



DEVELOPING FLIPBOOK MULTIMEDIA: THE ACHIEVEMENT OF INFORMAL DEDUCTIVE THINKING LEVEL

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Abstract

The geometry in flipbook multimedia can improve the necessary skills of the 6th graders, so that achieve the highest level of geometric thinking that is informal deductive. The flipbook which uses technology with flipping experience, animation, video, and music is different than the ordinary printed book. Also, it looks more exciting and interactive for students. The aim of this research measures flipbook effectiveness on limited-scale and wide-scale tryout, it is reviewed from Skill Gist Competence domain (KI-4) of Curriculum 2013 on geometry primary skill indicator, also examining flipbook efficacy if it is compared with the printed book which has been used before. The instrument used on a limited-scale tryout and wide-scale tryout is a rubric assessment of product-based and performance-based. However, the tool used on the efficacy test is an achievement test which consists of twenty questions of multiple choice. The test material in the achievement test is about quadrilateral and problem-solving. Based on statistic analysis result on the efficacy test, the research result shows that student's capability who uses flipbook is better than the student who doesn't, in learning geometry. Furthermore, the conclusion is that flipbook multimedia is more efficacy than before product.

Keywords: geometry, informal deductive, Van Hiele, curriculum 2013, flipbook.

Abstrak

Materi geometri yang dikemas dalam multimedia flipbook dapat meningkatkan keterampilan dasar siswa kelas 6 sehingga dapat mencapai tingkat berpikir geometri deduktif informal. Flipbook menggunakan teknologi dengan pengalaman seperti membuka buku, animasi, video, dan musik sehingga tampak berbeda jika dibandingkan buku cetak. Flipbook terlihat lebih menarik dan interaktif untuk siswa. Tujuan dari penelitian ini adalah mengukur tingkat efektivitas flipbook pada uji coba skala terbatas dan uji coba skala luas yang ditinjau dari Kompetensi Inti Keterampilan (KI-4) pada Kurikulum 2013 dengan indikator keterampilan dasar geometri, juga menentukan uji keampuhan flipbook apabila dibandingkan dengan buku cetak yang telah digunakan sebelumnya. Instrumen yang digunakan pada uji coba skala terbatas dan uji coba skala terbatas adalah rubrik penilaian berbasis produk dan rubrik penilaian berbasis kinerja. Instrumen yang digunakan pada uji keampuhan adalah tes prestasi belajar yang terdiri dari 20 butir soal pilihan ganda. Materi pada instrumen penelitian adalah tentang bangun datar segiempat dan pemecahan masalah. Berdasarkan analisis statistik pada uji keampuhan menunjukkan bahwa kemampuan siswa yang menggunakan *flipbook* lebih baik dibandingkan dengan siswa yang tidak menggunakan *flipbook* dalam pembelajaran geometri. Dengan demikian dapat disimpulkan bahwa multimedia *flipbook* lebih ampuh (unggul) dibandingkan dengan produk sebelumnya.

Kata kunci: geometri, deduktif informal, van hiele, kurikulum 2013, flipbook.

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Geometry is one kind of mathematics branch occupies the particular position in Mathematics curriculum with much material portion. Hsiu-Lan (2015) justified that the proportion of geometry in the mathematics curriculum has a larger portion of the material, because geometry is one of the most important topics in mathematics. It also happens in Indonesia; Jupri (2017) said the same thing that from elementary school to secondary school has more geometry material in the mathematics curriculum. The importance of geometry learning purpose is also stated in journals (Ahamad, et al. 2018; Rofii, Sunardi, & Irvan, 2018). Yildiz,

Aydin, and Kogce (2009) described the aim of the geometry is learning the properties of the geometrical shapes in plane and space, included finding the relations between plane and space, and describing the position of geometrical. The last phase is proving a geometrical argument. Even, Abdullah and Zakaria (2012) also confirmed that geometry is important in architecture and design, in engineering and most of all aspects of construction work. So it can be concluded that learning geometry is very useful for students. On the other hand, it is opposite with the fact condition of geometry learning nowadays. Sariyasa (2017) also stated that in traditional geometry learning, students just told by the teacher about the definitions and theorems, the problems and evidence; student also does not find the experience of geometric relation. Adolphus (2011) pointed out that one of the problems in learning geometry is students cannot solve problems even when examples are given, because students have less base on geometry skills. The other possibility related to the difficulty in geometry learning is caused by student's comprehension which is low. The deep conceptual understanding and visualization of geometry properties is the essential basic skill for students at the elementary school before to achieve the higher level (Abu, Ali, & Hock, 2012).

Crowley (1987) described that someone to learning geometry would pass five thinking geometry level based the van Hiele Theory. Erdogan and Durmus (2009) also justified that five geometry thinking level in van Hiele Theory is hierarchical, consecutive, and in phases has been adopted in some approaches and geometry learning model in some countries. The preliminary study that the most of 6th-graders students could only achieve the level of visualization (first level) which is about 69%, therefore based on the VHG Test criteria it is known that students have not reached Deductive Informal (Andini, Fitriana, and Budiyo, 2018; Prahmana, Zulkardi, & Hartono, 2012). The highest geometry thinking level achievement on elementary school is on the informal deductive level. Thus, a student needs to master the geometry basic skill which consists of visual, verbal, drawing, logic, and application aspect. Multimedia development which uses technology such as flipbook can help to improve student's geometry basic skill. It is because the printed book can not balance with flipbook's ability in integrating sound, graph, picture, animation, and movie presentation. Technology integration in education has demonstrated that using computers in the classroom benefits students learning in mathematics (Isiksal & Aşkar, 2005; Olkun, Altun, & Smith, 2005). However, often found that technology is not used as maximal as possible for improving Mathematic learning quality. Genlott and Gronlund (2016) stated that the number of computers and other relevant technologies increases in schools, but it is not balanced by the teacher's ability to use the new technology improving learning quality in mathematics.

The Geometry Thinking Levels (van Hiele's Theory)

Van Hiele Theory is developed by two educators from Dutch, Pierre Marie van Hiele and Dina van Hiele-Geldof. This theory explains the development level of student's thinking in learning geometry. Haviger and Vojkuvkova (2015) described the postulates of van Hiele Theory, a model of geometric thinking with three main attributes there are the existence of the level, the properties of the level, and the movement from one level to the next level.

Hsiu-lan (2015) explained that at the visualization level students learned geometry through visualization. A child studies the geometry based the plane forms. At this level, students identify and operate other geometric shapes and sections based on appearance. At the analytic level, a student may realize that a rhombus has all sides equal, the student also analyzes that the rectangle has the same diagonals, but they do not explicitly interrelate figures empirically, and use the properties to solve problems. On an informal deductive level, a student will understand why every square is a rectangle. At this level, properties are ordered, and are deduced one from another. The focus of this study was elementary school student and the first three van Hiele levels.

The Basic Skills of Geometry (Hoffer's Theory)

Hoffer (1981) stated that when a student must achieve an informal deductive thinking level, it means she/he must master geometry basic skills. Those basic skills are: 1) visual skill, including the ability to: recognize various plane and space figures; observe parts of a given figure and their interrelation; identify centres, axes, and planes of symmetry of given figure; classify given figures by their observable characteristic; deduce further information from visual observation; and visualize the geometric representation (models), or counter-examples, which are implied by given data in a given deductive mathematical system, 2) verbal skill, including the ability to: identify various figures by name; visualize figures from verbal description of them; describe given figures and their properties; formulate proper definition of the words used; describe relationships among given figures, recognize the logical structure of verbal problems; and formulate statements of generalization and of abstractions, 3) drawing skill, including the ability to: sketch given figure and label specified points; sketch figure from their verbal descriptions; draw or construct figure with properties; construct figures having a specified relation to given figures, sketch plane sec auxiliary element to figures; and sketch of construct geometric models or counter-examples, 4) logical skill, including the ability to: recognize differences and similarities among given figures; recognize the figures can be classified by their properties; determine whether or not a given figures belong to a specified class; understand and apply the describe properties of definition; identify the logical consequences of given data; develop logical proogs; and recognize the role and limitation of deductive methods, and 5) applied skill, including the ability to: recognize physical models geometric figures; sketch or construct geometric model of physical objects; use properties of geometric model to conjecture properties of the usefulness of geometric models for natural phenoma, sets of element in the physical sciences and sets of elements in the social science; and use geometric models in problem solving.

Flipbook Multimedia as Learning Media

Flipbook multimedia role or flipping book is adequate big as learning media. From the display which is different than the ordinary printed book, also it looks more interesting and interactive for students. Beside it is supported by output and various kind of file format (*.swf and *.exe) or HTML,

flipbook is able to receive material and document without passing print process. Purwanto (2004) states that geometry material in flipbook multimedia has been constructed. Thus the students are able to reach an informal deductive level and have geometry basic skill.

Arsyad (2011) explained that flipbook (e-book) multimedia which has characteristic hypermedia has more interesting features than a printed book. Based on a literature study, flipbook learning media be able to raise a student's geometry learning interest. Flipbook presents the image with an interesting composition so that students' interest to be higher in learning geometry. Views on each page, composition, and design also refer to the results of questionnaires teachers and students (need analysis questionnaires), which is how the teacher expectations of the form of multimedia products developed. The material presented in the flipbook is designed more easily understood by the students. Flipbook-based images and animations. In addition, the flipbook involves activating students in practising individual and group activities in the Mini Mathematics Laboratory Worksheet. Such learning conditions facilitate understanding and improve students' skills on aspects of geometry skills (visual, verbal, logic, drawing, and application).

Nieveen (in Zulkifli, 2013) stated that 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 apply to a much wider array of the educational product". Based on that opinion, in this research there are three aspects which determine product quality, they are validity level, practicality, and effectiveness.

METHOD

This research is the part of "Geometry in Flipbook Multimedia: A Technology Role in Improving Mathematical Learning Quality in Madiun". In the previous research, it has been reviewed about validity, practicality, and product effectiveness level from the average score of pre-post test result, so this research focus is for measuring flipbook effectiveness on limited-scale and wide-scale tryout, it is reviewed from Skill Gist Competence domain (KI-4) of Curriculum 2013 on geometry basic skill indicator, also examining flipbook efficacy if it is compared with printed book which has been used before. The kind of the research is development research in the education field (Education Research and Development) with the research procedure uses R&D phases from Budiyono model which has been modified. Population in this research is 13 (thirteen) schools which apply Curriculum 2013 in Madiun with the user target is 6th-grade students, and it takes a sample by using a multistage cluster random sampling technique.

Limited-Scale Tryout and Wide-scale Tryout

Limited-scale tryout in this research is a tryout step to see the product effectiveness level; it is whether flipbook multimedia can improve geometry basic skill of 6th-grade students in informal deductive thinking level achievement. For determining that informal deductive thinking level achievement, the researcher applies pre-post design research toward the same student's group (before-

after research) with the sample only one school. This tryout is done by applying flipbook as a learning media with the same teacher for four times meeting. Each meeting consists of 3 x 35 minutes. The instrument used is a rubric assessment of product-based and a performance-based. Limited scale tryout is done six times, including the pre-test and post-test meeting.

The aspect assessment of product-based assessment are: 1) classify the puzzle piece based on the types of polygons (the basic skill of visual and logic), 2) construct a puzzle pieces become new creations (the basic skill of visual, logic, and drawing), 3) the level of creativity results puzzle construction (the basic skill of visual and drawing), and 4) the composition of the colour (the basic skill of drawing). On performance-based assessment rubrics, aspects that are assessed is the ability to resolve problems associated with quadrilateral solved by measuring and counting. Heavy point assessment is on the steps of completion provided students when working on problems.

As in limited scale tryout, the phases of wide-scale tryout which is done by the researcher is as good as an instrument, the number of the learning meeting, and also sampling technique. However, the sample number which is taken more in a wide-scale tryout, they are two elementary schools. Although, in both tryout pre-post test has been done but in this research, there is no review about pre-test and post-test result.

The Test of Efficacy of Flipbook Multimedia

Budiyo (2017) states the test phase of this research is the product efficacy test. Nevertheless, in the tryout phase (limited-scale tryout and wide-scale tryout) it has been measured toward all things wanted and has been proved that those things wanted have been appeared, but the things done are still on product development phase. Those steps have not already measured product efficacy test yet; it is because there is no comparator group. The product efficacy test follows the experimental research phases which compare the previous product which is used before (Budiyo, 2017). As the dependent variable in this experimental research is informal deductive thinking level achievement which is reviewed from the geometry basic skill as student's learning achievement. The instrument used is a learning achievement test which consists of twenty questions of multiple choice test. The test material is about quadrilateral.

The sample in this efficacy test phase are two schools, and each of them consists of two learning group who role as experiment group and control group. Experiment group is the group which gets flipbook multimedia learning, while the control group is the group which gets the old product, it is printed book of Curriculum 2013.

Budiyo (2017) states in efficacy test, the researcher uses the static program without randomisation. Both groups are assumed the same or equal in the relevant field based on normality test, homogeneity test, and balance test result. The difference is in the way of treating X in each group. After X treatment has been given to the experimental group, both groups are given the same learning achievement test (T2). Then, T2 achievement test result in both groups is compared to determine whether there is an effect of X treatment or not.

Data Analysis

In the product-based assessment and performance-based assessment, the score interval is 0-100. This assessment focuses on Basic Competence in skill field (KI-4) with assessment technique in a group activity. The average class, the student is assessed in achieving informal deductive level if getting at least 75% score from the maximal score in each number, so it is in $X > 75,00$ with the transformation score $= \frac{\text{result score}}{40} \times 100$. The average result score is classified in this following van Hiele thinking level achievement shown in Table 1.

Table 1. Average Interval Score of Product Base Scoring Rubric and Performance Base Scoring Toward van Hiele Thinking Level Achievement

Average Interval Score	Thinking Level Achievement
$75,00 < X \leq 100$	3 rd level (Informal Deductive)
$50,00 < X \leq 75,00$	2 nd level (Analysis)
$X \leq 50,00$	1 st level (visualization)

In statistic analysis of flipbook efficacy test, there is an analysis prerequisite test which is treated as a research subject; it is a normality test with Lilliefors method and homogeneity test with Bartlet method. In hypothesis test of flipbook efficacy in experimental research, the test used is t-test with comparing experimental group capability after getting flipbook multimedia learning with control group capability which get printed book learning.

RESULTS AND DISCUSSION***The Validity of Flipbook Multimedia***

Amstrong, Edward, & Lonsdale (in Cumaoglu; Sacici; & Torun, 2013) stated that “... any piece of electronic text regardless of size or composition (a digital object), but excluding journal publications, made available electronically (or optically) for any device ... “. Furthermore, this study states the results of comparisons of geometry learning in 6th graders using flipbook multimedia (as an experiment group) with a printed book (as a control group).

The result of flipbook validation in research of “Geometry in Flipbook Multimedia: A Technology Role in Improving Mathematical Learning Quality in Madiun,” consist of theoretical assessment and prototype assessment by the experts, is stated that flipbook multimedia is valid and proper to use in geometry learning on a limited-scale tryout and wide-scale tryout. “... from all validity results, it can be concluded that flipbook prototype is proper to use in limited and wide-scale tryouts.” (Andini, et al. 2018). In Figure 1, Figure 2, and Figure 3 shown display of flipbook multimedia that have been through the stages of validation by the experts.



Figure 1. A display of a flipbook cover

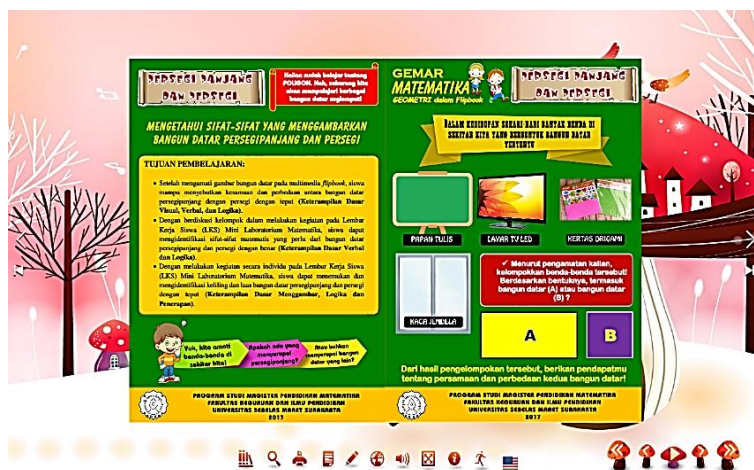


Figure 2. A display of the content in a flipbook



Figure 3. A display of the group activities content in a flipbook

The Practicality of Flipbook Multimedia

The practicality on multimedia flipbook has also been reviewed on research “Geometry in Flipbook Multimedia” by Andini et al. (2018), a result of a limited-scale tryout and wide-scale tryout,

that the intensity of the use and attention of students to the prototype is very high. The learning objective is achieved optimally. The result of 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.

The Effectiveness of Flipbook Multimedia

The effectiveness of the flipbook on a limited-scale tryout and wide-scale tryout reviewed by the average score of the pre-post test, product-based assessment, and performance-based assessment. The results of the pre-post test have been reviewed in previous research as shown in Figure 4.

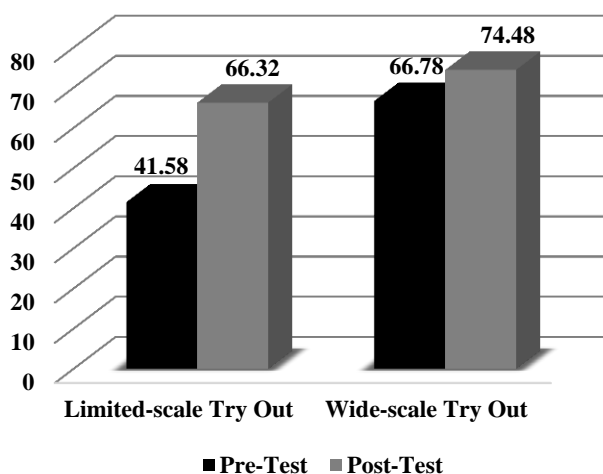


Figure 4. Graph of Average Score of Pre-Post Test on Limited-scale and Wide-scale Tryout (Andini et al. 2018)

The result of product-based assessment on a limited-scale tryout retrieved data that almost the entirety of the student has reached the level of deductive thinking informal because there is the average score of 80,63, but from the results of score average of performance-based assessment accomplished students are lower than 75,00, that is 74,26. It can be said that the students' problem-solving aspects have not yet reached the level of informal deductive. Figure 5 shown graph of the average score of product-based assessment and the performance-based assessment on a limited-scale tryout.

From the achievement scores on a limited-scale tryout can be analyzed that almost all student: 1) able to follow the teacher's instructions well to provide tools and materials, 2) able to fill the data table with appropriate classification polygon (regular polygons, concave polygons, convex polygons) as well as to record the number of each type of polygon, 3) able to create well in constructing puzzle pieces so that it becomes a new puzzle form, and 4) able to cooperate in groups well to try to solve the geometry problems presented in terms of measurement and quadrilateral wide-area, although there is still a mistake in writing the steps of workmanship and calculate the workmanship.

On the wide-scale tryout, based the average score as shown in Figure 5 can be interpreted as follows. 1) able to carry out instructions on the student worksheet correctly, 2) the students can write

the number of polygons formed from the puzzle pieces as well as distinguish the types of polygons (regular polygons, irregular polygons, concave polygons, and convex polygons) by filling in tables, 3) able to create a new puzzles from puzzle pieces given with high creativity, and 4) students able to write the steps systematically to solve the problem of measurement and quadrilateral wide-area.

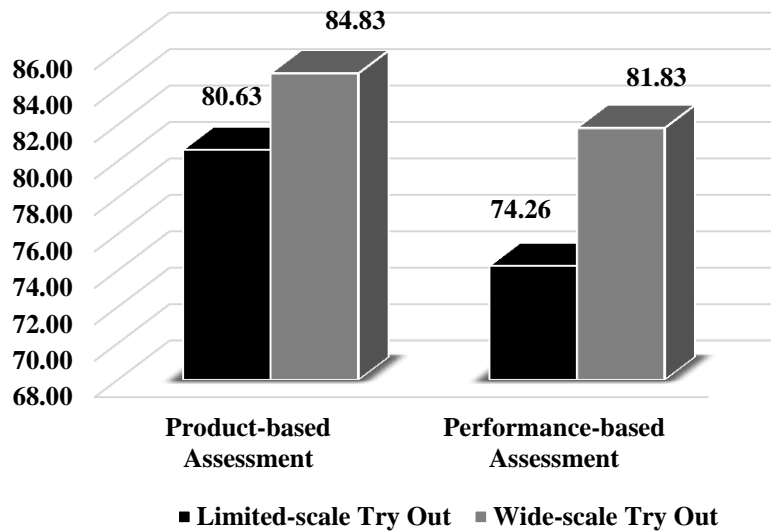


Figure 5. Graph of Average Score of Product-based Assessment and Performance-based Assessment on a Limited-scale and Wide-scale Tryout

Test of the Flipbook Multimedia Efficacy

The samples were selected for the flipbook efficacy test are SDN 05 Madiun Lor and SDN 02 Manisrejo with the subject of 63 students and 62 students respectively. After the learning with flipbook multimedia in the experimental group, students are given a geometry achievement test. Similarly, the control group was also given a geometric learning achievement test without any learning treatment with flipbook multimedia. Table 2 shows the results of the geometric learning achievement test in both groups.

Table 2. The Geometry Test's Results on the Group of Experimental and Control

Group	<i>n</i>	\bar{X}_i	<i>S_i</i>
Experiment	63	75,00	15,632
Control	62	65,08	13,321

Before conducting hypothesis testing efficacy of flipbook multimedia, the researcher performs analysis of normality test and homogeneity test toward the achievement test result of geometry material (the learning achievement test which consists of twenty questions of multiple choice test). Normality testing is a prerequisite for normally distributed population analysis. The method used is Lilliefors and the results obtained in Table 3.

Table 3. The Summary of Normality Analysis

Group	n	L_{obs}	L_{table}	Decision
Experiment	63	0,1032	0,1116	Normal
Control	62	0,1029	0,1125	Normal

Based on the test decision in Table 3, the data obtained from the achievement test of experiment group has $L_{obs} = 0.1032$ less than $L_{table} = 0.1116$. Based on critical area guidelines that *Critical Area* = $\{L|L > 0,1116\}$ then $L_{obs} \notin \text{Critical Area}$, so that the decision of H_0 is received which means that the experiment group population is normally distributed. The data on achievement test results in the control group found that $L_{obs} = 0.1029$ less than $L_{table} = 0.1125$. Based on *Critical Area* guidelines that *Critical Area* = $\{L|L > 0,1125\}$ then $L_{obs} \notin \text{Criticital Area}$, so that the decision of H_0 is received which means that the control group population is also normally distributed. After the researchers conducted the normality test, the next test is the homogeneity test between groups using the Bartlet method and obtained the results as in Table 4.

Table 4. The Summary of Homogeneity Analysis

Group	k	χ^2_{obs}	$\chi^2_{(\alpha; k-1)}$	Decision
Experiment	2	1,553	3,841	Homogeneous
Control				

Based on the test decision in Table 4, the data obtained from the achievement test of experiment group and control group has $\chi^2_{obs} = 1,553$ less than χ^2_{tabel} . Based on *Critical Area* guidelines that *Critical Area* = $\{\chi^2|\chi^2 > 1,553\}$ then $\chi^2_{obs} \notin \text{Critical Area}$, so that the decision of H_0 is received which means that the population is homogeneous. After both prerequisite tests are carried out and stated that normal and homogeneous populations, the next is hypothesis testing with a t-test. The following results of the research hypothesis test are summarized in Table 5.

Table 5. The Summary of Hypothesis Analysis

Group	\bar{X}	t_{obs}	t_{table}	Decision	Conclusion
Experiment	75,00	3,8157	1,660	<i>The null hypothesis is rejected</i>	<i>The hypothesis is rejected</i>
Control	65,08				

Based on the test decision in Table 5, obtained that $t_{obs} = 3,8157 > t_{(\alpha; n_1+n_2-2)} = 1,660$, and therefore $t_{obs} \in \text{Critical Area}$. The test decision is H_0 rejected, which means that the geometry learning achievement of the experimental group is higher than the control group after using flipbook multimedia flipbook.

Comparison of Research Results with Previous Research

In previous research on the geometry thinking level based on van Hiele's theory are explained about the gender differences of students towards an understanding of geometrical concepts, the

student's thinking levels of geometry from the lowest level to the highest level, and the application of learning models based on van Hiele's theory. On the other hand, the focus of this research is to develop a multimedia flipbook as teaching material for 6th grader to achieve an informal level of deductive thinking based on van Hiele Theory.

CONCLUSION

Based on the description of research results, the conclusions of the research of flipbook development can be described as follows: 1) on a limited-scale tryout, the average score of product-based assessment and performance-based assessment of 80,63 and 74,26 respectively. At this phase, the overall student can achieve the Informal Deductive thinking level based of product-based assessment (in term of puzzle construction), while from the problem-solving aspect the student has not reached the thinking level of Informal Deductive, 2) on a wide-scale tryout, the average score of product-based assessment and performance-based assessment of 84,44 and 81,83 respectively and stated that almost all students have reached the thinking level of Informal Deductive, 3) the results of statistic test analysis known that students with learning using flipbook multimedia and not using flipbook multimedia have different learning achievement with the average score of 75,00 and 65,08, 4) from the results of flipbook efficacy test can be concluded that student achievement with flipbook multimedia is better than student achievement without using flipbook multimedia. Thus multimedia flipbook more efficacy (superior) compared with previous products (the printed book).

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