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Developing Learning Devices Based on GeoGebra Assisted Discovery Learning with SAVI Approach to Improve Motivation and Mathematical Communication of Senior High School Students MTs Aisyiyah

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Abstract This study aims to: 1) Obtain discovery-based learning with SAVI approach assisted GeoGebra (DLSG) that meet validity, practicality, and effectiveness criteria; (2) Describe the improvement of mathematical communication skills (MCS) of the students taught through DLSG; (3) Describe learning motivation of the students taught through DLSG. This research is a development research conducted in two stages, the first stage is developing a DLSG based learning device, the second stage is implementing a DLSG based learning device at grade IX senior high school students MTs Aisyiyah Medan. The learning devices produced from this research are: Learning Implementation Plan (LIP), Teacher's Book (TB), Student's Book (SB), Student Worksheet (SW) and MCS test. The results of the research are: (1) the DLSG-based learning devices developed have met the validity, practicality, and effectiveness criteria; (2) there is the improvement in MCS of the students taught through DLSG. The average MCS score in trials I and II were 81.82 and 94.12; (3) there is the improvement in learning motivation of the students taught through DLSG, the motivation score increased from 85.97 to 86.20.

Keywords: *research development, mathematical communication skills, student learning motivation, development of learning devices, discovery learning with SAVI approach assisted by GeoGebra*

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1. Introduction

The success of a country depends on the success of the education sector. Therefore, education in the 21st century needs to be managed as well as possible, because this century requires educational output that has the ability to do mathematics, more specifically the ability to solve mathematical problems. Meanwhile, the teacher as the spearhead of the world of education must be able to choose, develop and apply models or learning approach that can foster the problem-solving ability.

Educational success is also be marked by the active participation of students in learning, the growth of motivation to learn and the willingness of students to become lifelong learners. In short, education is a means to produce output (students) who are able to think. This is in line with what is written in Miratika, et al, that "Education is one of the right tools to build quality human resources so that it can advance a country. And mathematics education is one part of national education that has an important role to foster student thinking skills" [1].

Along with that, changes for the better must be made because the quality of education in Indonesia is currently declining. This can be seen from the declining ranking of the quality of Indonesian education in the world. Based on data in the Education for All (EFA) Global Monitoring Report 2011: "The Hidden Crisis, Armed Conflict and Education" released by UNESCO, states that Indonesia's Education Development Index has dropped from 65th to 69th out of 127 countries. Due to the low quality of education in Indonesia, Indonesia has low competitiveness, which only ranks 37th out of 57 countries surveyed in the world [2]. Also, Indonesia was only predicated as a follower not as a technology leader from 53 countries in the world. Moreover in mathematics, TIMSS 2009 repots that Indonesian students is very weak in solving mathematical problem [3].

Meanwhile, a research revealed that from day to day mathematics has increasingly developed and has always been a supporter of the development of science, technology, engineering, business and government, as well as various human activities [4]. Therefore, in order to become a person who can participate in the world of work and social life, people must know at least basic mathematics. If more specific participation is desired in advanced mathematical mastery, then high order mathematical thinking skills (HOTS) that include mathematical comprehension, mathematical communication skills (MCS), reasoning, connection and representation, and problem-solving skills is needed to be acquired.

Mathematical communication skills (MCS) must be possessed by senior high school (SHS) students because MCS is the main part of problem solving. Therefore, learning in the classroom must enable students to achieve an MCS. Surya, et.al. stated that MCS of the students are still low because of teacher use direct instruction (teacher center learning approach) [5]. Acording to Ronis, direct instruction is hard to enable the students reach problem solving skills and MCS as well since this instruction designed to enable the students grasp a burden of factual knowledge [6].

Besides mathematical communication skills (MCS), the students also need to acquire motivation in learning because motivation contribute to the learning process as well as in students' daily life. The importance of maintaining motivation in the learning process is undeniable. Because by moving the hidden motivation and keeping it in the activities carried out can make students more active in learning. It can be inferred from Reid that motivation is encouragement that allows students to act. Thus, it is a must that the teachers try to provide external motivation to encourage and stimulate students to be more active in learning [7].

Actually, the learning process will succeed when students have motivation in learning. Therefore, teachers need to foster student learning motivation. To obtain optimal learning outcomes teachers are required to be creative in arousing student learning motivation. Another important thing in learning activities is the accuracy of the selection of models in the process of learning mathematics and student motivation so that educational goals can be achieved fully. In addition, because this era is the era of internet for everything, then the government pushes the teacher to integrate internet and technology in learning process. Doing a renewal of learning devices in accordance with technological developments today is very important for an educator.

Several activities that teachers can do for self-development is written in Indonesian Ministry of Education and Culture, including: (1) preparation of lesson plans, work programs, educational planning; (2) curriculum and teaching material preparation; (3) development of teaching methodology; (4) assessment of student learning processes and outcomes; (5) the use and development of information and computer technology (ICT) in learning; and (6) learning process innovation [8].

Then, Indonesian 2013 curriculum clearly states that the teacher should try to use discovery learning and other learning approach so that students achieve problem solving skills, because discovery learning (DL) is considered capable of transforming teacher-centered learning into student-centered learning [9]. DL will be more useful if combined with the SAVI approach (Somatic, Auditory, Visualization, Intellectually). Through the SAVI approach students are required to participate actively in learning such as conducting experiments, observing, presenting the material they have obtained. Then solve the problem based on knowledge that has been obtained by students during learning.

Thus, the researcher developed learning devices to help teacher experience in implementing learning approach based on discovery learning with SAVI approach that integrated with GeoGebra (DLSG). GeoGebra can be used as a medium of mathematics learning to demonstrate or visualize mathematical concepts as well as devices to construct mathematical concepts. Learning devices here are defined as a set of learning resources arranged in such a way that students and teachers carry out learning activities [30]. Learning devicess include syllabus, lesson plans, teaching materials, student worksheets, learning media, and tests to measure learning outcomes. Learning devices are so important for a teacher because: (1) it is a teacher's guide in carrying out their assignments in class; (2) as a benchmark where the teacher can analyze the ability of students to the subject matter that has been presented. The teacher can see to what extent the material that has been presented is absorbed by students. How many students still need special guidance, and can be used as a reference in the next learning process. (3) as a driver of increasing professionalism; with the learning devices, teachers can further hone their abilities in developing learning implementation plans; (4) make it easier for teachers to help the learning facilitation process.

The learning devices is made after the researcher conducting observation and pilot research at MTs Aiyiyah private school Medan City. The results of observations and interviews with grade VII teachers showed that the teacher still used the lecture, discussion and question and answer methods. The learning approach is characterized by teacher center learning that does not provide an opportunity for students to actively learn and build their own knowledge. Another name for teacher center learning approach is direct learning, direct instruction, or conventional learning. Inded, direct instruction cannot make students able to solve problems [6], including solving MCS problems. That's why this research develops learning devices based on discovery learning with SAVI approach assisted by GeoGebra (DLSG) with the aim to be used by teachers in improving mathematical communication skills (MCS).

The research question is whether the developed learning device based on DLSG has valid, practical, and effective characteristics in improving the MCS of SHS students grade IX MTs Aisyiyah Medan? This paper describes the findings of the study implementing that learning devices in grade IX senior high school students MTs Aisyiyah in Medan.

2. Literature Review

2.1. Mathematical Communication Skills

Aufa, Saragih & Minarni write that "*the communication skills of mathematics is the ability to connect messages by reading, listening, asking questions, and then communicate the location of the problem and present them in solving problems that occur in a classroom environment, where there is a transfer messages that contain material math studied*" [11]. In turn, mathematical communication skills (MCS) can foster mathematical connection skills and mathematical problem solving skills (MPS) where MPS is the main goal of mathematics learning.

Measuring MCS can be done through instrument tests designed based on MCS indicators. Inferred from NCTM 2000, MCS indicators include (a) written text, i.e. providing answers using one's own language, modeling situations or problems using oral, written, concrete, graphs and algebra, explaining and making questions about mathematics that have been learned, listened to, discussed and writing about mathematics, making conjectures, compiling arguments and generalizations; (b) Drawing, i.e. reflecting real objects, drawings and diagrams into mathematical ideas; (c) Mathematical expressions, i.e. expressing mathematical concepts by expressing everyday events in mathematical language or symbols [12].

2.2. Learning Motivation

Reid states that motivation comes from the word motive which is interpreted as an effort to encourage someone to do something [7]. Motive can be said as a driving force within the subject to carry out certain activities in order to achieve a goal. Motivation is the reason for people's actions, willingness and goals. Motivation is derived from the word *motive* which is defined as a need that requires satisfaction. These needs could be wants or desires that are acquired through influence of culture, society, lifestyle, etc. or generally innate.

Motivation is one's direction to behaviour, or what causes a person to want to repeat a behaviour, a set of force that acts behind the motives. An individual's motivation may be inspired by others or events (extrinsic motivation) or it may come from within the individual (intrinsic motivation). Motivation has been considered as one of the most important reasons that inspires a person to move forward in life [13]; results from the interaction of both conscious and unconscious factors. Mastering motivation to allow sustained and deliberate practice is central to high levels of achievement e.g. in the activity of solving mathematical problem, worlds of elite sport, medicine or music. Motivation governs choices among alternative forms of voluntary activity.

Motivation of the students can be measured by a set of questionnaire that designed based on the following indicators [14]:

a. There is a desire and desire to succeed
b. There is encouragement and learning needs
c. The hopes and ideals of the future
d. Tenacious faces difficulties
e. Show interest in various problems
f. Happy to work alone
g. Fast bored with routine tasks
h. Can defend opinions
i. Happy to find and solve problems
j. Happy to follow learning in class
k. Diligent in learning and facing tasks

If someone has motivation then he will show the things just mentioned above, moreover if someone has high motivation then he will show the following behavior [15]:

1. Energy – not necessarily being extrovert, but alertness and quiet resolve.
2. Commitment – to the common purpose.
3. Staying power – in the face of problems/difficulties/setbacks.
4. Skill – possession of skills indicates purpose and ambition.
5. Single-mindedness – energy applied in a single direction.
6. Enjoyment – goes hand in hand with motivation.
7. Responsibility – willingness to seek and accept it.

Thus, these motivation components can also be reliabled for the purpose of designing motivation scale.

2.3. Discovery Learning

Written in Adelia and Surya that discovery is a mental process by which students are able to assimilate a concept or principle [16]. The mental processes in the question include: observing, digesting, understanding, classifying, making conjectures, explaining, measuring, making conclusions and so on. With this technique the students are left to find themselves or have their own mental processes, the teacher only guides and gives instructions. Thus, discovery learning is a learning that involves students in the process of mental activity through the exchange of opinions, with discussion, self-reading and self-test, so that children can learn alone. Bruner considers that discovery learning is in accordance with the active search for knowledge by humans and in itself gives good results [17].

The application of discovery learning models in learning includes operational steps as follows:

1. Preparatory Steps:
a. Determine learning objectives
b. Identify student characteristics
c. Select subject matter
d. Determine topics that students must learn inductively
e. Develop learning materials that are in the form of examples, illustrations, assignments, etc. for students to learn.
2. Application Procedures include:
1. Stimulation
b. Problem statements
c. Data collection
d. Data processing
e. Verification
f. Generalization (drawing conclusions)

2.4. Somatic, Auditory, Visualization, Intellectually (SAVI)

SAVI's approach to learning led to a concept of learning called activity-based learning. This approach involves all the senses, learning by moving physically active, using as many senses as possible, and getting the whole body or mind involved in the learning process. Learning does not automatically increase by instructing the child to stand up and move. However, combining physical motion with intellectual activity and optimizing all the senses can greatly influence learning outcomes.

SAVI model is a form of learning created by Meier in his book titled The Accelerated Learning Handbook. The underlying theory of Meier, in proposing the SAVI approach is the theory of active learning with support with the Learning Based Activities (LBA) [18]. This theory is backed by education in New England in the 19th century who tends to view the body of the human mind that it is separate and distinct. Thus, the rational mind is the focus of education, while the body is considered not relevant to the learning process, not only the physical movement considered important, but also disturbing. In addition, many cases that mention learning to use physical movement is a sign of low intelligence or innate learning disabilities, the activities of the body and mind are separated in learning activities so that learning takes place stiff and unpleasant.

Meier stated that learning is not a separate cognitive event but something that involves the whole person (body, mind and soul) and the intelligence intact. Opinion was delivered Meier in a research conclusion that man has a dimension of somatic, auditory, visual and intellectual (SAVI). Based on this view, Meier proposes an active learning approach called the SAVI approach. SAVI approach is pressed learning by utilizing the senses of students. In this learning model of learning students can move, speak or hear, see and think directly what they are learning, so that learning becomes more meaningful. Theory that supports learning SAVI is Accelerated Learning, learning based on constructivism, and theory of multiple intelligence [19]. SAVI Learning embraces modern cognitive science that learning is best to involve the emotions, the whole body, all the senses, and all the depth and breadth of personal, respect the other individual learning styles by realizing that people learn in different ways.

Meier [18] also describe the characteristics of SAVI included:

1. Somatic

Somatic comes from the Greek meaning of the body soma. So, Somatic learning means learning with tactile, kinesthetic, involves physical as well as using and moving your body while learning. Activity-based learning in general is much more effective than those based presentations and materials. Physical movement increases mental processes, parts of the human brain that are involved in body movement (motor cortex) is located right next to the part of the brain used for thinking and problem solving. Therefore, blocking the movement of the body means that hinder the mind to function optimally. Instead, it involves the body in learning tends to generate fully human integrated intelligence.

2. Auditory

Auditory means learning to speak and hear. Our minds are more powerful than we realize, our ears continuously capture and store information even without us knowing. When we create own voice by speaking a few important areas in our brain becomes active. This can be interpreted in learning teachers should encourage students to talk about what they are learning, translating the experience of students with sound. Talk to them when solving problems, making the model, gather information, create a work plan, master the skills, making reviews the experience of learning, or creating personal meanings for themselves.

3. Visual

Visual learn by observing and describing. In our brain there are more devices for processing visual information than all the other senses. Any student who uses visual learning easier if it can see what is being talked about a speaker or a book or a computer program. In particular, a good visual learner, i.e. when they can see examples from the real world, diagram, map ideas, icons and so when learning.

4. Intellectual

Intellectual learning by solving problems and thoughtful. Measures learners do something with their minds internally when using intelligence to create and reflect on an experience.

2.5. GeoGebra

GeoGebra is an interactive geometry, algebra, statistics and calculus application, intended for learning and teaching mathematics and science from primary school to university level. GeoGebra is available on multiple platforms with its desktop applications for Windows, macOS and Linux, with its tablet apps for Android, iPad and Windows, and with its web application based on HTML5 technology.

GeoGebra can be integrated in learning through mathematical problems that require solutions that are accompanied by pictures or graphics that make it easier for students to understand. Rose shows that GeoGebra software has succeeded in increasing the mathematical problem-solving ability of middle secondary school students [20]. So too according Arbein [21].

3. Research Method

This research is a development study using the 4-D development model of Thiagarajan, Semmel, and Semmel which consists of the stages of defining, designing, developing, and disseminating [22].

3.1. Subject and Object Research

The subjects in this study were senior high school students grade IX at MTs Aisyiyah Medan City in the 2019/2020 school year, while the object of this study was a learning devices based on Discovery Learning with the SAVI approach assisted by GeoGebra (DLSG) on the Equation and Square Function material. The learning devices developed consist of Learning Implementation Plans (LIP), Teacher's Books (TB), Student Books (SB), student worksheets (SW), MCS tests and Learning Motivation questionnaires.

3.2. Data Collection and Data Analysis

The instruments in this study consisted of tests, questionnaires and observation sheets. Explanations for all instruments and data observed are presented in Table 1.

3.3. The Validity of Discovery Learning Devices Based on GeoGebra's SAVI Approach

The DLSG Based Learning devices is validated by five validators. The validity criteria are listed in Table 2 as follows:

Table 1. Data Analysis Instruments and Techniques

Rated aspect	Instrument	Observed Data
Validity	Validation Sheet	LIP, TB, SB, SW, MCS Tests, Student Learning Motivation Scale
Practicality	Validation Sheet	Implementation of Learning Devices
	Observation sheet	Learning Practice Sheet
Effectiveness	Test	Classical Mastery of Mathematical Communication Skills
	Test	Mathematical Communication Skills (MCA)
	Questionnaire	Student Response

Table 2. Validity Level Criteria

No	Total mean value (Va)	Criteria
1	$1 \leq Va < 2$	Invalid
2	$2 \leq Va < 3$	Not Enough
3	$3 \leq Va < 4$	Valid Enough
4	$4 \leq Va < 5$	Valid
4	$Va = 5$	Very Valid

Meanwhile, to calculate the validity of the MCA Test and Student Learning Motivation questionnaire the product moment correlation formula is used as follows [23].

$$r_{xy} = \frac{N\sum XY - (\sum X)(\sum Y)}{\sqrt{\left\{N\sum X^2 - (\sum X)^2\right\}\left\{N\sum Y^2 - (\sum Y)^2\right\}}}$$

Note:

N = Number of respondents
$\sum X$ = Number of variable scores X
$\sum Y$ = Number of variable scores Y
r_{xy} = the value of the correlation coefficient of variables X and Y.

Determining the reliability coefficient of test instrument used the following alpha formula:

$$r_{11} = \left(\frac{N}{N-1}\right)\left(1 - \frac{\sum s_i^2}{s_t^2}\right)$$

Note:
r_{11}: test reliability coefficient
N: the number of test items
$\sum s_i^2$: the number of variance scores for each test item.
s_t^2: total variance

3.4. Practicality of DLSG Based Learning Devices

The practicality of learning devices is assessed by education experts with the following criteria:
Very Low, If $0 \leq P < 1$
Low, If $1 \leq P < 2$
Satisfactory, If $2 \leq P < 3$
Good, If $3 \leq P < 4$
Very Good, If $4 \leq P \leq 5$.
Note:
P = the average score of the learning devices practicality

DLSG based learning devices are said to be practical or easy to implement if they are attain good or very good category.

3.5. Effectiveness of Learning Devices

Nieveen proposed effectiveness of learning devices, among others the achievement of students' learning classically [24], in this case is MCS achievements. Each student is said to have MCS if the MCS test score is more than 75. To determine the completeness can be used the following equation:

Learning completeness per class or percentage of classical completeness (CC) is obtained by calculating the percentage of students who completed MCS test individually. A class is said to complete its study if completeness class (CC) ≥85%. Percentages can be calculated by formula:

$$CC = \frac{\textit{Number of Students who Complete Learning}}{\textit{Total Number of Students}} \cdot 100\%.$$

The level or criteria of student mastery over MCS is presented in Table 3.

Table 3. Level of MCA Mastery

$0 \leq MCA < 45$	Very less
$45 \leq MCS < 65$	Less
$65 \leq MCS < 75$	Enough
$75 \leq MCS < 90$	Good
$90 \leq MCS \leq 100$	Very good

3.6. Student Response

The student response to learning devices was analyzed by calculating the percentage of many students who responded positively to the statements in the questionnaire sheet. The formula is:

$$PSR = \frac{\sum A}{\sum B} \cdot 100\%$$

Note:
PSR: Percentage of students who gave a positive response to the statements in the questionnaire.
$\sum A$: The number of students who gave positive responses.
$\sum B$: The number of students (respondents).

The criteria established to say that students have positive responses to learning devices are developed when the number of students who respond positively is greater or equal to 80% [24].

4. Results

4.1. The Validity of Learning Devices

The results of the validation of the DLSG-based learning devices by five validators are presented in the following table. Furthermore, the validators stated that this learning devices only needed a little revision. Result of learning devices validity is presented in Table 4.

Table 4. Validity Results of Learning Devices

No.	Judged Object	Average	Validity Level
1	Learning Implementation Plan (LIP)	4.52	Valid
2	Teacher's Book (TB)	4.44	Valid
3	Student Book (SB)	4.40	Valid
4	Student Worksheet (SW)	4.38	Valid

Table 4 shows that average score given by all of validators is more than 4.00. It means, all validators agree that learning devices based on DLSG is valid. As an initial step of the study, learning devices including the MCS test instrument and student learning motivation questionnaire were tested in class IX-4 of Aisiyah Medan City senior

high school. The result is that the learning devices and instruments developed are practice with MCS instrument and motivation scale reliability respectively of 0.8441 (very high category) and 0.9629 (very high category). A valid learning devices is then implemented in class IX-1 SSH Aisiyah Medan City. The results show that the learning device developed has valid, practical and effective characteristics.

4.2. Trial I

Practicality

The DLSG-based learning devices developed is said to be practical if it meets two indicators. First, the learning device practitioner states that the device can be used after going through a few revisions. The validity average value obtained is very high (4 ≤ ▯ <5). The results of the analysis of the feasibility of the learning kit are presented in Table 5 below:

Table 5. Average Observation Value of the Learning Devices Implementation at Trial I

Overall 2 Observers	Meeting				Total Average	Explanation
	1	2	3	4		
Testing	4.32	4.39	4.44	4.48	4.40	Very High

Effectiveness

The results of the completeness level assessment of DLSG-based learning devices are presented in Table 6 as follows.

Table 6. The Completeness Level of MCS Achievements Classically in Trial I

Category	MCS	
	Total students	Percentage
Complete	27	81.8%
Incomplete	6	18.2%
Total	33	100%

The completeness of learning objectives is reviewed from the results of the MCS Test that has been developed in this study in accordance with DLSG-based learning. Students MCS achievements are presented in Table 7.

Table 7. Achievements of MCS in Trial I

MCS Achievement	Indicator		
	Written Text	*Drawing*	*Mathematical expressions*
Percentage	85.00%	69.41%	69.41%
Average	74.61%		

Student Response

Student responses toward learning devices based on DLSG in the first trial have reached a high category, that is 97.78%. This shows that, this learning device has fulfilled one of the criteria of an effective learning device.

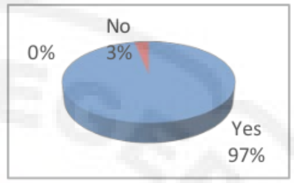

Figure 1. Percentage of Student Response Scores

It can be seen in Figure 1 that students response toward learning devices based on GLSG is high enough, that is 97%.

4.3. Trial II

Practicality

The DLSG-based learning devices developed has met the practicality criteria with very high scores (4 ≤ ▯ <5). The results are presented in Table 8 below.

Table 8. Average Observation Value of the Implementation of Trial Learning Devices II

Overall 2 Observers	Meeting				Total Average	Category
	1	2	3	4		
Testing	4.74	4.76	4.79	4.73	4.73	Very high

Effectiveness

The DLSG-based learning devices that was developed has met the effective criteria because it has met students' mastery of learning classically, i.e. more than 75% of students who take part in learning can achieve a score of ≥75. This criterion fulfills the learning completeness criteria [24]. Furthermore, the teacher's ability to manage learning has been quite good. All of these criteria are presented in Table 9.

Table 9. Completeness Level of Classical Learning Objective in Trial II

Category	MCS	
	Total Students	Percentage
Complete	32	94.12%
Incomplete	2	5.88%
Total	34	100%

The completeness of learning objectives is reviewed from the results of the MCS Test that has been developed. A description of the percentage of completeness learning objectives in trial II is shown in Table 10.

Table 10. Percentage of Completeness in Student Learning Objectives in Trials II

Learning objectives	Indicator		
	Written Text	*Drawing*	*Mathematical expressions*
Percentage	88.24%	85.59%	85.88%
Average	86.57%		

Student Response

The results showed that the majority of students gave positive responses to DLSG based learning. Student responses on trial II have reached the high category, that is 98.04%.

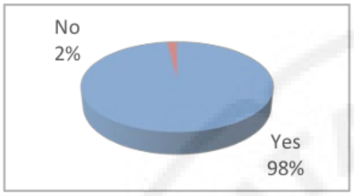

Figure 2. Percentage of Student Responses in Trial II

It can be seen in Figure 2 that students response toward learning devices based on GLSG in trial II is high enough, that is 98%. Students response is one of three component of learning devices effectiveness criteria.

The Improvement of Mathematical Communication Skills (MCS)

Descriptions of learning objective improvement of the students taught using the DLSG-based learning devices in trial I and II are presented in Table 11. Learning objective means the students achievement in MCS.

Table 11. The Improvement of Students' Mathematical Communication Skills

Number of Trials	Description	Average Score			
		Indicator 1	Indicator 2	Indicator 3	Average
I	**Total Score**	289/330	236/330	236/330	76.87
	Percentage	87.58	71.52	71.52	
II	**Total Score**	300/340	291/300	293/340	86.57
	Percentage	88.24	85.59	85.88	
Improvement		0.66	14.07	14.36	9.7

The Improvement of Student Learning Motivation

The average score of students' learning motivation that is taught using the DLSG-based learning devices at every indicator in trial I and trial II is presented in Table 12.

Table 12. Average Student Learning Motivation at Every Indicator

No.	Indicators of Learning Motivation	Trial I	Trial II
1	Confident in using mathematics	16.79	17.08
2	Flexible in doing mathematical work	13.03	13.61
3	Willingness to leave other obligations or duties	13.55	13.50
4	Perseverance in doing mathematics	14.39	14.26
5	Can defend opinions	13.91	14.05
6	Persistent and tenacious in doing math tasks	14.24	13.67

Based on Table, 12 it can be concluded that student motivation after the teacher implements a DLSG based learning devices has increased at every indicator.

5. Discussion

Based on data obtained from the results of trials I and II show that: (1) DLSG-based learning devices have fulfilled valid, practical, and effective criteria in accordance with those set by Nieveen [21]; (2) there was an increase in student MCS; (3) there is an increase in student motivation.

Based on the validation, component of learning devices based on LDSG such as Learning Implementation Plans (LIP), Teacher Books (TB), Student Books (SB), and Student Worksheets (WS) has a good level of validity. In addition, MCS instruments and student learning motivation questionnaires also have a good level of validity. This shows the DLSG-based learning devices developed in both LIP, TB, SB, WS, MCS tests and student learning motivation questionnaires have met valid criteria.

The practitioners stated that the learning devices developed in the form of LIP, TB, SB, WS, MCS Tests, and Student Learning Motivation Questionnaire only needed a little revision, especially in the format and language used.

Test analysis from trial I and trial II showed that the MCS of students had met the individual or classical completeness criteria. This is because the material and problems contained in student books and activity sheets are developed in accordance with the conditions of the student's learning environment and refer to the learning devices based on Discovery Learning with the SAVI approach assisted by GeoGebra (DLSG). In addition, the teacher has implemented learning in accordance with the syntax of DLSG-based learning. Furthermore, the use of GeoGebra software to solve MCS problems has made students interested and motivated to solve MCS problems manually, as well. Student activities in learning significantly increase so that it can be understood why an increase in mathematical communication skills (MCS). So, it appears that motivation grows as DLSG-based learning takes place, in turn the motivation is successful in increasing students' enthusiasm to solve problems so that students achieve an average MCS test score above 75 from an ideal score of 100.

The increasment of students MCS and learning motivation occur because in DLSG classroom, students will be actively involved in the problem solving process. Students analyze and evaluate their own thinking processes and make conclusions from the knowledge that has been found with or without the guidance from the teacher or friend. Moreover, DLSG learning devices is based on the premise that problematic situations that are confusing or unclear will arouse students' curiosity so that it makes them interested to investigate. In other words, learning devices based on DLSG can arouse students' learning motivation so as to cause learning activities to be effective.

Furthermore, students give a positive response to the learning tools because the teacher has provided stimulus in the form of feedback and reinforcement in accordance with students' answers to the MCS problems. In other words, the teacher in this study has carried out his role well, especially in terms of providing scaffolding, feedback and reinforcement.

The findings of this study indicate that the mathematical communication skills of Indonesian students still have the opportunity to increase if direct instruction (the learning approach used so far), accompanied by student-centered learning such as discovery learning. Even better if the teacher implements a DLSG-based learning devices that is develoved in this research.

6. Conclusion

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Based on the results of the analysis and discussion, the following conclusions are obtained:

1. Learning devices developed based on Discovery Learning with the SAVI approach assisted by GeoGebra (DLSG) meet valid, practical, and effective requirements to improve MCS and student motivation.

2. Student MCS test scores increased from 81.82 to 94.12.

3. Student motivation scores increased from 85.97 to 86.20.

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