MATHE*dunesa*
Jurnal Ilmiah Pendidikan Matematika *Volume 8 No. 2 Tahun 2019*
ISSN :2301-9085

DEVELOPMENT OF COMPUTER GAME "ARCHITECT MAN" AS ASSESSMENT TOOL OF QUADRILATERAL AND TRIANGLE FOR 7th GRADE STUDENT

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Abstract

Along with the development of sciences and technologies, assessment tool can be modified as a computer game. Computer game based assessment has more advantage than paper and pencil assessment. However, paper and pencil assessment is more commonly used. Therefore, this research tend to describe the process and result of development of computer game "Architect Man" as assessment tool of quadrilateral and triangle for 7th grade students. The development of the game used ADDIE as the model which has 5 phases that are analys, design, develop, implement, and evaluate. The collected data were validity scores and pretes-posttest scores. The validity scores were collected from validation sheet, while pretes-posttest scores were collected from experiment. The experiment used pretest-postest design with experiment subjects are students grade 7th F of SMP Negeri 1 Cerme. There were three kinds data analysis that are validity, reliability, and sensitivity. The development result of computer game "Architect Man" fulfilled good category because it is valid, reliable, and sensitive. The validity analysis result showed that the average total score is 3,57 and categorized as strongly valid. The reliability analysis result showed that reliability coefficient is 0,784 and categorized as high level of reliability. Then, the sensitivity analysis showed that every question item has sensitivity index which is categorized as acceptable sensitive or strongly sensitive.
Keywords: computer game, assessment tool, quadrilateral and triangle.

INTRODUCTION

Assessment is an important component of learning which should be done to know the effectiveness of learning. Based on Kemendikbud (2016), Assessment is a process of collecting and processing information to measure students' achievement. While carrying out assessment of learning, a good assessment tool should be used so that will give the accurate information (Arifin, 2009). Commonly, paper and pencil test is used as assessment tool in learning (Asrul dkk, 2014).

Research by Killi and Ketamo (2016) showed that students have high test anxiety while doing paper and pencil test in mathematics learning. However, based on Asrul dkk (2014), it gives impact on students' performance. Hence, test anxiety will influence the accuracy of students' achivement report. Research by Mavridis and Tsiatsos (2016) showed that instrinsic aspect of game can motivate students and camouflage the test pressure. Therefore, using game as assessment tool will decrease students test anxiety.

On the other hand, development of sciences and technologies gives impact on education. Recently research showed that computer game can be used as assessment tool of learning (Mavridis and Tsiatsos, 2016; Killi and Ketamo, 2016). The use of computer game as assessment tool can encompass both advantages of game based assessment and computer based assessment. Hence, this research is tend to develop a computer game as assessment tool of mathematics learning. However not all mathematics topics can be used because computer only read logical codes (Syarifudin dan Setianingsih, 2009). The suitable topic is the one that can be assessed using question which easly in doing and correcting. One of the suitable topics is quadrilateral and triangle for 7th grade students.

The computer game which developed in this research is a casual game. A major element of casual game is the content and theme should relate with daily life (Cheng, 2011). The suitable theme for quadrilateral and triangle is about architecture so the name of computer game which developed in this research is "Architect Man". The computer game "Architect Man" is an aplication developed by using Construct 2 that can be instaled in personal computer. Therefore, the aimed of this research is to describe the development process and result of computer game "Architect Man" as assessment tool of quadrilateral and triangle for 7th grade students which fulfills valid, reliable, and sensitive.

METHOD

The type of this research is a research and development which develop computer game "Architect Man" as assessment tool of quadrilateral and triangle for 7th grade students. The procedure of this research based on ADDIE model which has 5 phases that are analys, design, develop, implement, and evaluate. In the analys phase, curriculum analysis and material analysis were carried out. In the design phase, the question items, game flowchart, and instruments needed were composed. In the develop phase, an initial prototype was made. Furthermore, the game that had been made was validated by experts and revised for improvement. The experts were two mathematics lecturers and one mathematics teachers. Then, the game that had met valid criteria was tested at implement phase. The experiment design used was a pretest-posttest design with the experiment subjects were 30 students of VII F class SMPN 1 Cerme. Finally, an analysis of reliability and sensitivity was carried out at evaluate phase.

There are two kind of data in this research, namely validity scores and pretest-posttest scores. The validity scores were collected from validation sheet, while the pretest-posttest scores were collected from experiment. From validity scores of each expert, the average validity score of computer game was determined. Then, the average validity score was interpreted by using following criteria:

Table 1. Validity Criteria

Interval	Validity Criteria
$3{,}25 \leq RV \leq 4$	Strongly valid
$2{,}5 \leq RV < 3{,}25$	Valid
$1{,}75 \leq RV < 2{,}5$	Low valid
$1 \leq RV < 1{,}75$	Not valid

(Khabibah, 2006)

The assessment tool fulfills good category if the average validity score is valid or strongly valid.

Pretes-posttest scores were used in reliability and sensitivity analysis. From posttest scores, reliability coefficient was determined by using split half method. The steps included spliting the score based on odd-even items, determining the reliability coefficient of the half part by using product momment correlation, determining the reliability coefficient of the full part by using Spearman-Brown Formula, and interpreting by using following criteria:

Table 2. Reliability Criteria

Reliability Coefficient	Reliability Criteria
$0{,}8 < r_{11} \leq 1{,}0$	Very High
$0{,}6 < r_{11} \leq 0{,}8$	High
$0{,}4 < r_{11} \leq 0{,}6$	Acceptable
$0{,}2 < r_{11} \leq 0{,}4$	Low
$0{,}0 < r_{11} \leq 0{,}2$	Very Low

(Arikunto, 2012:89)

The assessment tool fulfills good category if the reliability coefficient is acceptable, high, or very high.

From pretest-posttest scores, sensitivity index of each question item was determined. Then, the index sensitivity was interpreted by using following criteria:

Table 3. Sensitivity Criteria

Sensitivity Index	Sensitivity Criteria
$S < 0$	Not Sensitive
$0 \leq S < 0.1$	Low Sensitive
$0{,}1 \leq S < 0{,}2$	Acceptable Sensitive
$0{,}2 \leq S < 1{,}0$	Strongly Sensitive

(Li dkk, 2012)

The assessment tool fulfills good category if the index sensitivity is acceptable sensitive or strongly sensitive.

RESULTS AND DISSCUSSION

Results

The description of development process and result of computer game "Architect Man" as assessment tool of quadrilateral and triangle for 7th grade students as follows:

1. Analys Phase

An analysis of the curriculum in Indonesia was carried out, namely the 2013 curriculum. According to Permendikbud No. 24 of 2016, Knowledge Basic Competence of Quadrilateral and Triangle material for 7th grade students is KD 3.11 linking the circumference formula and area for various types of quadrilateral (square, rectangle, rhombus, parallelogram, trapezoid, and kite) and triangles. Referring to the KD, then the indicators were arranged as follows:

3.11.1 Explain the properties of various types of quadrilateral (square, rectangle, rhombus, parallelogram, trapezoid, and kite)
3.11.2 Determine the circumference of various types of quadrilateral (square, rectangle, rhombus, parallelogram, trapezoid, and kite)
3.11.3 Determine the area of various types of quadrilateral (square, rectangle, rhombus, parallelogram, trapezoid, and kite)
3.11.4 Explain the properties of a triangle
3.11.5 Determine the types of triangles based on the length of the sides and the size of the angle
3.11.6 Explain special lines on a triangle (perpendicular bisector, angle bisector, median, and altitude)
3.11.7 Determine the circumference of a triangle
3.11.8 Determine the area of a triangle
3.11.9 Estimating irregular 2D figure

After arranging indicators, material analysis was carried out to find out the contents of the quadrilateral and triangle material taught to 7th grade students. The analysis results and the indicators become the basis for compiling the spesification table. Based on the results of the analysis, it was found that the material content of quadrilateral and triangle included types, properties,

circumference and area of quadrilateral; types, properties, circumference area and special lines of triangle; and also irregular 2D figure.

2. Design Phase

There were three activities carried out at this phase, namely arranging the question items, composing the game flowchart, and designing research instruments. The question items and flowchart that had been compiled at this phase were used as guidelines for making the initial prototype. Question items were arranged according to the spesification table. The question item consists of 20 multiple choice questions and 10 short item questions. While the research instrument in the form of a validation sheet was compiled used to assess the initial prototype. Game validation includes four aspects, namely aspects of content, construction, language, and display.

3. Develop Phase

The activities carried out at this phase were developing initial prototype, validating, and revising. The computer game "Architect Man" was created using the game engine Construct 2. But besides Construct 2, supporting applications were also used, namely Adobe Illustrator and GeoGebra. Adobe Illustrator was used to design and edit background images, characters, and other supporting images. Whereas GeoGebra was used to make quadrilateral and triangle shapes.

The steps to develop the initial prototype of the computer game "Architect Man" were:

1. Preparing the images, music, and sound effects needed
2. Creating a new project titled "Architect Man" in the Construct 2
3. Inserting images, music, and sound effects that have been prepared into the new project
4. Adjusting the position and size of the image that has been entered in the available layout
5. Adding text to the layout according to the needs of the problem and the game prologue
6. Creating a programming code in the form of action events in the eventsheet section, for example, provides functions on the button, runs animations, connects layouts, corrects answers, gives responses, adjusts sound effects, etc.
7. Checking the game from the beginning to the end. Checking is done to find out if there is a program that is not suitable or error.
8. Exporting the project so that the game can be installed in personal computers

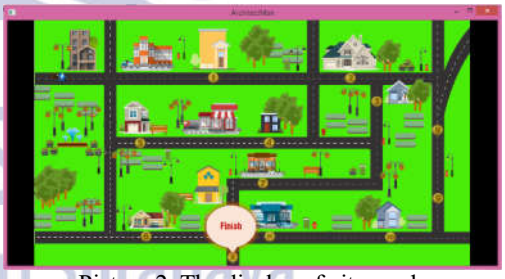
There are three main parts of the computer game "Architect Man", namely the initial display, the main of game display, and the final display. The initial display consists main menu display, help submenu display, about submenu display, identity input display, game prologue display, and job list display.

The theme of the game is about helping an architect complete his work. When a player is able to help the architect get the job done, the player will get money. So the aim of the game is to collect money as much as possible. There are two parts of this game. The first part is about the architect's first job, which is designing sketch according to the customer's desires. In the first part, questions number 1 to 10 are presented.

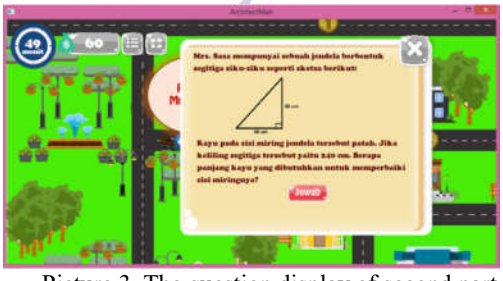
Picture 1. The question display of first part

The display above contains the customer's prologue about the desired design. The question was inserted in the prologue. After all the prologues are displayed, four sketch papers appear. Players must choose one of the sketch papers that corresponds to the answers of given questions. If the player chooses the correct sketch paper, the design image that the customer wants will appear. Players can also raise money.

Whereas in the second part, players control cars through city roads to solve problems faced by customers in certain locations. In the second part questions number 11 to 30 are presented.



Picture 2. The display of city roads



Picture 3. The question display of second part

In solving problems can be done in different ways, namely drag and drop the items needed from the cupboard, determine the number of items, or choose the appropriate paint color. When the player is able to solve

the problem, the player will get money and things or designs that are related to the problem arise.

In the end of the game, the final display will showed. This final display contains the student's personal data and the achievements that have been obtained by students, namely the total money earned. It also show what medals students get and the results of the assessment.

After developing initial prototype, the validation activity was carried out. The results of validation for the content aspect is 3.22 so that it is included in the valid criteria. While for the aspects of construction, language, and display, the validation results are more than 3.25. This means that the results of the validation of the three aspects meet strongly valid criteria. Likewise the average total validation shows that "Architect Man" computer games fall into the strongly valid category of 3.57. Thus this computer game can be tested. But before that, a small revision was made based on suggestions from the validator, namely changing the input type in the absent textbox becomes positive number, adding help buttons and additional instructions on each part of the game to make it easier for players, revising some multiple choice questions that have more than one answer, revising the design list display so that the designs that have been successfully worked on can be accessed/viewed again, and adding wrong-correct reinforcement by adding the answer key and the discussion.

3. Implement Phase

The protoype that had met valid criteria was tested. The experiment was conducted at SMPN 1 Cerme, Gresik with experiments subjects 30 students in 7F class. The experiment was carried out with a pretest-posttest design. The pretest was held on April 12, 2019, while the posttest was held on April 26, 2019. From the experiment, obtained the pretest and posttest score.

4. Evaluate Phase

The pretest and posttest score were analyzed to determine the reliability coefficient and sensitivity index. First, the reliability coefficient was determined based on posttest data. By using the product moment correlation formula obtained the reliability coefficient of half the test is 0.644. Then the reliability coefficient of all the test was calculated using the Spearman-Brown formula. It was obtained that the reliability coefficient of all tests was 0.784. This means that the reliability level of the computer game "Architect Man" belongs to the high category.

Then the sensitivity index of each item was calculated based on the pretest and posttest score. Item 1 included in acceptable sensitive because the sensitivity index is 0.167, while other items included in strongly sensitive category because the sensitivity index is more than 0.2. Thus it can be said that each item had been able to measure learning outcomes effectively. Because it had been obtained that computer games "Architect Man" met the criteria of valid, reliable, and sensitive.

Disscussion

In this study, the computer game "Architect Man" had met the criteria of valid, reliable, and sensitive. The computer game "Architect Man" fulfilled the valid criteria, which means that the game is the right tool for measuring student learning outcomes related to quadrilateral and triangle material. The computer game "Architect Man" fulfilled reliable criteria, which means that the results of assessment related to the quadrilateral and triangle material using this game can be trusted. Finally, computer games "Architect Man" fullfilled sensitive criteria, which means that each item in this game can measure student learning outcomes related to quadrilateral and triangle material effectively.

The presentation of questions in this game begins with everyday problems. This is in accordance with the concept of casual games, namely the content is familiar in everyday life so it is fun to play (Cheng, 2011). In addition, this is also in accordance with the characteristics of learning in the 2013 curriculum which always begins with giving contextual motivation about the benefits and application of the material in everyday problems (Shafa, 2014).

There is a suggestion from the validator that the researcher did not implement, namely giving clarity regarding the use of the given money reward so that more interesting. In this game, the money given as a reward is only to determine the achievements obtained by the player so that the player has the right to win a gold, silver or bronze medal. This is in accordance with the characteristics of casual games which are far from complexity, do not require special skills and commitment to play, and generally aim to collect coins, stars, or money as much as possible (Sholihin and Farouq, 2016; Cheng, 2011).

CLOSING

Conclusion

The development process of computer game "Architect Man" used ADDIE as the model which has 5 phases that are analys, design, develop, implement, and evaluate. First, analysis of curriculum and material were carried out at analys phase. Then, there were three activities at design phase, namely arranging the items, arranging the game flowchart, and compiling research instruments. There were also three activities at develop phase, namely making the initial prototype, validating, revising according to some

suggestions from the validators. At implement phase, the valid prototype was tested. Finally, the reliability and sensitivity analysis were carried out at evaluate phase.

The results of the development in this research is computer game "Architect Man" which fulfilled the criteria of valid, reliable, and sensitive. The computer game "Architect Man" fulfilled a strongly valid category with an average total validation of 3,57. Computer game "Architect Man" fulfilled reliable criteria because it has a high reliability coefficient of 0.784. The computer game "Architect Man" fulfilled sensitive criteria because each item has a sensitivity index that meets the criteria acceptable sensitive or strongly sensitive.

Suggestion

Suggestions that can be given by researchers after carrying out this research are the use of computer games "Architect Man" as an assessment tool can be applied at school and in future study about development of computer games as instruments tool, it is expected to be more varied for example in terms of the type of game, the material used, and the features of the game. In addition, it is expected that the questions in the game are more dynamic and can appear randomly when used by different players.

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