
THE CONSTRUCTION LEARNING MEDIA AND LEVEL OF STUDENTS' MATHEMATICAL COMMUNICATION ABILITY

Dian Fitri Argarini^{*1}, Nok Izatul Yazidah², Anik Kurniawati³
^{1,2,3} Insititut Keguruan dan Ilmu Pendidikan Budi Utomo Malang

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ABSTRACT

This study aims to look at the effect of the use of instructional media on student learning achievement in terms of students' mathematical communication. The learning media in this study are textbooks with a constructivism approach that has been validated and tested previously. This study will compare the learning achievements of students who learn using constructivism learning models with constructivism media, constructivism learning models without media, and direct learning. This is a quasi-experimental research with a 3×3 factorial design. It involved junior high school students in Malang district as the research population. Based on the hypothesis, it is revealed that : (1) students who learn using constructivism approach with constructivist media had better performance than other groups, (2) students with high mathematical communication had higher learning achievement than students with moderate and low communication skills, (3) based on the category of high, moderate and low mathematical communication, students with constructivist learning and constructivist media gained better achievements, (4) in the constructivist learning group using constructivist media, constructivist learning without media, and direct learning, students with high mathematical communication gained better achievement than students with moderate and low mathematical communication

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Corresponding Author:

Dian Fitri Argarini,
Department of Mathematics Education,
Insititut Keguruan dan Ilmu Pendidikan Budi Utomo Malang
Jl. Simpang Arjuno No.14B, Kauman, Malang City, East Java 65119, Indonesia
Email: kejora.subuh14@gmail.com

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1. INTRODUCTION

One way to measure the success of a classroom learning is to look at students' achievement. Learning achievement is one of the results that the students achieved from a learning process by students and teachers to achieve an educational goal (Paulpandi & Govindharaj, 2017). To assess student achievement teachers usually conduct regular evaluations and assessments. It is teacher's authority to evaluate the method used and its implementation, because evaluation has no specific benchmark, except that it is based on learning objectives designed by the teacher himself. In general, to see student achievement

in learning a certain subject, the teacher can rely on students' cognitive aspects, whether it increases, remains the same, or decreases. Based on the explanation from the research and development (R & D) department, the Ministry of Education and Culture stated that the results of the 2019 UNBK (National Exam) decreased, since the students' overall mathematics score only reached 46 points, below the 55 point standard.

What are the factors affecting the declining achievement? In addition to changing the assessment system, it is important to highlight teacher performance in designing and implementing the learning process to suit the students need. This is so because teacher quality, academic climate, and student achievement in understanding mathematics have a significant relationship (Daso, 2013). High student achievement as seen from their cognitive aspects is very closely related to understanding students' mathematical concepts. Students are required to understand mathematical concepts in order to solve the problems given.

Comprehension on concepts indicates students' ability to explain concepts, use concepts and develop matters relating to concepts (Duffin & Simpson, 2000). Ferrini-Mundy (2001) states that 'students' understanding of mathematical concepts can be seen from (1) students' ability to define concepts both verbally and in writing, (2) students' understanding of examples and not examples, (3) using mathematical symbols to explain concepts, (4) changing forms of a representation, (5) ability to recognize and interpret a concept, (6) ability to identify characteristics and ability to explain, and (7) ability to compare several concepts.

Skemp (2006) divides concept understanding into two types, namely instrumental understanding and relational understanding. Instrumental understanding is indicated by students' ability to memorize formulas and use them, without the ability to explain their reasons. Meanwhile, rational understanding can be seen from the ability of students to understand more complex concepts and relate several concepts to solve mathematical problems. Based on Skemp's opinion, it is conclusive that students' relational understanding is more meaningful than instrumental understanding (Qohar, 2011).

The importance of understanding concepts greatly affects the level of student mathematics achievement. Therefore, teachers are expected to create a good academic atmosphere to improve student mathematics achievement. Mathematical achievement in this study is seen from the obtained results after carrying out mathematical achievement tests in geometry. In addition to understanding mathematical concepts that needs improvement, teachers must also understand other factors that can influence student achievement in designing the learning process and learning objectives to achieve the maximum target. Other factors are indicated by various angles, for example cognitive abilities, cognitive styles, learning styles, spatial abilities, mathematical communication skills or other reviews. One aspect to highlight in this research is students' mathematical communication skills.

In general, it is possible to interpret communication as a way of conveying messages from the sender of the message to the recipient of the message to inform opinions either directly (verbally) or with the help of the media (Tinungki, 2015). Mathematical communication skills are the ability of students to use mathematics as written language in the form of vocabulary, notations, and mathematical structures in understanding problem solving. Mathematical communication is influenced by three aspects, namely aspects of drawing, aspects of mathematical expressions, and aspects of written texts. On the other hand, there are five aspects of communication, namely representation, listening, reading, discussion, and writing. Representation is the ability of students to translate a problem or a diagram from a physical model into symbols or words. Listening is students' ability to hear a question of a certain problem. Reading, in this

ability is related to several aspects owned by students, namely remembering, understanding, comparing, finding, analyzing, organizing, and applying what is contained in the reading. Discussion is the ability of students to express ideas related to problems and material provided. In contrast, writing is the ability to express and reflect ideas in the form of writing that is carried out consciously. There are two reasons that underlie the importance of communication in mathematics, namely mathematics as language and mathematics as a social activity.

In addition to understanding the level of students' mathematical communication, it is certain that the teacher must design learning to maximize the learning process to achieve the highest learning achievement. One of such attempts can be done using the right learning model to help students' better master the material when the learning process takes place. One learning model offered is a constructivism learning model. Constructivism can be interpreted as knowledge gradually built by humans expanded through a limited context. To do constructivist learning at school, a teacher needs access to models and strategies that they can apply effectively with relative ease (Boddy, Watson, & Aubusson, 2003) Constructivist-based learning aims to (1) provide experience with the knowledge construction process, (2) provide experience and appreciation for various perspectives, (3) conduct learning in a realistic and relevant context, (4) voice opinions in the learning process, (5) apply what is gained during the learning process into social experience, (6) encourage the use of some representations, and (7) encourage self-awareness to carry out the process of knowledge construction (Koochang, Riley, Smith, & Schreurs, 2009). In this study, students were taught using a constructivism model with material related to geometry. The researcher chose some material in the field of geometry for junior high level and compiled a constructivism-based learning media to help maximize the learning process with a constructivist learning model.

The National Education Association (NEA) defines the media as anything that can be manipulated, seen, heard, read, or talked about along with the instruments used for these activities. Media also means something that carries information between sources and recipients (Nurseto, 2012). Media can be classified into several types based on the form and method of presentation, including (1) graphics, printed materials and still images, (2) silent projection media, (3) audio media, (4) audio-visual silent media, (5) live audiovisual/film media, (6) television media, and (7) multi media. In this study, the researcher used printed books media known as "smart books". This smart book media contains geometry materials for students in junior and senior high school levels. SMART Book is a textbook developed by researchers. This textbook is a constructivism-based textbook. The constructivism approach is chosen so that students are able to build on the material or initial knowledge they have with the newly received knowledge. The SMART Book contains mathematical geometry material received at junior high school level, namely (1) lines and angles, (2) straight line equations, (3) rectangles and triangles, (4) Pythagorean theorems, (5) circles, (6) geometry transformation, (7) build flat side space, and (8) build curved side space.

This smart book media was developed with a plomp development model, which consists of three stages. The first stage is known as preliminary research that aims to make initial observations about matters related to the development of constructivist-based smart books. The second stage is the prototype design stage, by developing constructivist-based smart book and formative valuation. The last stage is the assessment stage conducted by a summative or semi-summative evaluation. This smart book media has been validated both in the fields of material, media, and language by expert fields. After being validated and revised, the media was also tested on students to ensure its feasibility to use. The use of

constructivist-based media is expected to improve student mathematics learning achievement.

Based on the above mentioned description, this study aims to find out: (1) which method give better mathematical achievement by comparing students who learned using constructivist learning models assisted by constructivist media (smart books), and those who learned using constructivist learning models without media assistance, or direct learning model. (2) which student has better performance among students with high, moderate, or low mathematical communication skills. (3) In each of the categories of mathematical communication skills, which one provides better learning achievement among students who learned using constructivist learning models assisted by constructivist media (smart books), constructivist learning models without the help of media, or direct learning models. (4) in each learning model, which one has better learning achievement among students with high, moderate, or low mathematical communication skills.

2. METHOD

In this study, subjects will also be grouped based on their mathematical communication skills. Classification of students' mathematical communication skills is done by considering 5 aspects of mathematical communication skills according to Baroody namely, (i) making a representation of an idea or problem, (ii) listening to the topics being discussed, (iii) reading, (iv) discussion to express ideas, and (v) writing as an effort to convey ideas through various media. In this study, a preliminary test of students' mathematical communication skills will be conducted to group the research subjects. Mathematical communication skills of students will be measured through the ability of students to express their mathematical communication skills in writing in solving mathematical problems. For each mathematical problem, measurement of written communication skills is carried out by taking into account several aspects and indicators according to the [Table 1](#).

Table 1. Aspects and Indicators of Mathematical Communication Skills

Material	Measured Communication Aspects	Indicator
Triangles and Squares	States and illustrates mathematical ideas in the form of mathematical models	Students can express and illustrate ideas and problems given in the form of images Students can state the problems given in the form of mathematical models in the form of equations and solve them
Volume Builds Side Space Flat	States and illustrates mathematical ideas in the form of mathematical models	Students can state and illustrate ideas and problems related to the ballroom of flat side spaces Students can state the problems given in the form of mathematical models in the form of equations and solve them
Surface Area Build Flat Side Space	States and illustrates mathematical ideas in the form of mathematical models	Students can state an image into an idea or mathematical problem related to congruence. Then students can solve these problems

After the mathematical communication ability test questions are made based on the grid in [Table 2](#), the test is given to students. The results of students' mathematical communication ability tests in each class of learning models are grouped into three groups namely, high mathematical communication skills, medium mathematical communication skills, and low mathematical communication skills. The research design based on the learning model and the results of tests of mathematical communication skills can be seen in [Table 2](#).

This is a type of quasi experimental research using the factorial 3×3 design. It involved all junior high school students in Malang district as the research population. The research sampling was done using stratified cluster random sampling techniques. In this sampling technique, the population was divided according to strata, which were drawn randomly from sample sub-populations (Budiyono, 2003). From the sampling technique, the researcher selected Tarbiyyatus Shibbyan Middle School, KH. Amir Wajak, and Tambaksari YBPK Middle School. For each school, 2 experimental groups and 1 control group were taken. In the first experimental group, students learned using a constructivism model assisted by smart book media with a constructivism approach. The second experimental group conducted learning with a constructivism model without media assistance. Meanwhile, the control class received learning materials using a direct learning model.

Table 2. Research Design

Learning Model (<i>a</i>)	Mathematical communication (<i>b</i>)		
	High (<i>b</i> ₁)	Moderate (<i>b</i> ₂)	Low (<i>b</i> ₃)
Constructivism model using constructivism media (<i>a</i> ₁)	(<i>ab</i>) ₁₁	(<i>ab</i>) ₁₂	(<i>ab</i>) ₁₃
Constructivism model without media (<i>a</i> ₂)	(<i>ab</i>) ₂₁	(<i>ab</i>) ₂₂	(<i>ab</i>) ₂₃
Direct learning model (<i>a</i> ₃)	(<i>ab</i>) ₃₁	(<i>ab</i>) ₃₂	(<i>ab</i>) ₃₃

Information:

- ab*₁₁ : Student learning achievement with high mathematical communication skills who get a model of cooperative learning assisted by constructivist media (smart book).
- ab*₁₂ : Student learning achievement with moderate mathematical communication skills who get a model of cooperative learning assisted by constructivist media (smart book).
- ab*₁₃ : Student learning achievement with low mathematical communication skills who get a model of cooperative learning assisted by constructivist media (smart book).
- ab*₂₁ : Student learning achievement with high mathematical communication skills who get cooperative learning models without the media.
- ab*₂₂ : Student learning achievements with moderate mathematical communication skills who get cooperative learning models without the media.
- ab*₂₃ : Student learning achievement with low mathematical communication skills who get cooperative learning models without the media.
- ab*₃₁ : Student learning achievement with high mathematical communication skills who get a direct learning model
- ab*₃₂ : Student learning achievement with moderate mathematical communication skills who get a direct learning model.

ab_{33} : Student learning achievement with low mathematical communication skills who get a direct learning model

The study involved 99 students as research samples, consisting of 33 students in the experimental group one, 33 students in the experimental group two, and 33 students in the control group. This study used two independent variables, namely the learning model and students' mathematical communication skills and one dependent variable namely mathematics learning achievement of students.

Data were collected using the test documentation method. Documentation methods were used to collect data on students' initial abilities, test methods were used to collect final learning achievement data, and mathematical communication tests were used to collect data on students' mathematical communication skills. This study used a description test on geometry material that the students received as research instrument. The second instrument, a mathematical communication test, was used to distinguish between high, moderate, or low mathematical communication groups.

The instrument testing was conducted at SMP KH. Amir Wajak with 20 students as respondents. The learning achievement test instrument referred to the criteria namely content validity, differentiation ($D=0.3$), difficulty level ($0.3 \geq P \geq 0.7$) and reliability ($r_{11} \geq 0.7$). Of the 15 items in the description that were tested, 12 items were used as test instruments for students' mathematical achievements. The mathematical communication test was used as a test instrument that has been validated by material experts to suit for use in this research study. The prerequisite test for the analysis is the normality test with liliefors and the homogeneity test with the Bartlett test. The data analysis test used two-way variance analysis with unequal cells.

3. RESULTS AND DISCUSSION

3.1. Results

This research is an experimental SMART Book textbook that has been developed previously. What distinguishes this book from mathematics or other geometry books? First, the SMART Book gives a very easy apperception to readers in everyday life and is assisted with relevant images at the beginning of each chapter (Figure 1).




Figure 1. The "Apperception" section of the SMART Book

Second, SMART Book has a section where students discuss. In this section besides discussing with peers, the reader is also expected to be able to construct old knowledge and new knowledge (Figure 2). This is because geometry material is always obtained at every level of Education.

Mari Berdiskusi

Gambar di samping adalah jam dinding yang pasti sering kita jumpai baik di rumah, sekolah atau tempat umum. Jika diperhatikan, pada jam dinding terdapat 3 jarum yang mewakili hitungan jam, menit, dan detik. Jika kita anggap jarum-jarum tersebut adalah garis, maka terdapat 3 garis pada gambar disamping yang kita ketahui.



Sumber: Google Online

Jam tersebut menunjukkan pukul 12 tepat maka dapat dilihat ketiga garisnya saling berhimpit.

Coba kalian diskusikan!

1. Ada berapa kali dapat ditemukan garis (jarum jam, jarum menit, dan jarum detik) saling berhimpit?
2. Ada berapa kali terbentuk sudut siku-siku (berpotongan tegak lurus) antara jarum menit dan jarum jam?

Diskusikan dan catatlah hasil diskusi kelompok pada buku laporan kelompok!

Figure 2. The "Let's Discuss" section of the SMART Book

The third difference from the SMART Book is that there is a self-evaluation section for readers. In the self-evaluation section, the reader is expected to write down what has been learned in the previous sub-chapter and write what the weaknesses of the reader while studying the material (Figure 3). This section can be used as a benchmark or note for the teacher to implement improvements for students in understanding further material.

Evaluasi Diri

Setelah mempelajari materi garis dan hubungan antar garis, tuliskan kelemahan kalian dalam memahami materi dengan jujur pada kolom ini.

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Figure 3. The "Self Evaluation" section of the SMART Book

After arranged the book and focused group discussion (FGD) together with mathematics education lecturers at IKIP Budi Utomo Malang, the SMART Book was then validated by experts in terms of material, media, and language. Following the final validation results obtained after the revision of the experts, the score is obtained from a scale of 5.0 (Table 3).

Table 3. SMART Book's Validation Results

Validator	Score
Material Expert	4,09
Media Expert	4,03
Linguist	4,50
Average	4,207

After validation with the material experts, the SMART Book can already be experimented on KH. Amir Wajak Junior High School's students. The balance test results were obtained from the initial data analysis. The initial data used was the students' math scores in the previous semester's grades. Based on the balance test of the initial data, it was revealed that the three populations had the same initial ability. The experiment obtained the student's mathematical achievement data. The mean mathematical achievement of students in the experimental group 1, experimental group 2, and the control group can be seen in [Table 4](#).

Table 4. The mean of each cell from the data model of learning and mathematical communication

Learning Model	Mathematical Communication			Marginal Average
	High	Moderate	Low	
Constructivism model with constructivism media	73,40	69,38	63,80	68,91
Constructivism Model without constructivism media	70,09	64,75	60,50	65,24
Direct Learning Model	69,33	58,13	58,22	61,21
Marginal Average	70,97	63,78	60,93	

Before carrying out a two-way analysis of variance, a normality test and a homogeneity test were used as a prerequisite for the analysis of variance. A summary of the normality test is presented in [Table 5](#).

Table 5. Summary of normality test results

Normality Test	Lobs	L0,05;n	Decision	Summary
Constructivism and media	0,0940	0,1542	H ₀ accepted	Normal
Constructivism without media	0,0972	0,1542	H ₀ accepted	Normal
Direct	0,0905	0,1542	H ₀ accepted	Normal
High mathematical communication	0,0963	0,1566	H ₀ accepted	Normal
Moderate mathematical communication	0,0821	0,1419	H ₀ accepted	Normal
Low mathematical communication	0,1404	0,1674	H ₀ accepted	Normal

Based on [Table 5](#), it can be seen that the sample comes from a population that is normally distributed, both in terms of learning models and in terms of students' mathematical communication. The next step is to do a homogeneity test. The summary of homogeneity test can be seen in [Table 6](#).

Table 6. Summary of homogeneity test

Samples	K	X^2_{obs}	$X^2_{0,05;(k-1)}$	Decision	Summary
Learning Model	3	3,5025	5,991	H ₀ accepted	Homogeneous
Mathematical Communication	3	3,8818	5,991	H ₀ accepted	Homogeneous

Based on [Table 6](#), it is clear that the data in each learning model and students' mathematical communication skills have homogeneous variance. Furthermore, a two-way variance analysis test was carried out with unequal cells. A summary analysis of variance analysis is presented in [Table 7](#).

Table 7. Summary analysis of two-way variance

Source	JK	dk	RK	Fobs	F α	Decision
Learning Model (A)	781,1563	2	390,5782	4,9622	3,11	H ₀ A rejected
Mathematical Communication (B)	1709,1189	2	854,5594	10,8569	3,11	H ₀ B rejected
Interaction (AB)	172,7210	4	43,1802	0,5486	2,49	H ₀ AB accepted
Error	7084,0249	90	78,7114	-	-	-
Total	9747,0211	98	-	-	-	-

The two-way variance analysis with unequal cells based on [Table 7](#) summarizes that (1) in terms of the main effects between lines (A), exposing students to constructivism learning models assisted by media constructivism, constructivist learning models without media, and direct learning models leads to a different effect on students' mathematics learning achievements. (2) In terms of the main effect between columns (B), high, moderate, and low mathematical communication skills have different effects on students' mathematics learning achievement. (3) In terms of the interaction effect (AB), it can be concluded from the table that there is no interaction between the learning model and students' mathematical communication abilities on students' mathematics learning achievement.

Based on the two-way anava analysis, it was found that H₀ A was rejected. H₀ A hypothesis states there is no difference in the effect between the use of learning models on learning achievement, then based on [Table 7](#) H₀A is rejected this means, at each constructivism learning model groups have different effects on students' mathematics learning achievement. Thus, it is necessary to do further tests after the analysis of variance by the Scheffe' method for inter-line warranty testing. The summary calculation of the average test between lines is presented in [Table 8](#).

Table 8. Summary of the multiple comparison tests between lines

Comparison	H ₀	H ₁	F _{obs}	2F _{0,05;2;90}	Decision
μ_1 VS μ_2	$\mu_1 = \mu_2$	$\mu_1 \neq \mu_2$	6,8183	6,19540	H ₀ rejected
μ_2 VS μ_3	$\mu_2 = \mu_3$	$\mu_2 \neq \mu_3$	3,4050	6,19540	H ₀ accepted
μ_1 VS μ_3	$\mu_1 = \mu_3$	$\mu_1 \neq \mu_3$	12,4190	6,19540	H ₀ rejected

Based on the two-way analysis, it is found that H₀B was rejected. The H₀ B hypothesis show there is no difference in the effect of students' mathematical communication abilities on learning achievement, so based on Table 7 H₀B is rejected, meaning that high, medium, and low mathematical communication abilities have different effects on students' learning achievement in mathematics. Thus, it is necessary to do further tests after the variance analysis with the Scheffe method to compare between columns. The summary calculation of the average intermediate test between columns (Table 9).

Table 9. Summary of multiple comparison tests between columns

Comparison	H ₀	H ₁	F _{obs}	2F _{0,05;2;90}	Decision
μ_1 VS μ_2	$\mu_1 = \mu_2$	$\mu_1 \neq \mu_2$	11,2643	6,19540	H ₀ rejected
μ_2 VS μ_3	$\mu_2 = \mu_3$	$\mu_2 \neq \mu_3$	6,7275	6,19540	H ₀ rejected
μ_1 VS μ_3	$\mu_1 = \mu_3$	$\mu_1 \neq \mu_3$	18,8677	6,19540	H ₀ rejected

3.2. Discussion

The comparison test between lines in each category of the learning model is concluded that students who obtain constructivism learning models assisted by constructivism learning media (smart books) provide better mathematics learning achievement than students who obtain constructivism learning model without media and direct learning. Whereas students who learned with constructivism learning models without media and direct learning models get the same learning outcomes. This is in accordance with the research conducted by Rudiyanto (2008), which stated that the use of media-assisted learning models with constructivist strategies had valid and effective effects centered on student interests, and were able to improve student learning outcomes. Rudiyanto (2008) stated that the use of media can help students in understanding the concepts of the material taught by the teacher. Thus, the purpose of using media to facilitate the learning process and help the achievement of learning objectives is met. The group model of constructivism learning without media provides the same learning achievement as students who get a direct learning model. This is due to researchers' limitations in controlling the course of learning during treatment. Implementation of the designed constructivism learning models is less than the maximum in the aspect of group discussion. Students seemed passive during learning implementation since they found it difficult to find a solution without learning media. On the other hand, the learning process of students who get direct learning was very centered on the teacher. As a result, students who tended to be passive only received materials and experienced one-way learning. Based on the problem in the constructivism learning model group without the media and the direct learning model group of geometry material, students did not well absorb the conceptual understanding and resulted in lower learning achievement than students who obtained learning with constructivist media-assisted constructivism models (smartbooks).

The comparison tests between columns in each category of students' mathematical communication skills (Table 2 and Table 7), it was concluded that students with higher mathematical communication skills had better mathematics learning achievement than students with moderate and low mathematical communication skills. Students with high mathematical communication are having better mathematics learning achievement than students with low mathematical communication. This result is in accordance with the research hypothesis. This is because students with high mathematical communication are better able to understand the problems associated with mathematical symbols and symbols given by researchers. The results of this study are in line with the results of research conducted by Tinungki (2015), which states that an increase in students' mathematical communication skills is directly proportional to an improvement in the learning process that also affects an increase in students' mathematics learning achievement. Based on these findings, it can be concluded that the understanding of students' mathematical communication is needed by the teacher in order to create an atmosphere of effective learning process and to obtain the maximum possible learning objectives.

Based on the two-way variance analysis, it was found that H_0 AB was accepted. The H_0 AB hypothesis states that there is no interaction between the use of learning models with students' mathematical communication skills on learning achievement. Based on Table 7, it can be concluded that H_0 AB is accepted so that there is no interaction between the learning model and students' spatial ability on student mathematics learning achievement. Thus, there was no interaction between the learning model and students' mathematical communication skills regarding mathematics learning achievement on geometry material, so there was no need to do a double comparison test between cells. That is, conclusions on special effects (on each learning model and on each mathematical communication ability) will be in accordance with the conclusions on the main effects. That is (1) on the level of high, moderate, and low mathematic communication skills, students' mathematics learning achievements obtaining a constructivist learning model assisted by constructivism media is better than students who obtained learning with a constructivism model without media and direct learning models. In addition, the achievement of students who obtained learning with constructivism learning models without media and direct learning models gets the same good results. Based on this, it can be seen that the third hypothesis in this study is not all in accordance with the results of the study, namely students with moderate and low mathematical communication skills who obtain constructivism learning models without media and direct learning models provide the same results of mathematical achievement. The failure to fulfill this hypothesis may be due to the fact that researchers are not able to fully control the condition of students both in terms of health and students' internal motivation when taking tests and taking lessons in class and due to lack of learning duration. This might be the reason why the learning achievement of students who received the constructivism model without media and the direct learning model equally good for students who have moderate and low mathematical communication skills. (2) In the media-assisted constructivism model, constructivism without the media or the direct learning model, the learning achievement of students who have high mathematical communication skills is better than students who have medium and low mathematical communication skills. In addition, the achievement of students who have moderate mathematical communication skills is better than students with low mathematical communication. Based on the hypothesis analysis, it can be seen that the fourth hypothesis in this study is not all in accordance with the results of the study. That is, in the direct learning model, the achievement of students with moderate mathematical communication skills is no better than students with low mathematical communication. The failure of the hypothesis is likely because students with low mathematical

communication abilities have better enthusiasm to try to understand the material well than students with moderate mathematical communication skills. In addition, researchers are not fully able to control the condition of students both during learning and during the test. This is the reason why students' achievement of moderate mathematical communication skills is no better than students with low communication skills.

4. CONCLUSION

Based on the results obtained as follows: (1) the learning achievement of students who obtain constructivism learning models assisted by constructivism media (smart book) is better than students' achievement who obtained constructivism learning models without media and direct learning models. In addition, the achievement of students who obtained a constructivist learning model without media was not as good as the achievement of students who obtained a direct learning model. (2) The achievement of students with high mathematical communication skills is better than students who have moderate and low mathematical communication skills. In addition, the achievement of students with moderate mathematical communication skills is better than students who have low mathematical communication skills. (3) In the category of high, moderate, and low mathematical communication skills, the mathematics learning achievement of students who have constructivism learning models assisted by constructivism media (smart books) are better than students who obtained the constructivism model of learning models without media and direct learning models. In addition, the achievement of students who obtained the treatment of constructivism learning models without media was as good as the achievements of students who obtained the direct learning model. (4) In the category of constructivism learning models assisted by constructivism media (smart books), constructivism learning models without media or direct learning models, the achievement of students with high mathematical communication skills is better than students with moderate and low mathematical communication abilities. In addition, the achievement of students who have moderate mathematical communication skills are also better than students who have low mathematical communication skills.

Based on the above conclusions, it is suggested that the mathematics teachers try to use an innovative learning media such as constructivism-based learning media (smart books) and apply it together with an appropriate learning model. This is so because based on the research, the use of instructional media provides effective results and helps students to understand mathematical concepts and improve students' mathematics learning achievements, especially on geometry material. In addition, the teacher should also pay attention to other factors in students, namely students' mathematical communication skills, because in this study students' mathematical communication skills influence student achievement. It is also advised for other researchers or prospective researchers to continue or develop this research other learning models with the help of constructivism-based media or constructivism learning models with constructivist media with other materials such as spatial abilities, logical mathematical intelligence, and so on to be developed on other material and levels.

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