran National Park conservation area.

Figure 2 shows the display of games in Baluran National Park-based game. The interaction between users and game is through tap



**Gambar 2.** Example of the developed SGs

(Click). This makes the users play more comfortably compared to keyboard usage (Imbellone et al., 2015). Therefore, students can concentrate more on the educational content rather than thinking on how to use the game. After the module is declared valid (Table 2) by the validation experts, the game based on Baluran National Park is applied into the lesson. The results for the experimental class 1, experimental class 2 and control class can be viewed in Table 4.

Table 4 shows the results obtained in both learning using video games (experimental groups) and the control class. After the application of the games, most participants got a good value ( $M = 73.25$  and  $71.70$ ). To be more specific, the post hoc test showed that learning by using video games resulted on better outcomes. To determine the effectiveness of the product, we carried out the effect size (ES) test and obtained a score of  $0.67$  with the average criteria. This proved that the use of video games based on the environment gave impact on student learning outcomes.

The motivation of the experimental classes' students was average with ( $M = 66.50$  and  $68.63$ ). Since there were differences in learning outcomes between the experimental classes and

control class ( $psig < 0.05$ ), we could do a further test using post hoc and found out that motivation of experimental classes' students was better than the control class. The use of game scored  $ES = 0.89$  with high judgment value. Junior high school students were motivated by the use of environment-based games learning. This is in line with the character of the students at the beginning of formal operating conditions. Jackson et al. (2012) found that the use of games to 12 years old children causes a multi-dimensional relationship of creativity. Learning through games eases the students to understand the environmental development, think creatively and be active in improving the digital society (Navarrete, 2013). The continuous development of the digital environment around students made them responsive to their new environment. Based on Sun et al. (2015), there are three advantages of using games in learning; a means of entertainment, building motivation and developing collaboration attitude.

There were two hypotheses that had been tested in this study. The first is the effect of the use of environment-based game toward students' creative thinking skill. The game was proven effective in improving students' creative thinking

**Table 4.** Analysis result using one way annova

Class	Pre-test mean	Post-test mean	SD	Sig	Posthoc
<b>Critical Thinking</b>					
(1) Exp 1	54.45	73.25	12.02	.035	1>3,2
(2) Exp 2	52.67	71.70	8.21		
(3) Control	53.20	64.17	13.63		
<b>Motivation</b>					
Exp 1	40.62	66.50	7.36	.027	2>3,1
Exp 2	39.40	68.63	10.24		
Control	40.12	61.18	8.35		

skill. This gaming media provided knowledge to students about the environment around the Baluran National Park. The students acquired the skill through observation, active interaction with the characters, performing repetitious experiments and interpreting the core part of the games associated with environmental effect in real life. This kind of game provides an interaction for players to learn how the avatars think about the environmental issues (Huang and Yeh, 2016). Therefore, in this game was divided into four different levels with varied avatars.

The use of Baluran National Park as the basis of the game had a significant impact in improving students' skill of creative thinking because most students of SMP N 1 Asembagus had visited Baluran National Park. Hawthorne et al., (2016) states that creativity test can be simulated in the real world. The state of the real world was made into a miniature in the form of role playing. Role playing allows individual to enrich creativity (Dyson et al., 2016). The ideal condition in the game enabled students to repeat the game against a failure. This repetition allowed students to plan better steps to pass certain level. This continuous experience caused students to be familiar with the game. The students did not solely pursue the completion of game, but they also devised a new strategy to be shared with others.

Through this game, the students owned the observation skill of the situation in Baluran National Park. They could even learn real experiences and generate real solutions through this game. Facing the environmental problem on the Baluran National Park that endangered the existence of biotic and abiotic environment, the students could suggest many solutions. For example, a student proposed to inhibit the rate of growth of acacia trees (*acacia denticulosa*) since it threatened the population of Java Bull (*Bos javanicus*). The achievement of flexibility indicators was done through the stages of the discovery of

the facts, finding the problem and resolving problems. In this environment-based game, students were projected to think divergently resulting on several alternative answers. Lee & Therriault (2013) states that divergent thinking is a form of creative critical process, and it is a form of orientation of many solutions to solve problems. Some of students' solutions were then evaluated as discussions in learning activities.

The element of novelty is inherent in the process of creative thinking (Gillebaart et al., 2013). Unfortunately, students scored low in this department. Novelty indicators stressed on the ideas for solution to problems in Baluran National Park. Most students only justified the answers submitted by others. The good news was in the experimental class 1 where in addition to using video games, students were also guided by the instructions to play the game, they got a more structured answers in analyzing the problem. Students were able to combine all the instructions to be practiced on the game. This visual advantage made the students organize his knowledge. Martin & Schwartz (2014) has revealed that the use of visual media will help a lot in terms of creative thinking of students. In this class, the researchers obtained a more varied alternative answers. In addition, students were also able to evaluate the answers they found. Students then select the most effective response in protecting biotic and abiotic environment in the region of Baluran National Park.

Novelty and originality are interconnected indicators in creative thinking. This relationship is related to their breakthrough, uncommon, and practical idea (Yoon, et al., 2015). The target to reach 65% for these indicators was too difficult. The lacking in generating ideas was caused by students' unfamiliarity with the model of creative thinking skill training. Students mostly still tended to follow others. Students' independence in deciding a problem remained low. Evaluation to

the serious game is the lack of verbal concepts explanation so that students did not know the important concepts implied in the game. Huang et al., (2013); Ulger, (2015) suggested that the visual and verbal material can be used as narrative and presentation to the development of creative thinking ability of students.

The game was developed to make the students happy and competitive in solving the existing problems. The adventure genre and the competition factor in play provided motivation for students to learn. Capturing real word setting impacted on the increased motivation for players (Kahn et al., 2015). Learning by using games instills emotional stimuli to the students to quickly accomplish tasks within the game. Design of each level in the game was created to trigger students to do the challenges. Giammarco et al. (2015) states that a game player's passion is to complete the challenge and go to the next level. Development of Environment-based game inspired by Baluran National Park had increased student's motivation to learn science especially in biotic and abiotic subjects.

Limitation of this study was the narrow scope of use. The selected sample was only a school near the Baluran National Park. It was suspected to influence the results since the student had already known almost everything about Baluran National Park. In addition there were students who had a high level of emotional anxiety that tended to disturb the motivation to learn. Further research needs to be conducted to determine the value of how much the level of anxiety in the learning process in using game influences the outcomes. Selection of larger samples is also necessary to give birth to a more reliable result.

## CONCLUSION

There were different results (creative thinking skills and motivation to learn) for the experimental classes and the control class. The experimental classes showed higher creative thinking skill while using a environment-based serious game inspired by Baluran National Park. The use of Baluran National Park-based Serious Games scored 0.67 in effectiveness (medium) to the creative thinking skill of students. The students' motivation resulted of 0.89 in effectiveness (high) through the use of this serious game. The finding in this study suggested that students of SMP Negeri 1 Asembagus would be more optimal in learning when they were supplied with both Serious Games and a module that was oriented to the surrounding environment.

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