International Journal of Academic and Applied Research (IJAAR)
ISSN: 2643-9603
Vol. 6 Issue 1, January - 2022, Pages:58-63

Developing "Full House" Mathematical Education Game with Coppercube Software on Numerization of Numbers to Improve Students' Ict Literacy

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Abstract: *The use of technology as a learning medium can develop students' ICT literacy. However, media that use in this research is game. This study aims to develop mathematic education game assisted by Coppercube on numerization number to improve students' ICT literacy skills. The development model used is describe by Plomp model, which consists of four phase, namely preliminary research, developing and prototyping, and surmatif evaluation. The subjects of this research were students of class VIII SMA Nuris Jember. The method of analysis data on this research was 3, the validity analysis obtained through validation by validator, effective analysis obtained from the survey an understanding of the user, and an analysis of practicality obtained from the user survey response. Furthermore, the effectiveness of learning media is obtained from the average N-Gain test and ICT literacy questionnaire. The results showed that the media proved to be effective because it could improve the ICT literacy of students. In conclusion, mathematics education game assisted by coppercube on numerization number can improve students' ICT literacy skills.*

Keywords: literacy, mathematic, game, coppercube

1. INTRODUCTION

According to Sutarman (Kurniasari et al, 2016) [9], technology has several advantages: (1) Rapid communication, (2) Sufficient storage capacity and high-speed access, (3) Providing fast and accurate transaction processes Technology and information are not only computer operation methods, but also technology and information in the present age. One of the uses of development is what is commonly referred to as a learning tool or learning medium. One of the efforts to make learning in class interesting and innovative is to use the media for learning [11]. The learning medium in question is an ICT-based learning medium (information and communication technology) that can increase students' interest in the learning process and facilitate their active role in learning activities.

According to ETS (2007)[3], ICT literacy is the ability to use digital technology or telecommunications equipment and apply it as a tool to access, manage, integrate, evaluate, and create information. There are five evaluation factors for ICT literacy. The five elements represent skills and knowledge and are presented in order of increasing cognitive complexity. The five components are: (1) Access knows how to collect and / or retrieve information. (2) Management is the application of existing schemes or classifications. (3) Integration is the interpretation and presentation of information, including summarization, comparison, and distinction. (4) Evaluation is to judge the quality, relevance, ease of use, and efficiency of information. (5) Create creates information by adapting, implementing, designing, creating, or creating information[10].

According to Afifah et al, (2018) [1], mathematics is one of the research fields that is Jerkan in both elementary and junior high schools. Therefore, mathematics is considered an essential lesson and is a basic lesson that must be taught in formal education. Mathematics is a science of numbers and space, mathematics is a language of symbols, mathematics is a language of numbers, mathematics is an abstract and speculative science, mathematics is a method of logical thinking, mathematics is A science that studies the relationship between patterns, form and structure, mathematics is the queen of science and a servant of other sciences. The difficulty for students in this regard is that it is difficult for students to find the main idea of a given problem, and it is difficult for students to make abstract generalizations [5]. According to Bungsu et al, (2018) [2], learners in Indonesia have relatively low math skills compared to other countries, so it is necessary to give math subjects to all learners from elementary school to higher education level. In addition, according to siregar et al research (2017) [13], the perception that students understand math learning is 45% of the results that math learning is difficult. According to Siregar (2017)[14], as many as 45% of students believe that mathematics is a very difficult subject. This can be seen from the results of math subjects in the 2019 National Entrance Examination. In all subjects, the average level of junior high school/MTs and high school/MA is lower than 47 (Kemdikbud, 2019). Therefore, the process of learning mathematics should be as interesting as possible to make learners interested in learning mathematics. The research carried out also shows that mathematics subjects lack learning motivation and spirit, and mathematics has become a scourge for some students. On this basis, with the help of CopperCube software, a mathematics learning media was created in the form of a personal computer (PC) educational game for development and research.

In addition to the simple methods and steps, the CopperCube procedure is not very complicated, so the CopperCube application is very suitable for beginners.

According to CopperCube (2017), coppercube software is an application developed by a company called Ambiera in 2017. The features offered by CopperCube are very diverse, so it is able to be an education that can be adapted to the desired subject. In addition to using the design provided in the program, users can create animations, graphics, and images that suit their needs, and then import them into the application. In addition, this application is very suitable for passing online courses, and Edmodo online courses are used as learning games. Edmodo is a learning platform using social network media for teachers and students who are ready to learn and learn, and can create teacher-student interaction [4]. Learning supported by learning media, in this case educational game, makes a significant contribution to the learning process and is reflected in the improvement of the students' learning outcomes in the classroom. The same research was also carried out by Insani et al. (2016) [8], who uses media-based CTL methods that have been shown to improve the quality of the learning process with increasing interest of the learners in the learning process.

Based on the background of the problem, the author will develop a game education game supplemented by coppercube. The materials taken are the eighth grade number of pattern materials of junior high school.

2. RESEARCH METHODS

The type of research carried out in this research is development research, and the development model used is the model developed by Plomp & Nieveen (2013) [12]. The product developed in this research is a mathematics educational game on number of pattern materials with the help of CopperCube software. The Plomp & Nieveen developing model (2013) includes 3 stages, namely: (1) preliminary research stage or preliminary research; (2) development or prototype design stage or development stage; (3) evaluation stage or evaluation stage. The methods used in this study are observation method, interview method, test method, questionnaire method and expert verification method to achieve the standards of validity, practicability and validity. Model development research by Plomp & Nieveen (2013) begins at an early stage, namely the preliminary research phase. This phase aims to analyze the needs, context and problems of teaching at Nuris Jember Junior High School. Activities carried out at this stage include observation activities, interviews, documents analyzing the results of eighth grade students' mathematics learning, and field trips to review the game that used as mathematics learning media in this situation. Based on the results of the completed analysis and identification, the next activity is to design interactive educational games.

The second stage is the development or prototyping phase or development phase. In this phase, support interactive educational game design and preparation of learning tools. This interactive educational game will test the quality of the educational game through the media expert verifier and the material expert verifier to test the effectiveness of the educational game. Based on the results of the verification test, make modifications to obtain quality and effective educational games for field trials. After the test, students fill out questionnaires to find out the answer after learning using interactive learning games.

The third stage is the evaluation phase. This phase aims to determine the effectiveness of educational games developed on the basis of the learning outcomes achieved in the trial phase. After educational games have been declared effective, educational games will be disseminated in schools and through the Edmodo web media.

Data analysis techniques include effectiveness analysis, utility analysis, and effectiveness analysis.

1) The validity analysis is performed by summarizing the validity evaluation data of the learning media from each validator and determining the average total value of the verification results of the three validators.

Table 1 : Category interpretation of validity coefficient

Value of α	Validity Level
$0{,}80 < \lvert \alpha \rvert \leq 1{,}00$	Very high
$0{,}60 < \lvert \alpha \rvert \leq 0{,}80$	High
$0{,}40 < \lvert \alpha \rvert \leq 0{,}60$	Medium
$0{,}20 < \lvert \alpha \rvert \leq 0{,}40$	Low
$\lvert \alpha \rvert \leq 0{,}20$	Very low

2) A usability analysis derived from interviews and analysis of user observation sheets. If the percentage of the average in the user's observation sheet is rated “good” or “excellent,” then learning math using the complete copper cube math learning game is considered practical.

Table 2 : Presentation category for game user note sheet

Value of P	Presentation categories
$P > 95\%$	Very good
$80\% < P \leq 95\%$	Good
$65\% < P \leq 80\%$	Good Enough
$50\% < P \leq 65\%$	Not good
$P > 50\%$	Very bad

3) Effectiveness Analysis must satisfy the validity analysis of the three aspects of cognition, psychomotor and emotion. The cognitive aspect analyzed through the student test results reached a score greater than or equal to KKM. The criteria for completing the course are shown in Table 3.

Table 3 : Effectiveness categories of educational games

Value of Q	Presentation categories
$80\% < Q \leq 100\%$	Very good
$60\% < Q \leq 80\%$	Good
$40\% < Q \leq 60\%$	Good Enough

20% < *Q* ≤ 40%	Not good
$Q \leq 20\%$	Very bad

The second aspect is the psychomotor analysis performed by the observation table equipment classified in Table 3 above. At the same time, sentiment analysis was conducted on the third aspect through the student questionnaire. The percentage categories of students are shown in Table 4 below.

Table 4 : Precentage category of students' questionnaire

Value of *S*	Presentation categories
$S > 95\%$	Very good
$80\% < S \leq 95\%$	Good
$65\% < S \leq 80\%$	Good Enough
$50\% < S \leq 65\%$	Not good
$S \leq 50\%$	Very bad

Table 5 : N-Gain normalized categories

Value of N-Gain normalized	Interpretation
g > 0,7	High
0,3 ≤ g ≤ 0,7	Medium
g < 0,3	Low

2. RESULTS

The educational media developed in this study is a Coppercube-assisted educational game-based learning medium on number style materials to improve students' ICT literacy abilities. The following are aspects of ICT literacy according to the Educational Testing Service (ETS) [3] as amended.

Table 6 : Modified ICT Literacy

Aspek Literasi ICT	Indikator
1. Mengakses (*Access*)	- Membuka *game* edukasi matematika - Mengakses petunjuk *game* edukasi matematika
2. Mengelola (*Manage*)	Mempelajari menu dan tombol pada *game* edukasi matematika
3. Menyatukan (*Integrate*)	Menentukan bilangan selanjutnya sesuai dengan pemasalahan pada tiap level
4. Mengevaluasi (*Evaluate*)	Menemukan kunci yang bernilai bilangan yang sesuai dengan pola bilangan
5. Membuat Informasi (*Create*)	Menggunakan informasi yang didapat setelah bermain *game* dengan mengerjakan latihan *post-test*

This research uses the Plomp development model (2013), which is composed of 3 phases, namely the preliminary research, the development or prototyping phase and the evaluation phase.

1. Phase of preliminary research

In this phase, several incremental steps, ranging from problem identification, student analysis, materials analysis, and environmental analysis, are helpful in obtaining data before the development or prototyping phase. According to the results of this progressive activity, people know that Nuris Jember junior high school lacks understanding and use of ICT use, especially in the use of PC (personal computer) to support student activities. Learning activities take place in the classroom and use media such as whiteboards. In this case, the learner who is a student of Class VIII Junior High School Nuris Jember as the subject of the mentioned study has never used a PC game in math learning, a game or an educational game. Thus, this study is expected to increase student learning interest in the use of technology as a tool in learning activities. And the material selected is a numerical scheme based on the academic test scores of some students who have not met the minimum completion criteria (KKM).

2. Development or Prototyping Phase

At this stage, use Coppercube software to design suitable learning media in the form of math educational games. Learning media in the form of educational games are expected to attract learners or students, make it easier for them to understand the materials taught and improve students' ICT literacy skills. Coppercube software has interesting features and is easy to use. This educational game is made with Coppercube software which can be downloaded in the following ways https://ambiera.com/coppercube/.

Fig 1. *Coppercube early display*

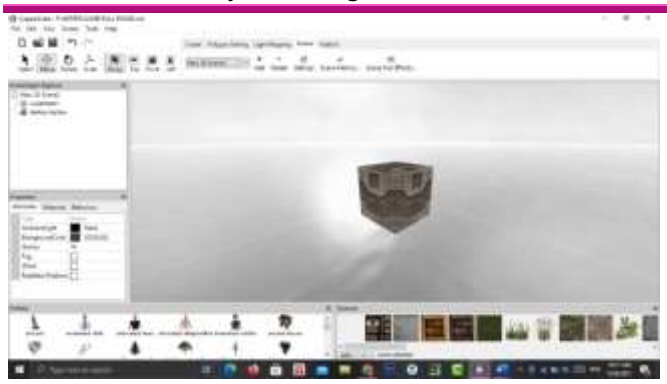

Fig 2. *Coppercube main menu*

The first look of a math education game features a simple menu to make it easier for learners or students to run or play math education games. The game also provides instructions to help learners and students understand each level of play and materials. In the production, the developer first creates Terrain, Camera, and Lighting, and then adds commands in a pre-prepared coding form. The purpose of this is to make the game run in accordance with the requirements of the developer while playing. Coding and commands are provided so that learners and students can follow the instructions when playing, from providing the commands for the buttons they use when playing to moving from one level to the next. This math education game contains one tutorial level and five main levels, each main level contains digital pattern materials of odd and even patterns, triangular digital patterns, square digital patterns, arithmetic digital patterns and geometric digital patterns. The creation of this game is based on ICT literacy indicators, starting with the code or command on each button and the instructions for playing this math educational game. The format selected for the development of math educational games is .exe format, no need to install third-party software, easy to run. In addition, the completed learning media is produced and output for formative evaluation, that is, the validity test is carried out by 3 verifiers. The verifier is composed of 2 mathematics education lecturers of Jember University and a junior high school mathematics teacher Nuris Jember.

3. Assessment Phase

At this stage, a trial version of the product was developed. The exam was conducted for students in Class VIII Nuris Jember Junior High School, with 18 students participating, and a 30 minute lesson was calculated every hour for 4 hours at Nuris Jembel Middle School. The learning media trial was held on August 2, 2021. This trial tested the practicality and effectiveness of learning media through learning media use activities, student learning outcomes, observations, and user feedback questionnaires. Then proceed to the summary evaluation phase, which is the analysis of the test result data in the implementation phase.

The results of the development of training media are considered in terms of the feasibility of the training media, the practicality of the training media, and the effectiveness of the training media. Based on the validation results obtained from 3 expert validators, the developed training games received an overall average score of 4.57 and a correlation coefficient value (a) of 0.91, which shows that this training game is valid and can be classified as very high.

The practicality of educational games is analyzed by the results of the user response, and results of 85.3% were obtained from the calculation of the user response questionnaires, which shows that educational games meet the criteria of practicality. In addition to the use of user response questionnaires, personal interviews with students or learners are also carried out directly. The interview was conducted after the students had finished playing the math learning games and completed the user response questionnaires along with the ICT literacy questionnaires. Based on interviews with students, the learning math game makes the learning process easier and more fun. Using learning games makes the classroom less boring and makes students more enthusiastic about math.

The effectiveness of an educational game depends on the learning outcomes of the student or learner before and after playing the math education game. Student learning test results result in a total of 18 students or learners with a completion rate of 88.89%. Due to the minimum completion criteria (KKM) for 75 Nuris Jember Middle Schools, there are two students with grades that do not meet KKM. According to the data obtained, more than 80% of students meet the KKM used by the school. According to the effectiveness analysis, if up to 80% of all test subjects meet the minimum completion standard (KKM), then the educational game can be said to be effective. Based on this, it can be concluded that the educational games in this study meet the validity criteria.

Meanwhile, literacy improvement assessment is determined based on the N-Gain Student Learning Outcome Test and literacy questionnaire results before and after playing math education games, and is supported by feedback when the experiment is conducted. There was an increase based on the results of the ICT literacy questionnaire and the learning outcomes test. From the results of the student learning test and the N-Gain analysis of the ICT literacy questionnaire, the results of 0.67 and 0.91 were obtained, and the average N-Gain was 0.79. Based on the criteria in Table 3.3, the N-Gain values show values of g> 0.7, so the average N-Gain falls into the high category. Therefore, we can conclude that educational games can improve students' ICT literacy abilities.

The difference from previous research, namely Hussen research (2020), 3D games made with Unity software that take up significant storage space. Unity software is also more intended to be used by users who have previously learned to code, so it will be difficult for users who have never learned to code and logic gates. This study is also consistent with the learning test results shown by Fatahillah (2021), 83.33% of 24 students completed the minimum completion standard (KKM), which is 75[4].

Table 7 : N-Gain tests of learning outcomes and ICT literacy

Average of	Before playing educational game	After playing educational game	
Average ICT literacy skills	0.46	3.68	0.91
Average test result	1.95	3.32	0.67
Average N-Gain			0.79

In addition, the ICT literacy questionnaire shows that after using the media, all aspects of literacy have improved. Table 8 shows the average N-Gain values for various aspects of ICT literacy.

Fig 3. *Full House early display*

Fig 4. *Full House game direction 1*

Fig 5. *Full House game direction 2*

Fig 6. *Tutorial stage*

Table 8 : N-Gain for every aspects of ICT literacy

Aspects of ICT Literacy	ICT literacy before using educational games	ICT literacy after using educational games	The value of observation	N - Gain
Access	0,56	4,00	3,70	1,00
Manage	0,44	3,76	3,76	0,93
Integrate	0,64	3,76	3,62	0,93
Evaluate	0,24	3,56	3,47	0,88
Create	0,44	3,32	3,33	0,81

3. CONCLUTION

The results of developing a math education game with the help of Coppercube program about numerization of numbers are validated to improve ICT literacy students because it has a correlation coefficient of α of 0.91 which is in a very high category. For the criteria of practical application of educational games based on user answer questionnaires and interviews, it got 85.3%, including practical criteria with good categories. In addition, the effectiveness of educational games is determined based on the percentage of students who learned the test results in the complete category, or the percentage of KKM who scored equal to or greater than 88.89% of the 18 students. On the other hand, by acquiring N-Gain learning test scores and ICT literacy questionnaires before and after using educational games, the improvement in ICT literacy of students obtained from learning outcome tests and ICT literacy skills before and after using educational games was 0.67 and 0.91, this results in the average N gain of 0.79. The average N-gain score falls into the high category, as normalized N-gain values show g> 0.7, so it can be concluded that educational games can improve students' ICT skills.

4. ACKNOWLEDGMENTS

We gracefully acknowledge the support from University of Jember Indonesia of year 2022

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