

DEVELOPING INTERACTIVE LEARNING MEDIA FOR SCHOOL LEVEL MATHEMATICS THROUGH OPEN-ENDED APPROACH AIDED BY VISUAL BASIC APPLICATION FOR EXCEL

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Abstract

This research is a merged descriptive and quasi-experiment research aimed to describe students' creativity in developing interactive learning media with Visual Basic Application for Excel. Besides that, it had done to review students' ability which learning used open-ended Visual Basic Application for Excel compared with the other students' which learning used the expository method with Visual Basic Application for Excel based. The subject contained 35 students in experiment class and 33 students in the control class, where the creativity of their learning media is reviewed and is analysed using SPSS. The research result shows that: (1) Students' creativity in creating interactive learning media that the learning used open-ended Visual Basic Application for Excel based is better than the one with expository method of Visual Basic Application for Excel found; (2) Students creativity in creating interactive learning media is the combination of their mastery towards school level mathematics and the ability in applying Visual Basic Application for Excel.

Keywords: Creative thinking ability, Open-Ended approach, Visual Basic application for Excel

Abstrak

Penelitian ini merupakan gabungan penelitian deskriptif dan kuasi eksperimen yang bertujuan untuk mendeskripsikan kreativitas mahasiswa dalam mengembangkan media pembelajaran interaktif berbasis Visual Basic Application for Excel. Selain itu juga untuk menelaah kemampuan mahasiswa yang pembelajarannya menggunakan pendekatan open ended berbasis Visual Basic Application for Excel dibandingkan dengan yang menggunakan metode ekspositori berbasis Visual Basic Application for Excel. Subjek penelitian terdiri dari 35 mahasiswa kelas eksperimen dan 33 mahasiswa kelas kontrol, di mana media pembelajaran yang dihasilkan ditelaah kreativitasnya dan dianalisis dengan menggunakan SPSS. Hasil penelitian menunjukkan bahwa : (1) Kreativitas mahasiswa dalam membuat media pembelajaran interaktif yang menggunakan pendekatan open ended berbasis Visual Basic Application for Excel lebih baik daripada yang menggunakan metode ekspositori berbasis Visual Basic Application for Excel; (2) Kreativitas mahasiswa dalam membuat media pembelajaran interaktif merupakan kombinasi dari penguasaannya terhadap materi matematika sekolah dan keterampilannya dalam mengaplikasikan Visual Basic Application for Excel.

Kata Kunci: Kemampuan Berpikir Kreatif, Pendekatan Open-Ended, *Visual Basic Application for Excel*

How to Cite: Rohaeti, E.E., Bernard, M., & Primandhika, R.B. (2019). Developing interactive learning media for school level mathematics through open-ended approach aided by Visual Basic application for Excel. *Journal on Mathematics Education*, 10(1), 59-68.

School level mathematics material is still elementary but is an essential concept as the basic as the prerequisites of higher mathematical concept mastery. It is by the mathematics fact as a structured knowledge in which according to Tim MKPBM (2001), in mathematics contains some topic or concept as a prerequisite for the basic to understand the next topic or concept. It is like constructing a multi-level building; there will be no second and subsequent manifestations if the foundations of the future have not been well conditioned.

As a structured-concept science that has an order that learns about the regularity of pattern, organized, structure, and mathematical concept served from the simplest to the most complex. The mastery of a topic is the basic and prerequisites to understand another idea. So as to school mathematics, the topics are chosen and adjusted in a particular way with students' intellectual stage and are expected to be able to stimulate the developing of students' thinking ability stated the nature and characteristic of school mathematics as: (1) the activity of searching patterns and relation, implication in learning gives a chance to student to discover and investigate the pattern to determine relation; (2) the activity that gives student to do some trial in their own way so that they could explore creativity that requires imagination and intuition. The implication of this activity in a learning context is to motivate the student initiative and to give the chance to think in their way differently. (3) The solving-problem activity which implied in the learning is to motivate the student to think logically, consistently, systematically to develop documentation system (Depdikbud, 2013).

In fact, some research found that the mathematical ability of student especially in comprehension, communication, connection, problem-solving and students' mathematical reasoning is not at the optimal result (Bernard & Rohaeti, 2016; Fatah, Suryadi, Sabandar, & Turmudi, 2016; Hendriana, Rohaeti, & Hidayat, 2017; Kadir, Lucyana, & Satriawati, 2017; Rohaeti, Budiyanto, & Sumarmo, 2014; Siswono, 2010; Sumarmo, Kusnadi, & Maya, 2018). Other than that, based on the research results from Hendriana, et al. (2017) towards students in some remote areas in West Java, shows that the low mastery of mathematics students on the concepts of mathematical essence led to low mathematical abilities.

The studies reported the superiority of innovative learning than conventional teaching on improving students' ability (Happy & Widjajanti, 2014; Shahrill, Putri, Zulkardi, & Prahmana, 2018; Sumarmo, Hidayat, Zukarnaen, Hamidah, & Sariningsih, 2012). Mathematics learning media is a tool for the student to deliver mathematical materials to a real form with the basic form to understand the use of mathematics, which it is not merely to memorize. Something to be considered, for mathematics education students as a prospective teacher, regarding the media is to be able to give clear depiction from the most abstract form. It is according to Bernard & Rohaeti (2016) said that related to the main function of the learning media of mathematics using props must adapt to its purpose. One of the mathematical learning media is that gives effectively and more economical is the one with ICT aid. Meanwhile, the constraints from students are to use new mathematical software and the technique to use animation cannot be mastered yet. Nevertheless, Microsoft Excel is conventional software that most people use to process data and is related to the utilization of mathematical function.

The relation between mathematics learning with *Microsoft Excel* needs students' creativity to create some ways, one of those is the achievement for the student to develop mathematical programs to understand elementary school students about numbers, operation, and geometry (Chotimah, Bernard, & Wulandari, 2018). *Visual Basic for Excel* is a programming language from Microsoft Excel that can utilize a mathematical function that set figural objects, called "shape," to be more

interactive. Students can bring up various ideas come to their mind using open-ended approach. The approach is useful when troubleshooting students about the images already provided in the "Forms" menu in Microsoft Excel. The first step of this learning started from the students. They had to ask the question from the specified picture and determine what to make about mathematical learning props as an initial creation planning. Secondly, students proposed solutions to make mathematical games. Lastly, students proposed solution after problem-solving with making new props creation plan or developing props (Silver & Cai, 1996).

METHOD

This research is a merged descriptive and quasi-experiment research aimed to describe prospective-teacher students' creativity in creating interactive learning media with Visual Basic Application for Excel. Besides that, the data was also obtained from two classes that had through different treatment in which the first class used Open Ended Visual Basic for Excel based (experiment class), involving 35 students. The other one used expository Visual Basic for Excel based (control class) including 33 students. Learning media produced by both classes is processed with SPSS to compare which classes have better creativity. The subjects in this research are the classes that got the subject ICT Application for mathematics learning.

RESULTS AND DISCUSSION

From the essential mathematical concept mastery test obtained from 68 students, the result shows 73.91% the students understand about arithmetical operation such as addition, subtraction, division, and multiplication. There are also 60.86% of students following the example picture or not creating on their own. 8.69% of students formed the other mathematical mastery such as geometry field, fraction, roots, exponents, any different than arithmetical operation resulted in 17.39% and calculator application related to the interactive pictures. These results describe that: (1) the making of arithmetical operation is more easily understood by students; yet, some errors found where students were not paying attention to the division. (2) Students could not be able to develop their creation or manifesting new ideas (3) Most of the students had difficulties in relating mathematical function to shapes form.

After the learning, some of the results shown students creative thinking ability at mathematical mastery and the other findings from students' new ideas from mathematics learning using *Visual Basic Application for Excel* through open-ended. 40% of students found to be mastered about the arithmetic operation, 45.7 % of students were able to relate and apply for the numbers in *Microsoft Excel* cells. 60% of students were able to use shapes to be given a command to run the result of the code they made using VBA for Excel. 20% of students can make games in *Microsoft Excel*. 51.43% of students were able to explain to create props using *Microsoft Excel*. 42.8% of the student was able to create props that related to geometry material. 28.57% of students were able to create props that

related to arithmetic. 31.43% of students were able to develop interactive prop with new findings, and 20% of students create animation-based props.

As we can see from the data that from the beginning of the introduction of ICT Application in elementary school mathematics for elementary school, 73.91% of students preferred arithmetic operation after knowing *Microsoft Excel* function. 40% of them like arithmetic operation but students could relate 42.8% geometry like shapes and solids and 28.57% development of arithmetic concepts like fraction, exponents, and roots. There were also found the gain of creativity of their creation that initially 8.69% and 60.86% of students still depending on example picture and the making of VBA for Excel means 39.14% still depending on the example of *VBA for Excel*. After the learning, 31.43% of students could create new ideas and made their creation without the following the example, and 20% of students made their interactive animation.

From the creation of making learning media between students with open-ended learning with ICT Application based (experiment class) and the one used ICT application only, it can be obtained that the creativity of students in making learning media shown as Table 1.

Table 1. Homogeneity Test and t-test Experimental and control classes

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	T	Df	Sig. (2- tailed)	Mean Differ ence	Std. Error Diffe rence	95% Confidence Interval of the Difference Lower Upper	
Score	Equal variances assumed	.211	.647	3.941	60	.000	6.046	1.534	2.977	9.115
	Equal variances not assumed			3.917	57.14 3	.000	6.046	1.544	2.955	9.137

From the result of homogeneity test, it can be obtained the value of sig Levene's Test 0,647 greater than 0.05 which means the two homogenous data continue with the difference of two averages is using t-test and obtained the value of sig. 0,000 (2-tail) and $\frac{0,000}{2} = 0,000$ (1-tail) are less than 0.05 which means the creation of experiment class in making learning media is better than control class.

The implementation of making learning media with Visual Basic Application for Excel aims for students so that they have prerequisites to develop simple props. Students firstly must understand about numbers such as natural numbers, odd numbers, even numbers and prime numbers (Bernard & Rohaeti, 2016). After that, students are given the basic knowledge of making a simple calculator. Some of learning media made by the group of students can be described in Figure 1.

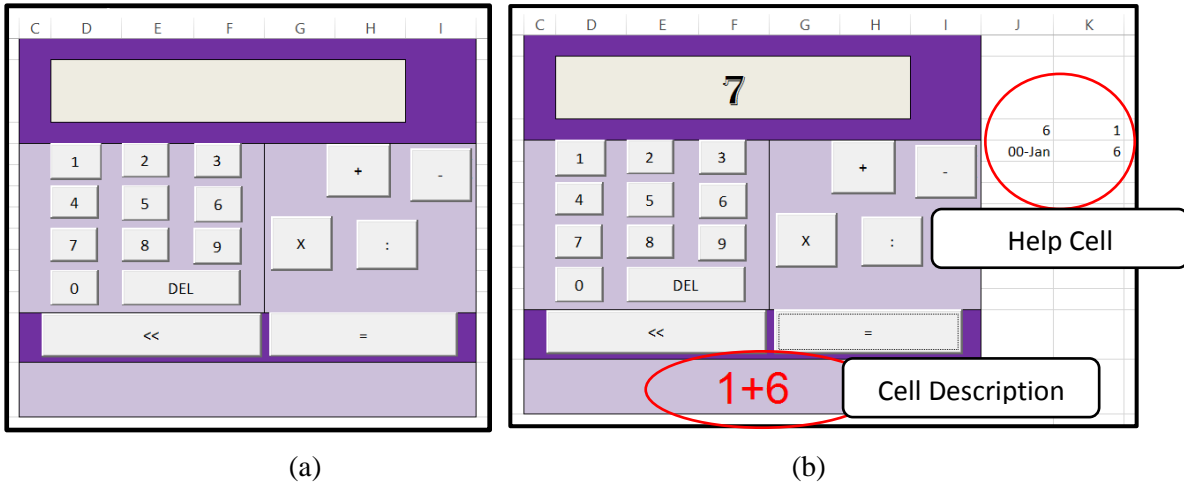


Figure 1. The making of simple calculator using *Command Button* (a) and the result of calculator (b)

The student aided by cells J3 and J5 in calculator making process using *Visual Basic Application for Excel*. The reason behind this is to avoid the errors at subtraction operation. When students put the number of 9-6 in cells, it was detected as a date that shows “6 September,” so that the label in the description box should be cleared in format to be set as a general format. However, the primary result showed no error. There could also be described that the students thinking process can be depicted in Figure 2.

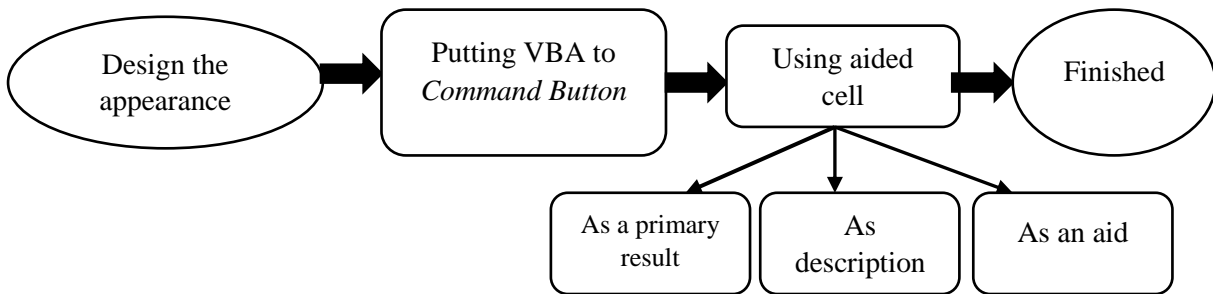


Figure 2. The steps of the first group’s thinking process

The second group of students made the calculator using shapes form the “INSERT” menu. Students put their ideas to design VBA for Excel using *Shapes* or picture to *Microsoft Excel* for Arithmetical operation games. The result can be seen in Figure 3.

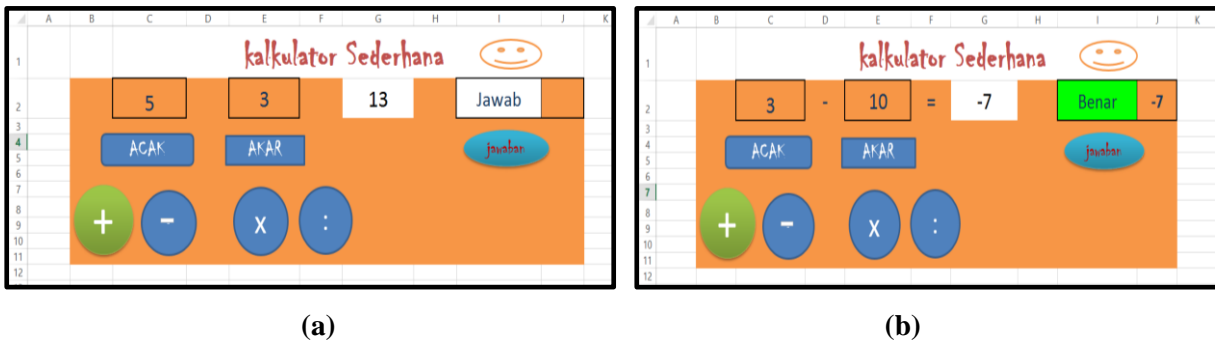


Figure 3. The making of calculator using *Shapes* (a) and showing the result of the second student (b)

The calculator made by the second students' group is different with connecting VBA for Excel through *Macro* tool, but still, they used *DEVELOPER* tab menu. The way of connecting between *shapes* and VBA for Excel is to use *Assign Macro*. There were some flaws found in the second group's calculator that is the random button function was still not function properly as it was not correctly integrated to Randomize function. Consequently, when the random button was pressed, the numbers the number back into initial number repeatedly. The second weakness came when random button clicked the answer was not cleared from the cell. But the strength of this calculator was the interaction when students answer correctly or incorrectly. The second students' group thinking process can be depicted in Figure 4.

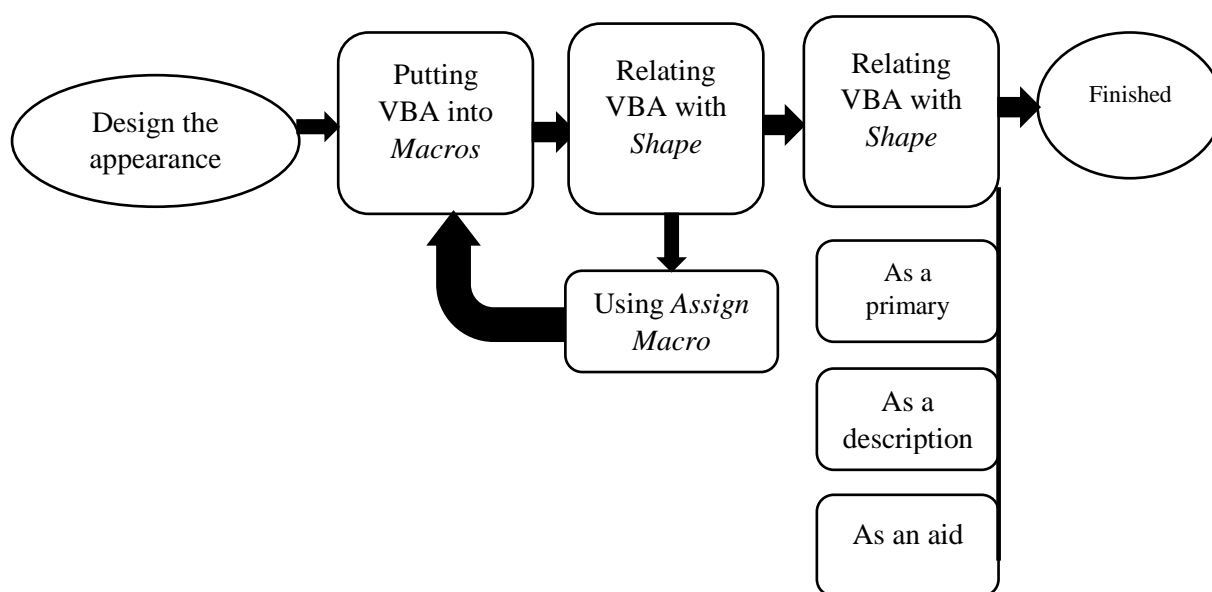


Figure 4. The steps of the second group's thinking process

The third group made a calculator using the relation of two positive numbers multiplication size with *Shape* as the area. The question from the third student was about how the result of the product determined interactively by a picture. Then, the third student made a design for the media and related it to VBA for Excel. The result of the third student can be seen in Figure 5.



Figure 5. Making a command and to be commanded using *Shapes* (a) and the result of interactive *Shapes* using VBA for Excel (b)

The third student calculator tried to make the command button to give a command for being commanded button with putting the name in the first place in the *shapes* using *Selection Pane* from HOME menu and select. There is a command that relates the name to *Visual Basic Application for Microsoft Excel*. The weakness of this calculator was seen when the shape size was not changing if the value entered to the input cell. The third student’s creative thinking process can be seen in Figure 6.

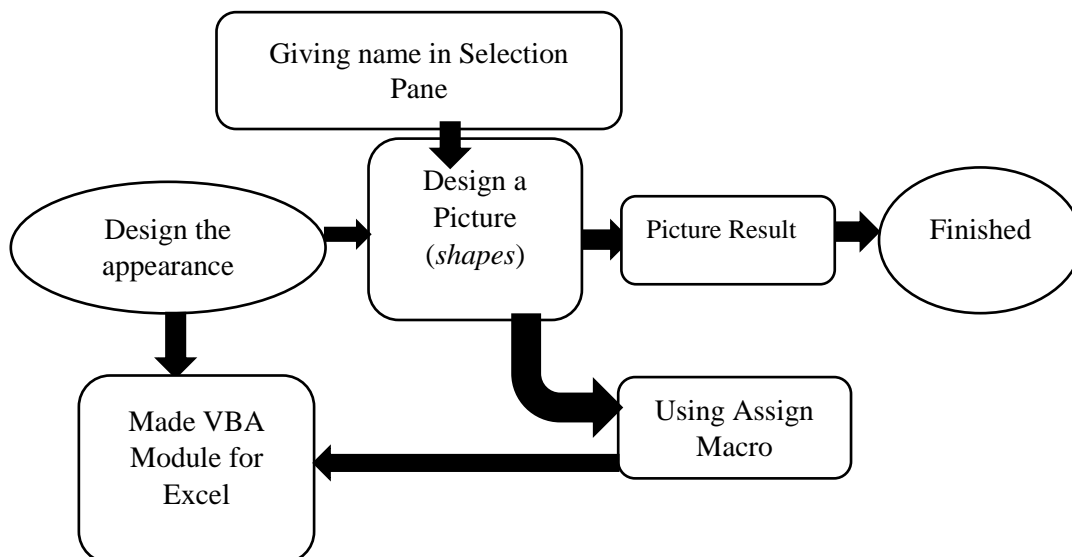


Figure 6. The steps of the third group’s thinking process

The fourth students’ group made a learning media using *jarimatika* (fingers of arithmetic) that can be described in Figure 7.

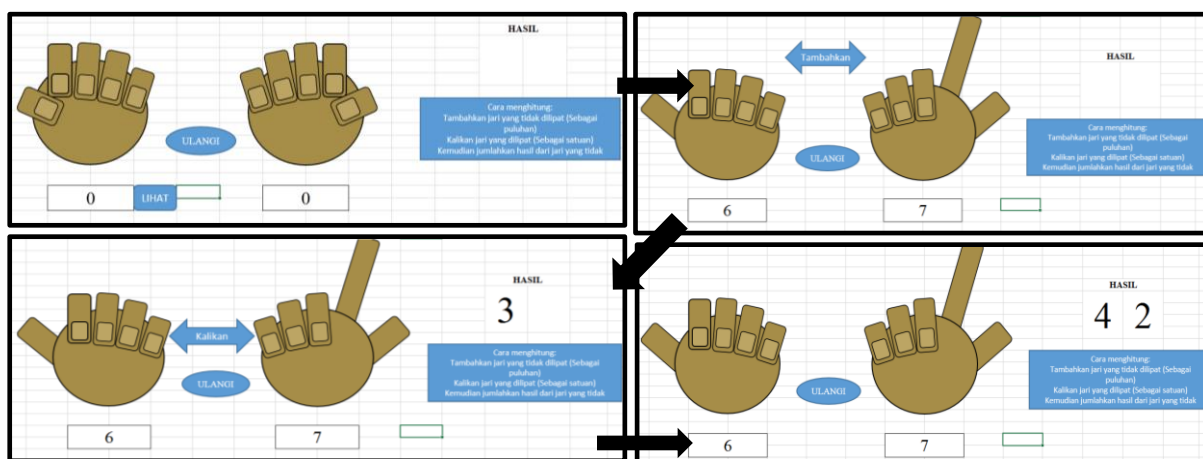


Figure 7. Students creative results of making *Jarimatika* props

The making of *jarimatika* props by the students are made to make multiplication easier that illustrated by fingers used in both two hands and are useful especially for second-grader students where the utilization of picture media in *Microsoft Excel* as a prop to master the multiplication. The sixth group of students used *Wayang Golek* (traditional puppet) Game to operate addition and subtraction of integers. The steps of making this *Wayang Golek Games Excel* (WAGGE) started by giving addition or subtraction sign of integers. Students were asked to click “-” sign. The second step is to press “2” button. The third step is

to click “+” sign. The fourth step is to click “4.” The fifth step is to look at the result on the black box. Student answered by typing numbers in *Microsoft Excel* cell. Then student choose one of the four *Wayang* that they like while seeing the name of *Wayang* in the box (Figure 8).

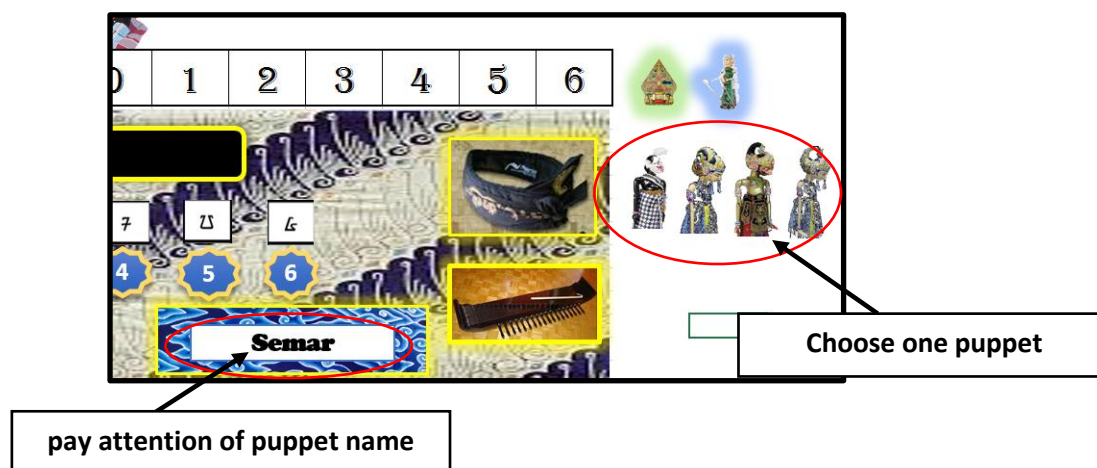


Figure 8. The preview of *Wayang Golek Games Excel* learning media

And then they started the game with the rules 1) when the number is positive, the *wayang* would face right side, if negative, the *wayang* turned to the left side. If it comes to addition, the *wayang* would move forward, and it would move backward if it is subtracted. The process is done the image that determines the answer was correct or incorrect appeared. It is shown in Figure 9.

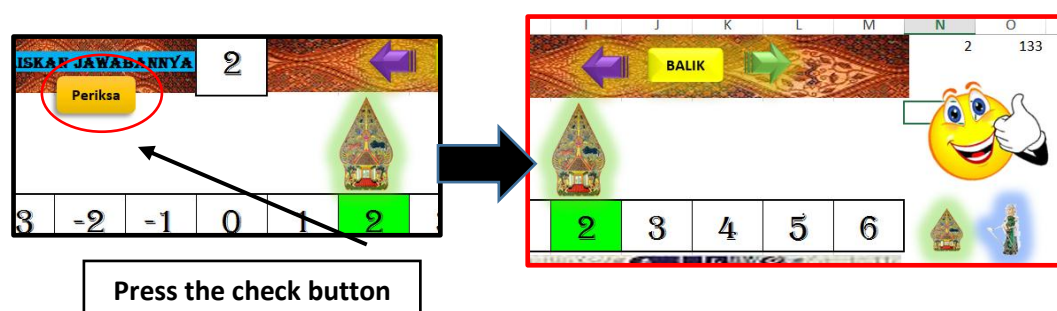


Figure 9. The final page of WAGGE

From the analysis result towards the learning media created by the group of students, there are various ways to produce the application results understanding of mathematical material into *Microsoft Excel* with the aid of *Visual Basic for Excel* to be a usable prop for students in school. The combination of students’ mastery towards school mathematics and the ability to make a learning media with the aid of *Visual Basic Application for Excel* is a good creative thinking process. The creative thinking is a process to make something involving elements and experiences that currently exist to be processed in the brain to create brand new things (Bernard & Rohaeti, 2016; Fatah, et al., 2016; Hendriana, et al., 2017; Kadir, et al., 2017; Rohaeti, et al., 2014; Siswono, 2010; Sumarmo, et al., 2018).

Coleman & Hammen (1990) that stated that the supporting factors of one's thinking ability besides ones' cognitive are the open attitude towards the internal and external stimulus, free attitude in thinking and expressing, the independent thinking that has no bound towards authority and existing social convention and most importantly is the believe of oneself.

CONCLUSION

The creativity of students using interactive learning media using open-ended learning with Visual Basic Application for Excel based is better than the one using expository Visual Basic Application for Excel based. Furthermore, the creativity of students in creating learning media is a combination of their school mathematical mastery and their creativity in applying Visual Basic Application for Excel.

REFERENCES

- Bernard, M., & Rohaeti, E. E. (2016). Meningkatkan Kemampuan Penalaran dan Disposisi Matematik Siswa Melalui Pembelajaran Kontekstual Berbantuan Game Adobe Flash CS 4.0 (STL-GAF). *Edusentris*, 3(1), 85-94.
- Chotimah, S., Bernard, M., & Wulandari, S. M. (2018). Contextual approach using VBA learning media to improve students' mathematical displacement and disposition ability. *Journal of Physics: Conference Series*, 948(1), 012025.
- Coleman, J. J. C., & Hammen, C. L. (1960). *Contemporary psychology and effective behavior*. Scott Foresman.
- Depdikbud (2013). Kurikulum Sekolah Menengah tahun 2013. Jakarta: Depdikbud
- Fatah, A., Suryadi, D., Sabandar, J., & Turmudi, T. (2016). Open-ended approach: an effort in cultivating students' mathematical creative thinking ability and self-esteem in mathematics. *Journal on Mathematics Education*, 7(1), 9-18.
- Happy, N., & Widjajanti, D. B. (2014). Keefektifan PBL ditinjau dari kemampuan berpikir kritis dan kreatif matematis, serta self-esteem siswa SMP. *Jurnal Riset Pendidikan Matematika*, 1(1), 48-57.
- Hendriana, H., Rohaeti, E. E., & Hidayat, W. (2017). Metaphorical Thinking Learning and Junior High School Teachers' Mathematical Questioning Ability. *Journal on Mathematics Education*, 8(1), 55-64.
- Kadir, K., Lucyana, L., & Satriawati, G. (2017). The implementation of open-inquiry approach to improve students' learning activities, responses, and mathematical creative thinking skills. *Journal on Mathematics Education*, 8(1), 103-114.
- Rohaeti, E. E., Budiyanto, A. M., & Sumarmo, U. (2014). Enhancing students' mathematical logical thinking ability and self-regulated learning through problem-based learning. *International Journal of Education*, 8(1), 54-63.
- Silver, E. A., & Cai, J. (1996). An analysis of arithmetic problem posing by middle school students. *Journal for Research in Mathematics Education*, 27(5), 521-539.

- Shahrill, M., Putri, R. I. I., Zulkardi, & Prahmana, R. C. I. (2018). Processes involved in solving mathematical problems. *AIP Conference Proceedings*, 1952(1), 020019.
- Siswono, T. Y. E. (2010). Leveling students' creative thinking in solving and posing mathematical problem. *Journal on Mathematics Education*, 1(1), 17-40.
- Sumarmo, U., Hidayat, W., Zukarnaen, R., Hamidah, M., & Sariningsih, R. (2012). Kemampuan dan disposisi berpikir logis, kritis, dan kreatif matematik (eksperimen terhadap siswa sma menggunakan pembelajaran berbasis masalah dan strategi think-talk-write). *Jurnal Pengajaran MIPA*, 17(1), 17-33.
- Sumarmo, U., Kusnadi, A., & Maya, R. (2018). Mathematical critical thinking ability and disposition (Experiment with vocational high school students using scientific approach). *Journal of Educational Experts (JEE)*, 1(2).
- Tim MKPBM. (2001). *Strategi Pembelajaran Matematika Kontemporer*. UPI: JICA.