Development of high school student work sheets using VBA for microsoft word trigonometry materials

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Abstract. The research was aimed to show that developing a learning media impacted to improve students ability in mathematical learning. The process implemented the application of VBA for microsoft word in mathematical learning. The formulation of the problem in this research are whether 1) can developing media assisted VBA for microsoft word improve mathematical ability? 2) Did Students show positive response in learning process? ADDIE was used as approach in this research. There are five stages in ADDIE approach. Population of this research was in group with 34 samples of vocational students. The instruments are cognitive test, interview and observation. Based on the results of the process, there was an increasing in mathematical ability of vocational students in trigonometry lesson through media VBA for microsoft word. The implementation of learning process through media VBA for microsoft word was success. Students enjoyed the process, active, responsive, and enthusiastic. The conclusions are the developing of media VBA for microsoft word can improve mathematical ability of vocational students before and after using media, and students showed positive response to learn by media in trigonometry.

1. Introduction
Learning Mathematics in secondary schools is always a burden for students. Moreover, faced with material relating to geometry and trigonometry. For high school or vocational school students, trigonometry is new material. Students discover new knowledge and require great effort to understand it. Of the 150 students who were given the questionnaire, 87% said trigonometry was one of the material that was felt to be heavy and frightening. Kariadinata [1] suggests that trigonometry is a branch of mathematics that deals with triangular angles and trigonometric functions. The importance of trigonometry is studied contained in the basic competencies of students who must be mastered. Mastery of trigonometric material is related to the level of thinking of students. For this reason, it is necessary to design constructivist learning processes. Semadiartha [2] says that Van Hiele Theory is a theory that is related to the level of thinking of a person, namely from the level of simple thinking to the level of complex thinking. The level of thinking includes intuitive phenomenological, which is the simplest, locally descriptive level of thinking, which concludes the intuitive thinking process, and subject matter systematics, namely the formal thinking process to find out certain events or phenomena. Van Hiele's theory is a reference in this trigonometric learning process. This constructional learning is expected to be able to support students' mathematical abilities in trigonometry [3].

In accordance with the principles of constructivism, student worksheets (LKS) are prepared with VBA media assisted learning for Microsoft Word. LKS will guide students in the stages of thinking until students understand the trigonometry concept well [4]. According to Sadiman [5], learning media
is everything that can be used to stimulate students' thoughts, feelings, interests and concerns so that the learning process occurs well. Learning media plays a role in presenting information clearly [6]. So as to direct students to increase their attention to the material provided by the teacher. Learning becomes effective, independent and quality. To support the learning process, Stenberg's triarchic theory [7] suggests that children learn well when done with varied learning methods, full of creativity and emphasizing practical ability. Papalia and Ruth [7] also explain that children can think logically about what was previously known. Then it becomes a provision to understand the next mathematical concept. For this reason VBA media for Microsoft Word is used as a simple medium which is an alternative learning to attract students' attention and not boring [8]. This media before being used through the process of testing the level of validation by media experts and material experts so that the quality can be accounted for. In its implementation, students are guided by LKS. So that students get a maximum understanding of this trigonometry concept. Thus the development of VBA media for Microsoft Word can improve students' mathematical abilities in trigonometry material.

2. Methods
The research method used is the ADDIE method, with 5 stages [9,10] namely Analysis, Design, Development, Implementation, and Evaluation. 1) The analysis phase, namely curriculum, material analysis, and the difficulty of students spelling trigonometry questions, 2) Design stage is designing trigonometry media by using flowcharts based on the needs of teachers and students, 3) Development, making media worksheets assessed by expert validators media, material experts, and user ratings, namely teachers. 4) Implementation phase, namely the student worksheet media is tested by high school students, then provides an assessment and input in the form of an interview. 5) Evaluation Phase is to develop and improve media based on input from teacher and student users.

Data collection is in the form of qualitative research, namely 1) assessment questionnaire and input from media experts, material experts and teacher users. 2) interviews with students in one of the high schools in cimahi in the form of responses from students about the media.

Evaluation of media criteria as a result of responses from media experts and material experts in the form of questionnaires on each variable, namely value 1 states very less, value 2 states less, value 3 states well, and value 4 states very well. The valuation tool uses the formula below.

\[ P = \frac{s}{N} \times 100\%; \quad NA = \frac{\sum P}{N} \]

Where
P: Percentage of each variable
s: Score for each variable
N: Value of maximum score
NA: Final score

In table 1 the criteria for final score validation (NA) are given by media experts and material experts on media [11] worksheets assisted by VBA students for Word.

| Percentage | Validation Level | Interpretation                  |
|------------|------------------|---------------------------------|
| 76 - 100   | Valid            | Worth / need not be revised     |
| 50 - 75    | Valid Enough     | Fair enough / partial revision  |
| 26 - 50    | Less Valid       | Less feasible / partial revision|
| < 26       | Invalid          | Not feasible / total revision   |

In the final table validation criteria (NA) criteria table is given by the high school user or teacher in the field of mathematics on the student worksheet media.
Table 2. User Validation (Teacher)

| Percentage of validity level | Description                     |
|-----------------------------|---------------------------------|
| 76 - 100                    | Practical                        |
| 50 - 75                     | Practical Enough                 |
| 26-50                       | Less Practical                   |
| <26                         | not Practical                    |

3. Results and Discussion

3.1. Research result
The results of the research on developing students 'worksheets on trigonometry material, obtained from media experts' assessment was 88% [12], he said that the media was valid and feasible to be implemented for high school students, to see media expert ratings shown in table 3 based on VBA for Word media indicators on questionnaire.

Table 3. Questionnaire Criteria for Assessing Media Expert

| NO | Indicators                                                                 | Numbers of Item | Value | Percentage |
|----|-----------------------------------------------------------------------------|-----------------|-------|------------|
| 1  | Display of image design                                                     | 10              | 35    | 87.5%      |
| 2  | The way each object / image works is associated with the VBA for Word function | 10              | 36    | 90%        |
| 3  | The concept of how the program works                                       | 10              | 37    | 92.5%      |
| 4  | The process of solving trigonometry with images.                           | 10              | 35    | 87.5%      |
| 5  | How to fill students on media in Microsoft Word                            | 10              | 33    | 82.5%      |
|    | Average                                                                     |                 |       | 88%        |

While for the questionnaire assessment for material experts on the media worksheets students using VBA for Word is 92.5% [13], meaning that the media is included valid and worthy of being tested on high school students to be used when learning trigonometry material takes place. Table 4 shows the results of material experts’ assessment of the media.

Table 4. Criteria for Rating Media Experts

| NO | Indicators                                                                 | Numbers of Item | Value | Percentage |
|----|-----------------------------------------------------------------------------|-----------------|-------|------------|
| 1  | Submission of definition of Trigonometry                                     | 10              | 38    | 95%        |
| 2  | Proof of formulas with figure                                               | 10              | 37    | 92.5%      |
| 3  | The accuracy of the steps uses the rules of the trigonometric formula        | 10              | 36    | 90%        |
| 4  | Student writing placement on media student worksheets in Microsoft Word.    | 10              | 37    | 92.5%      |
|    | Average                                                                     |                 |       | 92.5%      |

The validation results from media and material experts are valid, before being tested to students in the classroom, the media is given to users, namely a high school math teacher to perform media practicality tests on student worksheets using VBA for Word. The results of teacher assessment are shown in table 5.

Table 5. Criteria of Rating Media Experts

| NO | Indicators                                                                 | Numbers of Item | Value | Percentage |
|----|-----------------------------------------------------------------------------|-----------------|-------|------------|
| 1  | Conformity with curriculum objectives                                       | 10              | 36    | 90%        |
| 2  | Achievement of material delivered to students                               | 8               | 32    | 93.75%     |
| 3  | Conformity with students' thinking processes.                               | 10              | 37    | 92.50%     |
| 4  | How to overcome student difficulties in trigonometry material.              | 9               | 34    | 94.44%     |
|    | Average                                                                     |                 |       | 92.5%      |
In Table 5 the validation assessment by the user with a percentage average value of 92.5% [14] means that the student worksheet media using VBA for word is practically used in classroom learning.

3.2. Discussion

3.2.1. Analysis Phase
At the analysis stage, the researcher collected some data related to high school subjects, namely trigonometry class X material that was in accordance with the 2013 curriculum objectives, in addition to collecting data on student difficulties from student assignments and student test results and analysis of student difficulties. In Figure 1 found the factors of student difficulties when working on trigonometry problems.

![Figure 1. Errors of students' tracing angles](image)

Figure 1, explains that students do not understand how to determine the results of trigonometric functions with angles above 360°. things that need to be mastered by students are 1) students master the rules of trigonometric functions related to the concept of right triangle 2) students master simple special angles and the results of using trigonometry related to phytagoras theorems, 3) students are able to develop basic formulas such as how to find trigonometric identity formulas, 4) students have good ability to provide appropriate reasons for solving new problems. This becomes one of the initial keys to create a media worksheet for students so that students are able to understand the basic concepts

3.2.2. Design Stage

![Figure 2. Flowchart of Learning Media Development](image)
The researcher plans to create a medium for high school students' worksheets, based on student difficulties. This plan is designed by using a flowchart so that it can map learning strategies using VBA for Word media so that goals can be achieved, namely students are able to understand and master the basic concepts of trigonometry.

Figure 2, explains the manufacturing process from the analysis to the results of the media that are implemented, from the above process it can provide a very large positive impact for teachers and students through learning media worksheets assisted by VBA students for Word. In addition, other objectives for designing the media are 1) providing student learning motivation to understand and master trigonometry based on mastery of students 'initial prerequisites that are interrelated by using interactive and fun images in Microsoft Word, 2) Increasing students' interest in learning trigonometry more from the information obtained from the media sheet work on VBA assisted students for Word.

3.2.3. Development Phase

After making media worksheets for VBA-assisted students for Word, in addition to validation assessments from media experts, material experts, and users, inputs or responses from them are needed so that the learning media is better seen in table 6.

Table 6. Responses of Media Experts, Material Experts, Media User

| Response          | Description                                                                 |
|-------------------|-----------------------------------------------------------------------------|
| Media Experts     | The part that needs to be considered is the image content that is really related to trigonometric material. |
| Material Experts  | Explanation of steps for trigonometric problem solving can be easily understood by high school students |
| Media User        | The media provides a clear picture so students can follow the storyline.      |

Table 6 is an explanation of the responses of experts, material, and users as considerations for creating media that focus on students' abilities from simple forms namely pembatan initial trigonometry, understanding trigonometric definitions to prove the value of special angles using right triangles as the basic concept trigonometry.

Figure 3. Mastery of Basic Concept

Figure 3, explains the media creation from the results of media design that relates the basic concepts of trigonometry to the basic knowledge of right triangle and Pythagoras theorem [15].
Students are given a response in the form of images that trigonometry is not a new concept of mathematics but is a basic development of right triangles. During this time, many students assume that trigonometry is a mathematical material that is classified as difficult. Therefore, the importance of VBA media for Word provides an interesting and not scary, and makes classroom learning more interactive [16–18]. After implementing the media, several responses from high school students were more interested in using trigonometric media assisted by VBA for Word, based on interviews with 4 students as representatives of 36 students.

Table 7. Student Responses of Media Basic Concept

| Student | Response |
|---------|----------|
| S-1     | I became more understanding of trigonometry now when using VBA for Word media. |
| S-2     | Learning trigonometry was not too difficult as I imagined I was using media. |
| S-3     | The picture is more interactive and interesting |
| S-4     | The need for VBA for Word media to solve difficult mathematical problems. |

Table 7, students already understand the basic concepts, the results of trigonometry values of degrees or radians using right triangles. From the media, students try to pay attention to the image of right triangle from degrees 30°, 45°, and 60°. Students will type the results on the worksheet in the form of steps so that students make a conclusion from the findings they did.

![Figure 4](image-url)

Figure 4. Designing and Making Media Get to Know the Quadrant

Figure 4, explains how to design and create media using VBA for Word, students analyze each angle has 4 quadrants, this media aims to direct students to always explore from various examples of different angles, then students collect data to classify or classify to each quadrant after that, they
concluded. So that students have good abilities about the quadrant. Next, they are given a picture of angles larger than 360° and they complete themselves from the concept of the image.

Furthermore, from Figure 3, it can also explain how to prove and develop identity formulas of right triangles related to the phytagoras theorem, so students do not find it strange when looking at trigonometric identity formulas that develop towards the rules of sine and cosine rules.

Students can understand about sinu and cosine rule formulas, if they are able to identify questions and drawings first before completing the process or stage of completion so that students do not experience confusion in making decisions when using formulas.

Figure 5. Student Difficulties About Comparison of Sinus

Figure 5, explains the location of the student's error in identifying the problem whether the formula used is the sine rule or cosine rule, consequently students only write the formula but cannot understand its usefulness. Looks students want to try to get the final answer but the results do not provide the right reasons.

Figure 6. Develop a sinus comparison worksheet
Figure 7, explains the development of making media based on students' thinking processes, where students will try the truth of their own results, the aim is to provide students the ability to understand that cosine rules formulas are from triangular concepts, and students are able to conclude the use of cosine rules based on identification of findings from size elements in Microsoft Word images with Visual Basic Application help.

3.2.4. Stage of Implementation and Evaluation

Students test media worksheets assisted by VBA for word, students are given training in Microsoft Word, in addition to recording in student books also make the stages of learning by typing in Microsoft Word that has been made for the answer, this is so that students pour more ideas his thoughts into writing in Microsoft Word.

After students learn and practice the media during the last meeting of the whole learning, students are asked to respond to the media worksheets of VBA-assisted students for Word through interviews with 4 students in table 8.

| Question                                                                 | Response                                                                 |
|-------------------------------------------------------------------------|--------------------------------------------------------------------------|
| Was the media very helpful for solving problems?                         | a. Very helpful                                                          |
|                                                                        | b. Very helpful in proof                                                  |
|                                                                        | c. Very helpful, but need additional trigonometry game applications.     |
|                                                                        | d. Very helpful, but the picture must be more interesting.               |
| What do you think about the media?                                      | a. The media adds knowledge about trigonometry.                          |
|                                                                        | b. The learning media is very good and interesting, when using Microsoft Word. |
|                                                                        | c. Very impressed with using media can be interactive in Microsoft Word.|
|                                                                        | d. Trigonometry learning is easy to understand.                         |
| What’s the weakness of the media                                        | a. Students' answer sheets when they are raised don't be too empty given a few interesting shapes. |
|                                                                        | b. Provides a description of the steps when pressing the process button. |
|                                                                        | c. Picture frames of student worksheets in Microsoft Word were enhanced. |
|                                                                        | d. There are no trigonometry games yet                                   |

Table 8 is input from 4 students as representatives of all high school students as a form of their support in the quality of media making worksheets for VBA assisted students for Word.

4. Conclusion

Based on the research above, that students worksheet media which assisted VBA for Microsoft Word in Trigonometry materials can implementate to 10th grade students in high school. It can be looked from rating of media experts, material experts, and media users, that showed 88 %, 92.5%, and 92.5%. There were positive responses from students from beginning until end in learning. Some feedback about the media are more interesting content by pictures, interactive and students are very easy to understand.

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