Geometry in flipbook multimedia, a role of technology to improve mathematics learning quality: the case in madiun, east java

S Andini¹, L Fitriana¹, Budiyono ¹

¹Mathematics Education Department of Graduate Program, Sebelas Maret University, Surakarta, Indonesia

E-mail: andini08@yahoo.com

Abstract. Abstract. This research is aimed to describe the process and to get product development of learning material using flipbook. The learning material is developed in geometry, especially quadrilateral. This research belongs to Research and Development (R&D). The procedure includes the steps of Budiyono Model such as conducting preliminary research, planning and developing a theoretical and prototype product, and determining product quality (validity, practicality, and effectiveness). The average assessment result of the theoretical product by the experts gets 4,54, while validity result of prototype product by the experts is 4,62. Practicability is obtained by the implementation of flipbook prototype in each meeting of limited-scale try out based on learning observation, with the average score of 4,10 and increasing of 4,50 in wide-scale try out. The effectiveness of the prototype product is obtained by the result from pretest and posttest on a limited-scale and a wide-scale try out. The limited-scale pre-test result showed a significant increase in average score of wide-scale pre-test of 25,2, and there is an increase in the average score of posttest on limited-scale try out and wide-scale try out is 8,16. The result of product quality can be concluded that flipbook media can be used in the geometry learning in elementary school which implemented curriculum 2013.

1. Introduction
Geometry is an important branch of mathematics and it has been identified as a basic mathematical skill [8, 9, 17]. Geometry is important for students as it is also applied in other branches of mathematics [1]. Geometry is also seen as one of the most important topics in mathematics [13, 14, 18]. The tendency in the study of geometry can enhance the ability to solve mathematics problems. Many people enjoy the challenge of solving riddles and other types of puzzles, studied geometry offers similar intriguing challenges [11]. But, many studies [3, 15, 16, 21, 22, 26] have shown that students have difficulties in learning geometry, and in thinking geometrically. Moreover, although geometry has been introduced since the beginning age of school. However, some students still assume that learning geometry is something difficult. Most researchers focus on the geometrical curricula of secondary school; however, discovering the implications of the van Hiele theory for elementary school students is also very important. Thus, the focus of this study is at the elementary level [10].
The result of field research shows that the average thinking level of elementary school students is still on the lowest level. Almost all students have not been able yet to apply geometry learning skills comprehensively which consist of visual, verbal, drawing, logic, and application skill. It causes low ability in a problem-solving. The observation result of quadrilateral plane geometry learning process in grade 6th shows there is no interesting prop and media for supporting student’s learning activity. Questionnaire result of need assessment gives data that respondents state that they are interested towards audiovisual learning media (graphic and animation), video, also the facilitation in applying mathematics learning.

The multimedia which will be used must unite among the participant, learning material given, also the way in solving student’s boredom [19, 27]. Research on technology integration in education has demonstrated that using computers in the classroom benefits students learning in mathematics [12, 25]. Given the importance of mathematics, geometry, and spatial thinking on educational success, it is important to find better ways to teach them. There is ample evidence that real and virtual manipulatives can help elementary school children learn mathematics better [5]. Yet computers are still rarely used in the classroom to teach mathematics even in so-called developed countries, such as the USA [7].

Based on previous researches and the result of field research about the application of technology in mathematics, that the right multimedia development can improve the quality of learning mathematics. Flipbook (e-book) multimedia which has characteristic hypermedia has more interesting features than a printed book. Based on the literature study, flipbook learning media can raise student’s geometry learning interest [2]. Geometry material in flipbook multimedia has been constructed, and students are able to reach an informal deductive level and have geometry basic skill [23, 24]. Determining flipbook multimedia quality is based on quality criteria of development study result. We have been referring to the quality of educational products from the perspective of developing learning materials. However, we consider the three quality aspects (validity, practicality, and effectiveness) and also to be applicable to a much wider array of the educational product [20,19].

2. Methods
This research uses research and development method. This research modifies the Budiyono model of research and development [3]. Education research and development is a process that is used to improve and validate an education product such as teaching-learning model, instrument, textbook, module, and media [4]. Thus, the aim of this research is to develop a flipbook in the quadrilateral plane which is valid, practical, and effective. The media validity is assessed by the experts, they are the material substantial expert, learning and curriculum expert, also the multimedia expert. That expert’s validation is done in the early of design development (theoretical product) until prototype media construction. Assessment consideration and theoretical product validation refers to 1) material substantial, 2) Van Hiele theory characteristic analysis with material substance, 3) substantial discrepancy between the product and learning material of Curriculum 2013-Book of Integrative Thematic, 4) media display design, 5) exercise questions, and 6) evaluation in the form of test question. After theoretical product gets experts’ advice and revision, prototype media construction can be done soon. During this phase, the experts also give assessment and suggestion in order to make the media more perfect and be ready to use.

Practicability assessment and media effectiveness can be seen from the limited scale try out result and wide-scale try out. Media practicability level is measured through a questionnaire, interview, and observation paper of learning activity, while media effectiveness uses pre-post test design.

The limited-scale try out involves sample with 1 school from 13 elementary schools population which implement curriculum 2013. The sample is chosen by simple random sampling. For sample election result, it gets a school with 28 students. This try out is done by applying flipbook as learning media with the same teacher for four times meeting. Each meeting consists of 3 x 35 minutes. Pre-test and post-test instruments consist of 6 essay questions. Interview activity is done for the teacher and 6 students who have high, medium, and low academic level. Practicability questionnaire instrument in 5
scales is only given to the teacher, while observation activity in the classroom is done by other teacher and the researcher. Practicability experiment observer gives notes and suggestions for completing material of flipbook multimedia.

The wide-scale try out is done with the same technique as in limited-scale try out. This try out involves samples from two elementary schools outside limited scale try out samples. The number of respondent in interview activity is 12 students in high, medium, and low ability.

3. Result and Discussion

3.1 Validity of Flipbook Multimedia

The expert’s validation for a theoretical product is conducted by the scale of Likert (1-4) with interval score and category are shown in Table 1.

| Interval Score | Scale | Category     |
|---------------|-------|--------------|
| X > 4.21      | 5     | Very good    |
| 3.40 < X ≤ 4.21 | 4 | Good         |
| 2.60 < X ≤ 3.40 | 3 | Good Enough  |
| 1.79 < X ≤ 2.60 | 2 | Less Good    |
| X ≤ 1.79      | 1     | Very Unfavourable |

Based on Table 1, a minimum score of the theoretical product is "good" results obtained from the assessment of experts. If the overall aspects of the obtained results are "good", then the theoretical product can be made into a product prototype. Theoretical product assessment result by the experts is shown in Table 2.

| Criteria          | Skala | Material Expert | Curriculum and Learning Expert | Multimedia Expert |
|-------------------|-------|-----------------|-------------------------------|-------------------|
|                   |       | Frequency       | The Total of Score            | Frequency         | The Total of Score |
| Very Good         | 5     | 38              | 190                           | 13                | 65               | 7                | 35               |
| Good              | 4     | 22              | 88                            | 7                 | 28               | 13               | 52               |
| Good Enough       | 3     | 0               | 0                             | 0                 | 0                | 0                | 0                |
| Less Good         | 2     | 0               | 0                             | 0                 | 0                | 0                | 0                |
| Very Unfavourable | 1     | 0               | 0                             | 0                 | 0                | 0                | 0                |
| The Amount of Frequency | 60 | 20 | 20 | 4.63 | 4.65 | 4.35 |
| Average Value     |       |                 |                               |                   |                  |                  |

Based on Table 2 above, it is stated by material experts that flipbook theoretical product gets an average assessment of 4.63 with criteria 68% belongs to extremely good and 32% belongs to good. The result of assessment average score from curriculum and learning experts is 4.65 with criteria 70% belongs to extremely good and 30% belongs to good, while validity result of multimedia experts state assessment average score is 4.35 with criteria 40% belongs to extremely good and 60% belongs to good. From all validity results, it can be concluded that flipbook theoretical product is proper to be developed as a prototype product.

As in the assessment of the theoretical product, the expert’s validation for prototype product is conducted by the scale of Likert with interval score and category are shown in Table 3.
Table 3. The Interval Score of Prototype Product Assessment

| Interval Score | Scale | Category          |
|----------------|-------|-------------------|
| X > 4.21       | 5     | Very good         |
| 3.40 < X ≤ 4.21| 4     | Good              |
| 2.60 < X ≤ 3.40| 3     | Good Enough       |
| 1.79 < X ≤ 2.60| 2     | Less Good         |
| X ≤ 1.79       | 1     | Very Unfavourable  |

Based on Table 3, a minimum score of prototype product is "good" results obtained from the assessment of experts. If the overall aspects of the obtained results are "good", then the prototype product can be applied to a limited-scale try out and a wide-scale try out. The result of prototype product by the expert is shown in Table 4.

Table 4. Prototype Assessment Results by The Experts

| Criteria          | Material Expert | Curriculum and Learning Expert | Multimedia Expert |
|-------------------|-----------------|-------------------------------|-------------------|
|                   | Frequency | The Total of Score | Frequency | The Total of Score | Frequency | The Total of Score |
| Very Good         | 5         | 40                 | 15       | 75                 | 9         | 45                 |
| Good              | 4         | 20                 | 5        | 20                 | 11        | 44                 |
| Good Enough       | 3         | 0                  | 0        | 0                  | 0         | 0                  |
| Less Good         | 2         | 0                  | 0        | 0                  | 0         | 0                  |
| Very Unfavourable | 1         | 0                  | 0        | 0                  | 0         | 0                  |

The Amount of Frequency | 60 | 20 | 20
Average Value           | 4.67 | 4.75 | 4.45

Based on Table 4 above, it is stated by material experts that flipbook prototype gets an average assessment of 4.67 with criteria 71% belongs to extremely good and 29% belongs to good. The result of average assessment score from the curriculum and learning experts is 4.65 with criteria 79% belongs to extremely good and 21% belongs to good, while validity result of multimedia experts state the assessment average score is 4.35 with criteria 51% belongs to extremely good and 49% belongs to good. From all validity results, it can be concluded that flipbook prototype is proper to use in the limited-scale try out and the wide-scale try out. The Figure 1 is a display of a flipbook multimedia have been validated.

Figure 1. The Display of Flipbook Multimedia
3.2 Effectiveness of Flipbook Multimedia

The achievement result of the average pre-post test on a limited-scale and a wide-scale try out is shown in Figure 2 below.

![Graph of Average Score of Pre-Post Test on Limited-scale and Wide-scale Try Out](image)

*Figure 2. Graph of Average Score of Pre-Post Test on Limited-scale and Wide-scale Try Out*

Six questions are given to students consist of polygon material, the properties of the quadrilateral, the relationship between quadrilateral, and quadrilateral problem solving involving measurement and calculation.

The results of limited-scale tryout pretest analysis found that the low tendency of the average score of students is influenced by several aspects, those are skills in solving problems, weaknesses in analyzing relationships between structures such as "is the rectangle a parallelogram?", and mention the types of quadrilateral that have the same properties.

The limited-scale post-test results showed a significant increase in average score of 24.74. In general, the students are able to solve the problem of determining the types of polygons (concave-convex, regular-and irregular). It shows that students' drawing skills are improving. Students can also identify the necessary mathematical properties of a quadrilateral, in which case students apply logical skills with good and correct language/verbal skill. Questions which are related to problem-solving and constructing a quadrilateral have been done in the right way.

Based on Figure 2, there is an increase in the average score of wide-scale test on the pre-post test is 7.7. In this pre-test, it is known that students have been able to draw polygons and/or it is not polygon correctly, students can also solve problem-solving problems and get the right results even though the verbal skills are still limited to simply write out the wide-formula of a quadrilateral. Most students are able to give a name the quadrilateral based on visualization, but they have not been able to identify the necessary mathematical properties of the quadrilateral. Viewed from the level of logic skills, most students are only able to express the similarities and differences of quadrilateral properties.

As in the limited-scale try out, students' ability to link information by developing geometric models tends to be low. The average post-test results in wide-scale try out show an increase in learning outcomes. Students do not experience obstacles when working on problem-solving problems with the writing of language and how to work properly, the ability to measure and calculate the area is also getting better. Students do not experience difficulty when identifying equations and differences in a square with rectangular views from angles, sides, and diagonals. Drawing skills and declaring the concept of the circumference of a quadrilateral is also increases. Results the average post-test on the wide-scale try out indicate improved learning result. Students are not hard working on problem-
solving. They can write with the precise language and in the right way. The ability to measure and calculate the area of also getting better. Students do not find it difficult to identify similarities and differences between a rectangular and a parallelogram in terms of square angle, side, and diagonal. The skills of drawing and stated the concept of the circumference of a quadrilateral is also increasing.

3.3 Practicality of Flipbook Multimedia

Table of Prototype Practicality Distribution on the Limited-scale Try Out and Wide-scale Try Out are shown in Table 5 below.

| Kriteria            | Skala | Limited-scale Try Out | Wide-scale Try Out |
|---------------------|-------|-----------------------|--------------------|
|                     |       | Frequency              | The Total of Score | Frequency              | The Total of Score           |
| Very Good           | 5     | 2                     | 10                 | 20                   | 100                         |
| Good                | 4     | 18                    | 72                 | 20                   | 80                          |
| Good Enough         | 3     | 0                     | 0                  | 0                    | 0                           |
| Less Good           | 2     | 0                     | 0                  | 0                    | 0                           |
| Very Unfavourable   | 1     | 0                     | 0                  | 0                    | 0                           |
| The Total of Frequency | 20   |                       | 40                 |                      |                             |
| Average Score       | 4,10  |                       | 4,50               |                      |                             |

Based on Table 5 above, it can be said that the observer gives a positive response to the prototype product with the average score of learning observation of 4.10 and increasing of 4.50. In this try out, the observer stated that the intensity of the use and attention of students to the prototype is very high so that the learning objectives are achieved optimally. From an interview with can find that, the teachers feel comfortable in using prototype product because the product is user-friendly, the buttons work well, and the supporting apps run seamlessly. In terms of material substance, the prototype has been developed based on van Hiele levels of geometry thinking, there are prerequisite materials that meet the element of adequacy, and do not have a dependence on other teaching materials.

4. Conclusion

Conclusions of this study are: 1) the result of field research shows that the average thinking level of elementary school students is still on the lowest level. Almost all students have not been able yet to apply geometry learning skills comprehensively which consist of visual, verbal, drawing, logic, and application skill, 2) the result of average assessment from the expert on the validation stage of theoretical and prototype product is good category, 3) effectiveness test on limited-scale try out and wide-scale try out show a significant improvement and students are able to reach an informal deductive level and have geometry basic skill, 4) the average score of the learning observation of practicality aspects is increasing.

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