Development of Model-Based Learning Devices Cooperative Type Student Teams Achievement Division (STAD) Assisted by Geogebra to Improve Abilities Mathematics Problem Solving of Class X Students Man 1 Deli Serdang

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Abstract
This study aims to produce a valid, practical, and effective Geogebra-assisted STAD model-based learning tool to improve students' mathematical problem solving abilities. This development research uses a 4D development model with the target target or research subject is student class X MAN 1 Deli Serdang. The data analysis technique used is quantitative and qualitative data analysis and t-test. The results of the study concluded that: (1) the learning tool based on the Geogebra-assisted STAD model that was developed was declared valid (feasible), practical and effective to be used in mathematics learning material on two-variable linear equation system in class X MAN 1 Deli Serdang.
Keywords: Learning Tools, STAD, Geogebra, Mathematical Problem Solving Ability, 4D Model
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1. PRELIMINARY

Mathematics as a basic science is one of the subjects that plays an important role in every level of education as a means of logical, critical, analytical, rational and systematic thinking. According to the National Council of Teachers of Mathematics (NCTM) as quoted by Armadan, et al. (2017), there are 5 (five) basic abilities that are used as standards in the mathematics learning process, namely problem solving skills, reasoning abilities and reasoning. and proof), the ability to communicate (communication), the ability to connect (connections) and the ability to represent (representation).

Problem solving skills are one of the basic mathematical thinking skills that students are expected to have. Hudojo, as quoted by Sirait and Siagian (2017), states that problem solving is an essential thing in teaching mathematics because: (1) students become skilled at selecting relevant information, then analyze it and finally reexamine the results; (2) intellectual satisfaction that will arise from within is an intrinsic gift to students; (3) students' intellectual potential increases; and (4) students learn how to make discoveries through the process of making discoveries.

Problem solving skills are very important for students and their future. However, the reality shows that students' achievement in mathematics is still low and has not met expectations. The low ability of solving mathematical problems is due to the fact that there are still many students who experience difficulties in learning mathematics, are less interested, and always think of mathematics as a difficult science, causing fear to learn mathematics, as expressed by Abdurrahman (2012), that "from various field of study taught in schools, mathematics is a field of study that is considered the most difficult by students, both those who do not have learning difficulties, and especially for students who have learning difficulties.

The ability to solve math problems will be obtained by students well if there is communication between teachers and students and between students that stimulates participation. Teachers can ask questions that provoke students to solve a problem, also can design learning that allows students to get answers (Murniati, et al, 2013). The ability to solve math problems, especially in the form of math problem problems, requires students to think at a higher level. These abilities include: (1) determining something that is known, (2) determining what is being asked, (3) determining the required mathematical model, and (4) making calculations according to the mathematical model (Yulianti, 2012).

The success of learning mathematics must be accompanied by the availability of learning tools. Therefore it is necessary to develop learning tools that are in accordance with the demands of the curriculum and consider the needs of teachers and students so that it can improve students' mathematical problem solving abilities, especially solving problems in everyday life. According to Mulyasa (2014), "curriculum development 2013 is focused on the formation of competence and character of students, in the form of skills knowledge guides, and attitudes that students can demonstrate as a form of understanding the concepts they learn contextually".

2. LITERATURE REVIEW

According to Trianto in Siagian, et al (2016), "learning devices are devices used in the learning process. The arrangement of the tools is the initial stage in learning ". Therefore, the quality of the tools used also determines

the quality of learning. To produce good quality learning tools, learning tools must be carefully arranged and planned to produce a good learning activity.

Siagian, et al (2016), also explained that "improving the quality of learning will lead to an increase in the quality of human resources and the welfare of people's lives. One of the efforts that can be done is through improving the learning resources of mathematics material in schools ". The learning resources in question are in the form of learning tools such as teaching materials, lesson plans (RPP), assessment instruments, and student activity sheets.

In line with the 2013 curriculum which mandates that learning including mathematics learning must be student-centered with the recommended approach, namely the scientific approach, so to be able to improve students' mathematical problem solving skills, it is necessary to develop mathematics learning tools, one of which is based on cooperative type Student Team. Achievement Division (STAD) assisted by Geogebra.

Slavin (2011), explains that "the main idea of STAD is to motivate students to support and help one another in mastering the skills taught by the teacher". If students want their team to win team awards, they must help their teammates to study the material. Students must support their teammates to do their best, demonstrating the norm that learning is important, valuable and fun. Students work with their teammates, assessing their strengths and weaknesses to help them succeed on the quiz. Every student must know the material. Individual responsibility like this motivates students to explain well to one another, because the only way for the team to succeed is to make all team members master the information or skills being taught. According to Slavin (2011), "the STAD cooperative learning model consists of five main components, namely: (1) class presentation, (2) group activities, (3) individual tests (quizzes), (4) individual enhancement or development, and (5)) recognition or group awards ".

The STAD type cooperative learning model in mathematics learning will be more successful if it is assisted by the use of Geogebra software. This program can not only be used in schools, Geogebra can also be installed on personal computers and used anytime and anywhere by students and teachers. For teachers, Geogebra offers an effective opportunity to create an interactive online learning environment that allows students to explore a variety of mathematical concepts. (Fitra and Syahputra, 2018). Geogebra is very useful as a medium for learning mathematics such as: demonstration and visualization media, construction tools, and tools to help the discovery process (Budiman and Ramdhani, 2017). According to Antohe in Ariawan, et al (2017), "by using Geogebra students will be able to 'see' an abstract concept, students can make mathematical connections and discoveries ". Students' ability to find answers electronically will generate interest in mathematics and can improve and develop their cognitive abilities

Based on the phenomena and descriptions above, it is necessary to develop mathematics learning tools that can support the application of the Geogebra-assisted STAD type cooperative learning model, so that the model can be implemented effectively and optimally. The quality of the learning tools developed in this study is based on the criteria proposed by Nieveen in Rochmad (2011), covering three aspects, namely: "validity, practicality, and effectiveness".

3. RESEARCH METHOD

The research carried out includes the type of research and development (R&D). The research subjects of this development consisted of: 1) two instrument validators, namely the questionnaire validator, the test validator (students' communication skills and mathematical problem solving); 2) two expert validators to evaluate the learning tools developed, 3) teachers, and 4) students of class X MAN 1 Deli Serdang, totaling 30 students. While the object in this study is a learning tool based on the STAD cooperative model with Geogebra assistance to improve students' mathematical problem solving skills in the material of two-variable linear equation system (SPLDV) in class X SMA / MA. The learning tools developed include: lesson plans, teacher books, student books, student worksheets and students' mathematical problem solving ability tests.

The development model used is the 4-D development model proposed by Thiagarajan and Semmel (Trianto, 2014), which consists of four stages, namely: define, design, develop, and disseminate. Instruments and data collection techniques in this development research using interviews, validation sheets, observation sheets, questionnaires and tests. The data analysis technique used is quantitative and qualitative data analysis including validity analysis, practicality and effectiveness analysis as well as t-test.

4. RESULTS AND DISCUSSION

The development of learning tools is carried out using the 4D development model, namely: define, design, develop, and disseminate. The result of the development that has been done is a cooperative model-based learning tool type Student Teams Achievement Division (STAD) assisted by Geogebra on the material of two-variable linear equation systems in the form of lesson plans, teacher books, student books, student worksheets and valid (feasible) Mathematical Problem Solving Ability Tests, practical and effective in improving the mathematical problem solving skills of class XI students of MAN 1 Deli Serdang.

4.1 Validity Analysis Results

The feasibility (validity) of the learning tools that have been developed can be seen from the results of the validation sheets that have been filled in by the five expert validators (lecturers and teachers). The feasibility (validity) of the learning device is briefly summarized in Table 1.

Table 1. Summary of Learning Tool Validation Results

No.	Rated Device	Average Total Score	Category
1	Learning Implementation Plan (RPP)	4.28	Very Valid
2	Teacher's Book	4.06	Valid
3	Student Book	4.09	Valid
4	Student Activity Sheet (LKPD)	4.07	Valid
5	Math Problem Solving Ability Test	4.30	Very Valid

Table 1 above, shows that the total average validation value for RPP tools is 4.28 or declared very valid. The teacher's book set is 4.06 or declared valid. The Student Book set is 4.09 or declared valid. For LKPD equipment of 4.07 or declared valid. The Mathematics Problem Solving Ability Test device is 4.30 or declared very valid. Thus, based on the results of the assessment of practitioners and expert validators (teachers and lecturers), it is concluded that all learning tools developed are declared valid and suitable for use in the learning process in the classroom.

4.2 Results of Practicality Analysis

The practicality of the learning tools was analyzed based on data obtained from student response questionnaires and teacher responses. The practicality of the learning tools, is summarized briefly in Table 2.

Table 2. Summary of the Practicality of Learning Devices

Response	Assessed Learning Tools	Average Total Score	Criteria
Teacher	Teacher's Book	4.80	Practical
	Student Book	4.83	Practical
	LKPD	4.83	Practical
Students	Student Book	3.90	Practical
	LKPD	4.00	Practical

Table 2 above, shows that the total average value of the teacher's response to the Teacher Book set is 4.80 or classified as practical criteria. The average total value of the teacher's response to the Student Book set is 4.83 or classified as practical. The average total value of teacher responses to the LKPD is 4.83 or classified as practical. Furthermore, the average total student response score on the Student Book set is 3.90 or classified as practical. The average total student response score on the LKPD equipment was 4.00 or classified as practical. Thus, based on the results of teacher and student responses, it is concluded that the learning tools developed (Teacher's Book, Student Book and Student Worksheet) are declared practical to be used in the learning process in the classroom.

4.3 Effectiveness Analysis Results

The effectiveness of the developed learning device products was analyzed from the results of the students 'mathematical problem-solving abilities test based on students' learning completeness and the results of the student's response analysis. The effectiveness of learning tools is summarized in Table 3.

Table 3. Summary of the Effectiveness of Learning Devices

Analysis Results		Average Value	% Completeness	% Positive	Criteria
Postes		83.67	93.3%	-	Effective
Student Response	Student Book	3.90	-	100%	Effective
	LKPD	4.00	-	100%	Effective

Table 3 above, shows that the average post-test score of students' mathematics problem solving abilities is 83.67 with a completeness percentage of 93.3% or declared effective. The average total student response score on the Student Book set was 3.90 with a positive response percentage of 100% or declared effective. The average total student response score on the LKPD device was 4.00 with a positive response percentage of 100% or declared effective. Thus, based on the results of the test of students' mathematical problem solving abilities (posttest) and the results of the student response questionnaire analysis, it was concluded that the learning tools developed were declared effective in the learning process of mathematics in the classroom.

4.4 Improved Students' Mathematical Problem Solving Ability

The improvement of students' mathematical problem solving abilities in this study was analyzed using a pretest-postest-design pattern with one subject sample without a control sample as a comparison. Data descriptions of students' mathematical problem solving abilities (pretest and posttest), are summarized briefly in Table 4.

Table 4. Data Description of Students' Mathematical Problem Solving Ability

Statistics	Pretest	Postes	Gain
Number of Students (N)	30	30	30
Average Value	27.60	83.67	0.7753
Standard Deviation	7,074	7,068	0.09497
Variance	50,041	49,954	0.009
Lowest Value	12	68	0.56
The highest score	44	98	0.97
Total Value	828	2510	23.36

Table 4 above, shows that the students 'initial mathematical problem solving abilities from the pretest results obtained an average value of 27.60 and a standard deviation of 7.074 with the lowest score of 12 and the highest of 44. Students' mathematical problem solving abilities from the post-test results obtained an average a value of 83.67 and a standard deviation of 7.068 with the lowest value of 68 and the highest of 98. Furthermore, the level of mathematical problem solving ability based on the gain value is obtained by an average of 0.7753 or classified as high with the lowest gain value of 0.56 (moderate) and the highest gain value is 0.97 (high).

Furthermore, to analyze whether there was an increase in students' mathematical problem solving abilities, it was analyzed from the difference between the post-test scores and the pretest scores and analyzed using the t-test of one sample group or the paired sample T-test approach with the help of the SPSS program.

Table 5. T-test results (paired sample T-test)

		Mean	Std. Deviation	t	df	Sig. (2-tailed)
Pair 1	Posttest - Pretest	56,067	8,749	35,009	29	0,000

Based on the results in Table 5 above, it shows that the t-test results with the paired sample t-test approach obtained a t-count value of 35.009. with a probability value or Sig of 0.000 <0.05. Thus, it can be concluded that there is an increase in students' mathematical problem solving abilities taught using learning tools developed through Geogebra-assisted STAD cooperative model-based learning on two-variable linear equation system material in class X MAN 1 Deli Serdang.

The criteria for improving students' mathematical problem solving abilities based on normalized gain scores, are summarized in Table 6.

Table 6. Summarize the Level of Students' Mathematical Problem Solving Ability

No.	Gain value	The number of students		Category
		F	%	
1	g <0.30	0	0.0	Low
2	0.3 ≤ g ≤ 0.7	7	23.3	Moderate
3	g> 0.07	23	76.7	High
	amount	30	100	

Table 6 above, shows that of the 30 students there were 7 students (23.3%) whose level of mathematical problem solving ability was in the moderate category and as many as 23 students (76.7%) were in the high category (complete data in Appendix 29). This also indicates that the use of learning tools developed through learning based on the Geogebra-assisted STAD-type cooperative model on the material of the two-variable linear equation system has been proven to improve the mathematical problem solving abilities of students in class X MAN 1 Deli Serdang with the average belonging to the high category.

4.5 The process of solving students' mathematical problem solving ability test answers

The process of solving students' mathematical problem solving can be analyzed based on the student's answer sheet in solving post-test problems of mathematical problem solving abilities after being given treatment or learning in class. The number of post-test questions on the ability to solve math problems given to students was 5 questions in the form of essays or story questions on the SPLDV material. The results of the analysis based on the answer sheets for the students as a whole show that the process of solving post-test problems in mathematics problem solving abilities on average SPLDV material is classified as capable, both in the indicators of understanding the problem, planning problem solving, implementing problem solving and on checking indicators again.

Based on the results of the analysis of the student answer sheets, for the test questions number 1, 3, 4 and 5 the overall average of the students was capable. The results of the analysis, for question number 1 out of 30 students, there were 15 students (50%) who were able to solve the questions correctly; for question number 3 there were 20 students (66.7%); for question number 4 there were 26 students (86.7%); for question number 5, there are all students (100%) who are able to solve the questions correctly. However, for question number 2 there were only 3 students (10%) who were able to solve the questions correctly.

Overall, of the 5 post-test questions the ability to solve math problems on the SPLDV material were given an average of 4 questions the students could or were able to solve correctly (questions number 1, 3, 4 and 5) while as many as 1 question (question number 2) was still have not been able to or have not been able to finish the students correctly.

CONCLUSION

Based on the research and development findings that have been carried out, the following conclusions are obtained:

1. Learning tools based on the STAD type Geogebra-assisted cooperative model developed on the material of the two-variable class X linear equation system have been declared valid (feasible). The validity (feasibility) of learning tools is fulfilled qualitatively based on the assessment of the expert validators who on average are declared valid. For the lesson plans, an average total value of 4.28 (very valid) was obtained, for the Teacher's Book an average total value of 4.06 (valid) was obtained, for the Student Book an average total value was obtained of 4.09 (valid).), for LKPD obtained an average total value of 4.07 (valid), and for the Mathematical Problem Solving Ability Test instrument obtained an average total value of 4.30 (very valid).

2. The learning device based on the STAD-type Geogebra-assisted cooperative model that has been developed has been declared to be practical in learning mathematics material on the two-variable linear equation system in class X MAN 1 Deli Serdang. The practicality of the learning tools is fulfilled qualitatively based on the results of the questionnaire analysis of the responses of teachers and students which are overall classified as practical categories. For Teacher Books, the total average score of teacher responses is 4.80 (practical). For the Student Book, the total average value of the teacher's response was 4.83 (practical) and the average total value of the student's response was 3.90 (practical). For LKPD, it was obtained that the total average score of teacher responses was 4.83 (practical) and the average total value of student responses was 4.00 (practical).

3. The learning device based on the STAD-type Geogebra-assisted cooperative model that has been developed has also been declared effective in learning mathematics on two-variable linear equation system material in class X MAN 1 Deli Serdang. The effectiveness of the learning tools is met qualitatively based on the average post-test score of the students' mathematical problem solving abilities which is 83.67, the percentage of classical student learning completeness is 96.7% and the positive response of students to Student Books and LKPD is 100 %.

4. The use of learning tools based on the STAD-type cooperative model with Geogebra-assisted development has been proven to improve students' mathematical problem-solving abilities in the material of two-variable linear equation systems in class X MAN 1 Deli Serdang. This is evidenced by the results of the t-test with a t-test value of 35.009 and a probability value of 0.000 <0.05 and the results of the normalized gain score calculation of 0.7753 or classified as high category which also indicates that the use of learning tools based on the cooperative model type STAD assisted The developed geogebra can improve students' mathematical problem solving abilities by an average belonging to the high category.

5. The process of solving students' answers in solving the problem of mathematics solving ability on average is classified as capable, both on indicators of understanding the problem, planning problem solving, implementing problem solving and on checking indicators again. The results of the analysis, for question number 1 out of 30 students, there were 15 students (50%) who were able to solve the questions correctly; for question number 2 only 3 students (10%) were able to solve the questions correctly; for question number 3 as many as 20 students (66.7%) were able to solve the questions correctly; for question number 4 as many as 26 students (86.7%) were able to solve the questions correctly; and for question number 5 all students (100%) were able to solve the questions correctly.

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