USABILITY TESTING ANALYSIS ON THE BANA GAME AS EDUCATION GAME DESIGN REFERENCES ON JUNIOR HIGH SCHOOL

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ABSTRACT

Learning media is one of the important elements in the learning process. Technological development support makes learning media more varied. The approach of using digital technology as a learning media has a better and more effective impact than other approaches. In order to increase the students' learning interest, it requires the support of an interesting learning media. The use of gaming applications as learning media can improve learning outcomes. The benefits of using the maximum application cannot be separated from the determination of application design. The Bana game aims to increase the ability of critical thinking of the junior high school students. The usability-testing analysis on the Bana game application is used in order to get the design reference as an educational game development. The game is used as an object of the analysis because it has the same characteristics and goals with the game application to be developed. Usability Testing is a method used to measure the ease of use of an application by users. The Usability Testing consists of learnability, efficiency, memorability, errors, and satisfaction. The results of the analysis obtained will be used as a reference for educational game applications that will be developed.

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Keywords: learning media; education games; usability testing; design reference

INTRODUCTION

Various efforts were made to improve students' abilities. Research conducted by (Lestari, Widiyatmoko, Alimah, & Juliyani, 2015) showed that the use scenario of the game in a learning process could increase the ability of the participants. Digital technology offers many opportunities to create a compelling content (Tabor, 2013). The approach of using digital media technology as a learning media has better and more effective impacts than other approaches (Reeves, 1998). According to (Lee, 2015) in terms of social interaction and collaboration, the use of digital media (iPad & games) conducted in the learning center can increase the frequency of interaction of children, either with colleagues or with teachers.

It happens because when they get a new experience (either in the form of a difficulty or a solution), they tend to communicate with both the teachers and their colleagues. (Rutten, Van Joolingen, & Van Der Veen, 2012) also stated that the use of digital media (computer simulations) could improve the students' ability, especially for laboratory work materials. In addition, there is a learning motivation development in children because the use of digital media is interesting and fun (Lee, 2015). (Kocadere & Çağlar, 2015) also stated that students felt more enjoyed and motivated in learning when using digital media (video games). Digital media are also effectively able to help to practice some of the important learning theories developed (Pischetola & Cattolica,

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2011).

The game is a broad concept that refers to all game structures consisting of rules, goals, and challenges made for diversion or entertainment (Cheng, Chen, Chu, & Chen, 2015). Until now, the game has developed variedly; video games are one type of game variation that has grown rapidly. Currently, most people are encouraged to use the game as a means of play and entertainment (Felicia & Jabbar, 2016). A survey is conducted of more than 4,000 American households about the use of video games. From the survey results are obtained the data of age distribution of video game users, 27% under the age of 18 years, 29% between 18-35 years old, 18% between age 36-49% and 26% 50 years and above. The reason why the users like video games so much are 'enjoying' (Imbellone, Botte, & Medaglia, 2015). According to (De Aguilera & Mendiz, 2003) the benefits of using video games in learning activities are undoubtable. In terms of generating motivation, video games are very useful for users to practice skills, are also able to improve perceptions and stimulation and able to develop the ability of users in solving problems. In addition, video games are also able to develop the ability assessment of a strategy, organizing media and tools to get answers / intelligent solutions. (Dondlinger & Dondlinger, 2007) also stated that video games could have a positive effect on the learning process, although there is widespread consensus that games only motivate users to master their game skills.

The Bana game application is one of the serious game developed with the background of Baluran National Park with the aim to improve the ability of critical thinking of junior high school students (Men & Iqbal, 2016). This game is developed to make students feel happy and feel the competition in solving the existing problems. This game genre is adventure genre; competition factor in this game is able to provide motivation for students to learn. The use of game background using real-world conditions can also have an impact on increasing motivation for players (Kahn et al., 2015). This game consists of several levels. Each level has its own difficulty level. The Difficulties at each of these levels can trigger students to resolve the challenge. (Giammarco, Schneider, Carswell, & Knipe, 2015) stated that the game players basically have a spirit and passion for finishing every level of the game and advancing to the next level.

The age of students when entering the junior high school level in Indonesia ranges between the ages of 12-14 years. (Eccles, 1999)

states that in children aged 6-14 years (middle-aged and early adolescents) is a developmental period for children to build their identity. At this time, children prepare to move toward adults by being competent, independent and trying to get involved with the world outside of their families. The change also occurs on the biological and cognitive side of children. The proper learning methods will greatly help the learning process of children. (Rohwati, 2012) stated in a study conducted in SMP Negeri 1 Wonosobo that used Education Game was proven to improve learning outcomes and the activities of the students. Putra (2016) stated that Serious Games Inspired By Baluran National Park is able to Improve Students' Critical Thinking Ability. (Girard, Ecalle, and Magnan, 2013) also stated that the use of Serious Game in the learning process is very helpful. The use of Serious Game and Education Game associated with the design of Entertainment Games, making it more attractive (Arnab et al., 2015).

The availability of gaming applications as an interesting, easy-to-use, and useful learning media is essential to improve the students learning outcomes. The Interface of an application has a crucial role to the user. An app interface is a meeting point between users and apps. A good interface can represent the functionality of an application and make it easier for app users. To develop game applications that have a good interface, the required information needs the right interface. In order to develop easy-to-use applications, it has to meet the needs of users and able to provide benefits as expected. This study will be conducted using the test analysis using Usability Testing in gaming applications The Bana. This game is chosen as the object of analysis because it has the same characteristics and functions similar to the game application to be developed, namely as a learning media in junior high school students. The Usability Testing is an analysis of an application interface testing (Nielsen, 2012). The Usability Testing consisted of learnability, efficiency, memorability, errors, and satisfaction. The analysis results may become the source of interface reference design gaming applications that will be developed further. (Denton & Coysh, 2011) and (Sonsteby & DeJonghe, 2013) also run the same scenario to get references to further system development.

METHODS

Usability Testing method is the method used to measure the ease of use of an application

by the user. This method is very suitable for measuring the usability of an application or information system. In this study, the application will be used as a measurement object, which an educational game is called The Bana. The Bana is an educational game app for junior high school students to teach about the environment and nature conservation by locations setting in the Baluran forest located in Baluran National Park, Situbondo.

This research was conducted at SMPN 1 Asembagus of Situbondo Regency. The technique of sample selecting that will be the research respondent is using Non-Probability Sampling method. The numbers of respondents involved in this study were 90 students divided into 3 groups of users: the non-expert users, active users, and skilled users. The non-expert users are students who have never been entirely using The Bana game; the active users are students who often use The Bana game; whereas the skilled users are more advanced students (able to complete all of the levels) in The Bana game.

Data collection methods have an important role in the success of a study. In this study, data collection method used is by using questionnaire. The scale used is Likert scale (Beglar & Nemoto, 2014) with range 1 to 5 with details as follows:

1. The SA Answer (Strongly Agree) is rated 5
2. The A Answer (Agree) is rated 4
3. The N Answer (Neutral) is rated 3
4. The D Answer (Disagree) is rated 2
5. The SD Answer (Strongly Disagree) is rated 1

The usability criteria used to refer to (Nielsen, 2012) with the five following components:

- Learnability: measuring the level of users' convenience to fulfill the basic tasks when the users see/use the application for the first time
- Efficiency: measuring the level of speed in doing a particular task after studying the application
- Memorability: measuring the incidence of users' convenience in reusing the application after not using it for some time
- Errors: measuring the error performed by users, and how to fix or deal with it
- Satisfaction: measuring the level of user satisfaction in using the application

Game Experiment Scenarios

The experimental process of using the game application performed by students consists of several levels:

1. The ability to open the game app

2. The ability to comprehend the function of each menu on the home page of the game application
3. The ability to choose the game level
4. The ability to understand the game instruction
5. The ability to complete the game at the 1st level
6. The ability to complete the game at the 2nd level
7. The ability to complete the at 3rd level
8. The ability to complete the game at the 4th level
9. The ability to understand the function on the menu that appears when the game is finished
10. The ability to end the game and close the game app

After the data collection, it is conducted the data processing with the following stages:

1. Validity Test and Reliability to test the instrument (questionnaire) used
2. Descriptive analysis to determine the level of usability of The Bana
3. Grouping results of a calculation to measure The Bana application usability referring to Table 1.

Table 1. Grouping Category

Score	Qualification
4.01 – 5,00	Very good
3.01 – 4.00	Good
2.01 – 3,00	Enough
1.01 – 2.00	Less good
0.01 – 1.00	Very Less Good

RESULTS AND DISCUSSION

Before the respondents fill out the questionnaire, the respondents run The Bana in accordance with a predetermined scenario. It is hoped that each respondent gets the same user experience before filling out the questionnaire. Therefore, the results of the questionnaire are more focused.

The questionnaire used is divided into five groups of questions according to the criteria of usability as in Table 2.

The respondents of this study are 90 students divided into three groups of users: the non-expert users, active users, and skilled users. There are 30 people of the seventh grade students representing the non-expert users. It is because the seventh grade students still lay with the applications already in use long Bana in SMPN 1 Asembagus. Active users represented by 30 people of the

Table 2. Questionnaire Group

Variable	Item Question	Type	Function
Learnability	P1 - P6	Numerical	measuring the level of users' convenience to fulfill the basic tasks when the users see/use the application for the first time
Efficiency	P7 - P9	Numerical	measuring the level of speed in doing a particular task after studying the application
Memorability	P10 - P13	Numerical	measuring the incidence of users' convenience in reusing the application after not using it for some time
Error	P14 - P16	Numerical	measuring the error performed by users, and how to fix or deal with it
Satisfaction	P17 - P19	Numerical	measuring the level of user satisfaction in using the application

eighth grade students; it is because they have frequently used The Bana applications. Skilled users represented by 30 people of the seventh grade students; it is because they often use and have skills in completing The Bana application. Respondent profile classification is presented in Table 3.

Table 3. Respondent Profile Classification

User Category	Amount	Class
Non-expert Users	30 students	Seventh Grade Students
Active Users	30 students	Eighth Grade Students
Skilled User	30 students	Ninth Grade Students

Validity and Reliability Test

The first stage of data analysis is the validity and reliability test of the instruments used. The validity test is done to see whether the instrument (questionnaire) used is valid or not. The validity test performed was using Pearson Correlation with 0.05% significance level using SPSS. In order to analyze Pearson Correlation test results, the researcher first determines the r value of the table. The R value is obtained from r table with degrees of freedom (df) = n-2 where n is the number of respondents, so the df is 88. From the r table, its value is 0.2072. Then, the r table value is compared to the r value of Pearson Correlation test of all indicator (question item) on the instrument. An indicator or item of the question is said to be valid if the value of r count> r table. The validity test results are presented in Table 4.

Based on the validity test results conducted all indicator/item questions on the instrument, it has met the validity test criteria so that it is declared as valid.

Table 4. Validity Test Results

Variable	Indicator / Item	R count	R table	Results
Learnability (LN)	LN1	0.755	0.2072	Valid
	LN2	0.744	0.2072	Valid
	LN3	0.719	0.2072	Valid
	LN4	0.752	0.2072	Valid
	LN5	0.659	0.2072	Valid
	LN6	0.620	0.2072	Valid
Efficiency (EF)	EF1	0.906	0.2072	Valid
	EF2	0.908	0.2072	Valid
	EF3	0.921	02072	Valid
Error (ER)	ER1	0.733	0.2072	Valid
	ER2	0.751	0.2072	Valid
	ER3	0.767	0.2072	Valid
	ER4	0.734	0.2072	Valid
Memorability (MEM)	MEM1	0.912	0.2072	Valid
	MEM2	0.910	0.2072	Valid
	MEM3	0.874	0.2072	Valid
Satisfaction (SAT)	SAT1	0.835	0.2072	Valid
	SAT2	0.720	0.2072	Valid
	SAT3	0.783	0.2072	Valid

The next is the reliability test using Cronbach Alpha. An instrument is said to be reliable if the Cronbach Alpha value of the variable is greater than 0.60. Table 5 is the result of the reliability test of the instrument.

Based on the results of validity and reliability test, it can be concluded that all question items on the instrument used to measure The Bana application usability have fulfilled the criteria of validity and reliability test that can be said

to be valid and reliable.

Table 5. Reliability Test Results

Variable	Cronbach's Alpha	Results
Learnability (LN)	0.792	Reliable
Efficiency (EF)	0.899	Reliable
Error (ER)	0.721	Reliable
Memorability (MEM)	0.880	Reliable
Satisfaction (SAT)	0.704	Reliable

Descriptive Analysis of Usability Testing

This study will observe whether the usability level of The Bana application meets the usability criteria according to Jacob Nielsen. At this stage, the researcher analyzed 4 (four) data groups representing the respondent group such as:

1. All respondents are 90 students consisting of 30 non-expert users, 30 active users, and 30 skilled users
2. The non-expert users are 30 students
3. The active users are 30 students
4. The skilled users are 30 students

The average calculation result of all criteria in the four groups of respondents is presented in Table 6-9.

Table 6. The average calculation results of each criterion on all respondents

Criteria	Sample Number	Average	Median
Learnability	90	3.84	3.67
Efficiency	90	3.94	4
Error	90	3.89	3.75
Memorability	90	3.87	4
Satisfaction	90	3.7	3.67

Table 7. The average calculation results of each criterion on the non-expert users

Criteria	Sample Number	Average	Median
Learnability	30	3.53	3.5
Efficiency	30	3.48	3.33
Error	30	3.47	3.5
Memorability	30	3.48	3.33
Satisfaction	30	3.53	3.67

Based on the results of the calculations in Table 6-9, it appears that the level of usability of The Bana application across all user groups, as well as the non-expert, active, and skilled users. Based on Table 6 with the total respondents of 90 people, it shows that the Bana application has a good level of usability with Learnability criterion value (3.84), Efficiency (3.94), Error (3.89), Memorability (3, 87), and Satisfaction (3.7). This indicates that the average value of each criterion based on the perception of all users is a good category range (3.1 – 4.0).

Table 8. The average calculation results of each criterion on the active users

Criteria	Sample Number	Average	Median
Learnability	30	4.00	4
Efficiency	30	3.94	4
Error	30	4.02	4
Memorability	30	4.00	4
Satisfaction	30	4.02	4

Table 9. The average calculation results of each criterion on the skilled users

Criteria	Sample Number	Average	Median
Learnability	30	4.28	4.33
Efficiency	30	4.4	4.33
Error	30	4.34	4.5
Memorability	30	4.43	4.67
Satisfaction	30	4.35	4.33

According to the Table 7, the non-expert users who first-time use the Bana application were 30 people indicating that the Bana application has a good level of usability with Learnability criterion value (3.53), Efficiency (3.48), Error (3.47), Memorability (3.48), and Satisfaction (3.53). This indicates that the average value of each criterion based on the perception of a non-expert user is in a category range (3.1 – 4.0). These results indicate that the Bana application is easy to understand, easy to remember and easy to use by non-expert users who first time use it.

According to the Table 8, the active users that have been frequently used the Bana application are 30 people indicating that the Bana application has a good level of usability with Learnability criterion value (4:00), Efficiency (3.94), Error (4:02), Memorability (4.00), and Satisfaction (4.02). This indicates that the average value of 3 (three) criteria is in a good category range (Learnability, Efficiency, Memorability) and 2 (two) criteria are in the very good category range

Table 10. Result of All Respondents Capability Grouping

Users	Usability Testing Criteria (In Category)				
	Learnability	Efficiency	Error	Memorability	Satisfaction
All Users	Good	Good	Good	Good	Good
Non-expert	Good	Good	Good	Good	Good
Active	Good	Good	Very good	Good	Very good
Skilled	Very good	Very good	Very good	Very good	Very good

(Error and Satisfaction). These results illustrate that the Bana application has a good quality and tend to be very good based on votes of the active users who have often used the Bana.

Based on Table 9, the skilled users who are frequently and skillfully in the use of the Bana application are 30 people indicating that the Bana application has a good level of usability with Learnability criterion value (4.28), Efficiency (4.4), Error (4.34), Memorability (4.43), and Satisfaction (4.35). This indicates that the average criteria are in a very good category range. These results illustrate that the Bana application has a very good quality. The frequency of use and ability of skilled users affect the assessment of the application usability of the Bana as shown in Table 10.

CONCLUSIONS

From the results, it is inferred that the use of the Bana application by junior high school students can be very well received. It can be seen in the results of grouping capabilities in table 10. The non-expert users, as the first time users, did not experience such a constraint with the result as a good category. Based on the result of grouping ability of all respondents in table 10 also can be seen that the ability of the skilled users is in a very good category. It shows that the frequency of use in the Bana application is able to improve the mastery of gaming of its users. From these results, it can be concluded broadly that design interfaces in the Bana applications are good and easy to use category.

It is recommended that the Bana application can be used as a design reference for the further development of education game application. This reference will be valuably important because the development of an application will be able to meet the expected needs. However, the condition of respondents who will be the object of research should be well observed since the technological developments that occur in urban and rural areas are different. This will indirectly affect the habits and behavior of people (including children) as it to enable different designs to solve this problem.

REFERENCES

Arnab, S., Lim, T., Carvalho, M. B., Bellotti, F., Freitas, S., Louchart, S., ... & De Gloria, A. (2015). Mapping learning and game mechanics for serious games analysis. *British Journal of Educational Technology*, *46*(2), 391-411.

Cheng, M. T., Chen, J. H., Chu, S. J., & Chen, S. Y. (2015). The use of serious games in science education: a review of selected empirical research from 2002 to 2013. *Journal of Computers in Education*, *2*(3), 353-375.

De Aguilera, M., & Mendiz, A. (2003). Video games and education:(Education in the Face of a "Parallel School"). *Computers in Entertainment (CIE)*, *1*(1), 1.

Denton, W., & Coysh, S. J. (2011). Usability testing of VuFind at an academic library. *Library Hi Tech*, *29*(2), 301-319.

Dondlinger, M. J. (2007). Educational video game design: A review of the literature. *Journal of applied educational technology*, *4*(1), 21-31.

Eccles, J. S. (1999). The development of children ages 6 to 14. *The future of children*, 30-44.

Giammarco, E. A., Schneider, T. J., Carswell, J. J., & Knipe, W. S. (2015). Video game preferences and their relation to career interests. *Personality and Individual Differences*, *73*, 98-104.

Girard, C., Ecalle, J., & Magnan, A. (2013). Serious games as new educational tools: how effective are they? A meta-analysis of recent studies. *Journal of Computer Assisted Learning*, *29*(3), 207-219.

Imbellone, Alfredo, Brunella Botte, and Carlo Maria Medaglia. "Serious games for mobile devices: the intouch project case study." *International Journal of Serious Games* 2, no. 1 (2015): 17-27.

Jabbar, A. I. A., & Felicia, P. (2016). Towards a Conceptual Framework of GBL Design for Engagement and Learning of Curriculum-based Content. *International Journal of Game-Based Learning (IJGBL)*, *6*(4), 87-108.

Kahn, A. S., Shen, C., Lu, L., Ratan, R. A., Coary, S., Hou, J., ... & Williams, D. (2015). The Trojan Player Typology: A cross-genre, cross-cultural, behaviorally validated scale of video game play motivations. *Computers in Human Behavior*, *49*,

354-361.

Kocadere, S. A., & Çağlar, Ş. (2015). The design and implementation of a gamified assessment. *Journal of e-Learning and Knowledge Society*, *11*(3).

Lee, L. (2015). Digital media and young children's learning: A case study of using iPads in American preschools. *International Journal of Information and Education Technology*, *5*(12), 947.

Lestari, A., Widiyatmoko, A., Alimah, S., & Juliyani, I. (2015). Sounds Learning Using Teams Games Tournament With Flash Card As Media At The 13Th Junior High School Of Magelang. *Jurnal Pendidikan IPA Indonesia*, *4*(2).

Nemoto, T., & Beglar, D. (2014). Likert-Scale Questionnaires.

Nielsen, J. (2012). Usability 101: Introduction to Usability [Verkkosivu]. *NN/g Nielsen Norman Group.[Viitattu 9.3. 2015]. Saatavissa: http:// www. nngroup. com/articles/usability-101-introduction-to-usability*.

Pischetola, M. (2011). Digital media and learning evolution: A research on sustainable local empowerment. *Global media journal*, *11*(18), 1-14.

Putra, P. D. A., & Iqbal, M. (2016). Implementation of Serious Games Inspired By Baluran National Park To Improve Students' Critical Thinking Ability. *Jurnal Pendidikan IPA Indonesia (Indonesian Journal of Science Education)*, *5*(1), 101–108.

Reeves, T. C. (1998). The impact of media and technology in schools. *Journal of The Journal of Art and Design Education*, *2*, 58-63.

Rohwati, M. (2012). Penggunaan education game untuk meningkatkan hasil belajar IPA biologi konsep klasifikasi makhluk hidup. *Jurnal Pendidikan IPA Indonesia*, *1*(1).

Rutten, N., Van Joolingen, W. R., & Van der Veen, J. T. (2012). The learning effects of computer simulations in science education. *Computers & Education*, *58*(1), 136-153.

Sonsteby, A., & DeJonghe, J. (2013). Usability testing, user-centered design, and LibGuides subject guides: A case study. *Journal of Web Librarianship*, *7*(1), 83-94.

Tabor, S. W., & Minch, R. P. (2013). Student adoption & development of digital learning media: action research and recommended practices. *Journal of Information Technology Education: Research*, *12*, 203-223.