

Development of Learning Materials for Geometry Sequences and Series Materials with the Numbered Head Together Model

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Abstract: *This study aims to produce development products for mathematics learning tools in the form of Learning Implementation Plans (RPP), Student Worksheets (LKPD) and Evaluation of Learning Outcomes (EHB) that meet valid, practical and effective criteria using the 4 - D development model according to Thiagarajan who modified into 3 - D namely Define, Design and Develop on Geometry Sequences and Series material for class XI SMA Negeri 1 Motoling. The results of this study indicate that the quality of the product produced based on the validity aspect meets the good criteria for lesson plans with an average total validator rating of 4.19 and LKPD, EHB meets good criteria with an average total validator rating of 4.06. The practicality aspect based on the results of observations of the teacher's ability to manage learning meets the good criteria, as well as student responses to the device and positive learning. Meanwhile, based on the learning outcomes test it was found that the learning tools developed had a very good level of effectiveness with a learning completeness percentage of 81.25%.*

Keywords: learning tools, development, NHT, geometric sequences and series

1. Preliminary

Education is a conscious effort made by adults (educators) in carrying out self - development activities for students so that they become complete human beings in accordance with predetermined goals (Sagala, 2003). Education in its implementation so far is known as an effort in the form of guidance to students to lead children towards achieving certain goals and the process of changing behavior in a better direction (Kompri, 2016). Education is an effort that is carried out systematically and planned to create a generation that has character and is able to actively develop its potential within itself. According to Uno (2008), education is a process of empowerment, which is expected to be able to empower students to become intelligent human beings, knowledgeable and knowledgeable human beings, as well as educated human beings. Therefore, through the educational process it is expected to be able to give birth to students who have the ability to solve problems, and are able to develop their potential so that they can benefit society. However, the obstacle to increasing education in Indonesia today is the level of awareness of students who are less motivated in the learning process, especially in mathematics. Mathematics subjects need to be given to all students starting from elementary school. This is intended to equip them with the ability to think logically, analytically, systematically, critically, creatively, and the ability to work together (Daryanto, 2013). In teaching mathematics to students, if the teacher still uses a one - way learning paradigm, that is generally from the teacher to the students, then the teacher will dominate the learning so that the students feel bored and bored. Therefore, in teaching mathematics to students, teachers should prefer a variety of approaches, strategies, methods that are appropriate to the situation so that the planned learning objectives will be achieved. Based on the results of an interview with one of

the mathematics teachers at SMA Negeri 1 Motoling, the researcher found several problems during the teaching and learning process in class, namely: (1) lack of student confidence which resulted in students being less active, (2) when given assignments, most students only rely on answers from friends, (3) when students are grouped in discussions only 1 or 2 people are active and (4) the teacher's role is more dominant (teacher - centered) in the learning process. Therefore, to solve such learning problems, learning development efforts are needed, namely the development of student - centered learning and can activate students and emphasize that students themselves must build their knowledge. Learning that is not optimal, of course, results in a lack of students' mastery of the subject matter being taught, especially in the material of Geometry Sequences and Series. On the other hand, Geometry Sequences and Series are mathematical concepts that are widely used as the basis of other applied sciences so that they become one of the knowledge that plays an important role in developments in the 21st century.

The activeness of students in the learning process will lead to good interaction between teachers and students and with the students themselves. So the teacher must facilitate student activities in developing their competencies so that they have life skills for life and livelihood as independent human beings. Starting from this it is a challenge for teachers to be able to develop learning tools such as Learning Implementation Plans (RPP), Student Worksheets (LKPD), Learning Outcomes Tests (THB). RPP is a plan and guide for the steps that will be carried out by the teacher in learning activities. The function of the Learning Implementation Plan is as a reference for teachers to carry out teaching and learning activities so that they are more directed and run effectively and efficiently. In other words, lesson plans act as scenarios for the learning process. The

components in the RPP include: school identity, subject identity, class/semester, time allocation, learning objectives, basic competencies, competency achievement indicators, learning materials, learning methods, learning media, learning resources, learning steps, and assessment learning outcomes. (Ministry of Education and Culture, 2016b). According to the Ministry of National Education (2008: 13), Student Worksheets are sheets containing assignments that must be done by students. Worksheets are usually in the form of instructions or steps to complete a task in accordance with the basic competencies to be achieved. In line with this, Trianto (2007), argued that the worksheet contains a set of activities that must be carried out by students to increase understanding in the effort to achieve basic competencies in accordance with predetermined competency achievement indicators. The mathematics learning evaluation instrument is a measuring tool used to assess and evaluate the extent to which the mathematics learning process achieves its goals (Hamzah, 2014). In the Regulation of the Minister of Education and Culture of the Republic of Indonesia Number 22 of 2016 concerning Process Standards for Elementary and Secondary Education it is stated that evaluation of learning outcomes is carried out during the learning process and at the end of the lesson unit using methods and tools: oral/action tests, and written tests. Nazarudin (2007), argues that learning tools are preparations prepared by the teacher so that the implementation and evaluation of learning can be carried out systematically and obtain the expected results. Learning tools that must be prepared by teachers based on predetermined principles and rules are the Annual Program, Semester Program, Syllabus, Learning Implementation Plans (RPP), Learning evaluation instrument banks, Gradebooks, KKM, Student data books, teaching agenda books, Liaison books between teachers and parents of students, meeting minutes books and class inventory books. According to Zuhdan, et al (2011) learning devices are tools or equipment to carry out processes that enable educators and students to carry out learning activities. Student activities must refer to a learning model so that the devices developed become a single unit that is complementary and focused on the goals to be achieved. One effort to improve teaching and learning outcomes in the classroom is to develop learning tools, because with learning tools the teacher knows how to manage learning and how teachers are able to train process skills well. A good learning process certainly has good preparation from the teacher, namely in the form of readiness in teaching as seen from the readiness of learning tools. Each teacher in an education unit is obliged to develop complete and systematic learning tools so that learning takes place interactively, inspiring, fun, challenging, motivating students to participate actively, creatively, and independently in accordance with the talents, interests, and physical and psychological development of students (Ministry of National Education, 2007). The Numbered Head Together (NHT) cooperative model is a type of cooperative learning that conditions students to think together in groups where each student is given a number and has the same opportunity to answer the problems posed by the teacher through random number calling (Lestari, 2015). The advantages of this type of cooperative model are positive dependability, individual responsibility, personal interaction, and teamwork skills. One type of cooperative

learning that can build cooperation between students and encourage student participation in class. Based on the results of Rositawati's research (2012), that the NHT type cooperative learning model can increase group work activities and learning outcomes, can increase positive attitudes, can motivate during group work, gives students confidence, and makes learning fun. Slavin (2010) states that cooperative learning is a learning model or reference in which in the ongoing learning process, students are able to learn and work in small groups collaboratively whose members consist of 4 to 6 people, with heterogeneous group structures. or with different characteristics. In learning with this model, the results of student responses can be seen if students give a positive response to learning mathematics using the NHT type cooperative learning model. This response was in the form of students feeling interested and not bored during the learning process, students felt it was easy to understand the subject matter, students easily collaborated in group discussions and dared to express opinions. The steps for implementing NHT according to (Daryanto; 2013) are as follows: (1) The teacher conveys learning material or problems to students according to the basic competencies to be achieved, (2) The teacher gives individual quizzes to students to get a basic score or early, (3) The teacher divides the class into several groups. Each group consists of 4 - 5 students. Each group member is given a number or name, (4) The teacher poses a problem to be solved with the group, (5) The teacher checks students' understanding by calling one of the number (name) of group members to answer. The answers of one student appointed by the teacher represent the answers of the group, (6) The teacher facilitates students in making summaries, directing and giving confirmation at the end of learning, (7) The teacher gives tests/quizzes to students individually, (8) The teacher rewards the group through the next (latest) quiz score.

2. Research Procedure

The research design used in developing learning tools uses the Thiagarajan model known as the 4D Model which is modified (Trisna, 2005) into 3 (three) stages, namely the Define Stage, Design Stage and Develop Stage with the activity scheme as shown in Figure 2.1. To measure the achievement of development results, Nieveen's criteria (1999) were used which included the criteria for validity, practicality and effectiveness of the developed learning tools. The fulfillment of the validity criteria depends on the results of the assessment by experts and practitioners.

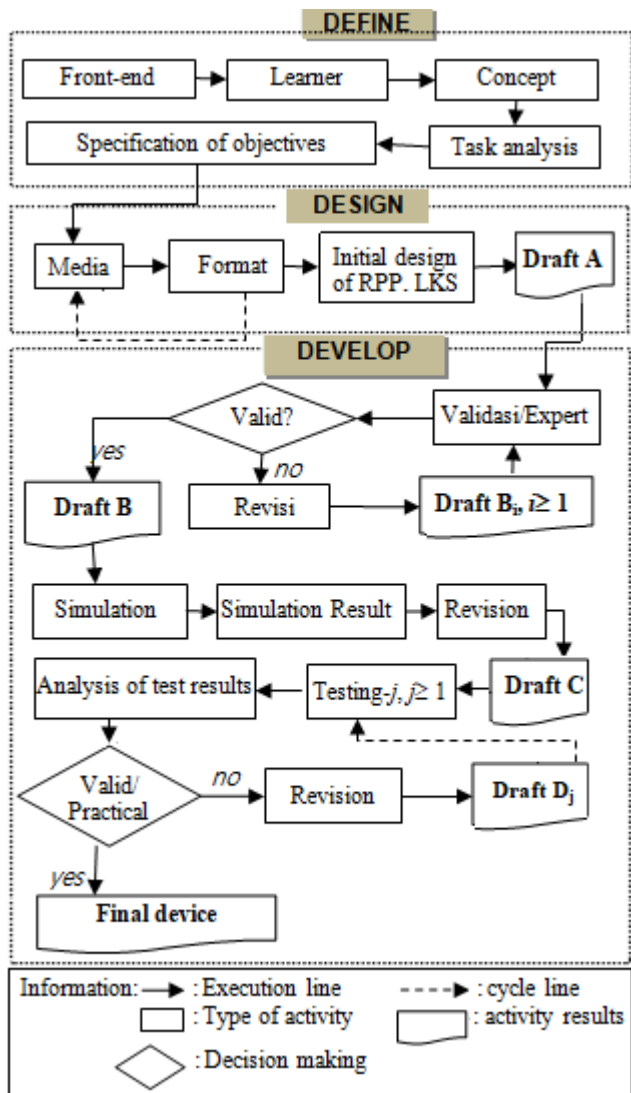


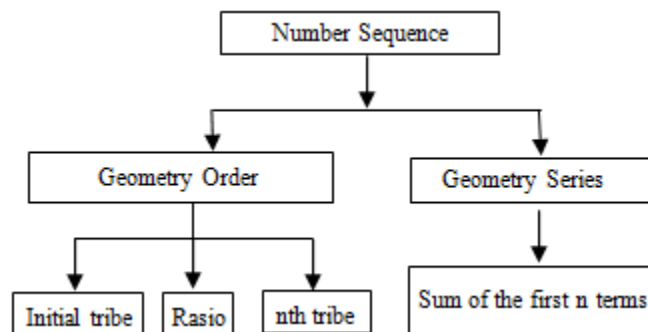
Figure 2.1: Modification of the 4 - D Learning Device Development Model adopted from (Trisna, 2005)

The fulfillment of practicality criteria depends on field data about the teacher's ability to manage learning. The fulfillment of the criteria for effectiveness varies with the fulfillment of the criteria for student learning outcomes and the results of student responses to learning and the tools used directly by students.

3. Results and Discussion

Results at the Defining Stage. Early - end analysis: Obtained information that the learning tools at the school are still classified as inadequate or have not used varied learning models seen from the learning process the teacher uses only one learning method, namely the lecture method so that the learning process is only centered on the teacher, the LKPD used in learning only in the form of questions that must be answered by students so that they cannot make students active in learning. Student Analysis: Analysis of student characteristics aims to determine the characteristics of class XI MIPA students of SMA Negeri 1 Motoling such as ordinary children, pleasant children, or children who are difficult to adjust to. Based on some of these student characteristics, a learning tool is needed to overcome

existing problems and to generate motivation, interest and activeness in learning mathematics in class. Therefore, researchers developed learning tools with the NHT model because in the NHT model, students can unite each other's opinions in group work activities, in order to deepen their knowledge. Concept/Material Analysis: At this stage the results are obtained in the form of identifying the concepts being taught which are arranged in a systematic and detailed manner. The results of this analysis are in the form of a concept map as shown in Figure 3.1. Task Analysis: This stage is carried out to analyze the main tasks or skills that students must have after studying the subject of Geometry Sequences and Series. The tasks that will be carried out by students referring to indicators of competency achievement in K - 13 during the learning process are (1) Explaining the concept of number patterns, (2) Explaining the concept of geometric sequences and series, (3) Solving problems related to sequences and series geometry, (4) Presenting problem solving related to geometric sequences and series. The learning objectives are adjusted to the basic competencies listed in the 2013 curriculum. The learning objectives that are used as a reference in making lesson plans, worksheets, and EHBs that are developed are (1) students can discover the concept of number patterns, (2) students can discover the concept of a sequence and geometric series, (3) Students can solve problems related to geometric sequences and series, (4) Students can present solutions to problems related to geometric sequences and series.



Gambar 3.1: Materi Barisan Dan Deret Geometri

Analysis of the Validity of Learning Devices: The validation of the learning instruments and devices used in the research was carried out by three experts, namely two Lecturers in Mathematics Education at Manado State University (UNIMA) and a mathematics teacher at the school where the research was conducted. The following are the results of the RPP validation in brief, which can be seen in table 3.1. Based on the results of data analysis in the table above, it can be seen that the initial RPP design that was developed met the minimum criteria both in all aspects and the average total score of RPP validation from the three experts, namely 4.23 with very good criteria. From these criteria it can be concluded that the RPP developed is very good (valid) and suitable for use in learning geometric sequences and series. The results of Student Worksheet Validation can be seen in the following table 3.2.

Table 3.1: Analysis of the Validity of the Learning Implementation Plan

No	Aspek Penilaian	Jumlah Butir	Nilai yang diberikan oleh tiap validator	Rata - rata	Kriteria
1	Identitas	8	100	4,25	Sangat Baik
2	Indikator dan Tujuan Pembelajaran	4	49	4,17	Sangat Baik
3	Pemilihan Materi	4	50	4,17	Sangat Baik
4	Pemilihan Pendekatan dan/atau Model Pembelajaran	5	62	4,20	Sangat Baik
5	Kesesuaian Kegiatan Pembelajaran dengan Model NHT	8	97	4,56	Sangat Baik
6	Sumber Belajar & Penilaian Hasil Belajar	8	98	4,33	Sangat Baik
Rata - rata skor total		37	455	4,23	Sangat Baik

Table 3.2: Student Worksheet Validation Results

No	Aspek Yang Dinilai	Jumlah Butir	Nilai Yang Diberikan Oleh Tiap Validator	Rata - rata	Kriteria
1	Format LKPD	7	87	4,19	Sangat Baik
2	Isi LKPD	7	86	4,10	Sangat Baik
3	Bahasa dan Tulisan	5	65	4,33	Sangat Baik
4	Ilustrasi, Tata Letak Tabel dan Diagram/Gambar	4	50	4,08	Sangat Baik
5	Manfaat/ Kegunaan LKPD	2	25	4,33	Sangat Baik
Rata - rata Skor Total		25	313	4,21	Baik

Based on the results of the data analysis in the table above, it can be seen that the initial LKPD design that was developed met the minimum good criteria on all aspects and the average total score of LKPD validation from the three experts was 4.21 with good criteria. From these criteria it can be concluded that the LKPD developed is very good (valid) and suitable for use in learning Arithmetic Sequences. The results of expert validation of EHB are presented in the following table 3.3

Table 3.3: Results of Validation Evaluation of Learning Outcomes

No	Aspek Yang Dinilai	Jumlah Butir	Nilai Yang Diberikan Oleh Tiap Validator	Rata - rata	Kriteria
1	Materi	4	49	4,17	Baik
2	Konstruksi	4	48	4,08	Baik
3	Bahasa	2	26	4,50	Baik
Rata - rata skor total		10	125	4,20	Baik

Based on the results of the data analysis in the table above, it can be seen that the initial EHB design that was developed met the minimum criteria both in all aspects and the average EHB validation total score of the three experts, namely 4.20 with good criteria. From these criteria it can be concluded that the developed EHB is very valid and suitable for use in learning Geometry Sequences and Series.

Practicality Analysis of Learning Devices: The results of the analysis of the teacher's ability to manage learning are presented in table 3.4. Based on the results of the analysis, the teacher's ability to manage learning at the first meeting reached the very good category and at the second meeting reached the very good category. This learning tool did not undergo revision based on the observations of the teacher's ability to manage learning. Questionnaires of Student Responses to learning tools and implementation are used to obtain an overview of students' opinions about subject matter, LKPD, EHB, learning atmosphere, way of learning.

Table 3.4: Teacher Ability to Manage Learning

No	Aspek	Butir	Pertemuan	
			I	II
1	Pendahuluan	1	4	4
		2	5	5
		3	4	5
2	Kegiatan Inti	4	4	4
		5	5	5
		6	4	4
		7	4	5
		8	5	5
		9	4	4
		10	5	5
		11	5	5
3	Penutup	12	5	5
		13	4	4
		14	5	5
4	Pengelolaan Waktu	15	5	5
		16	4	4
5	Suasana Kelas	17	5	5
		18	4	4
Rata - rata			4,4	4,5
Kategori			Sangat Baik	Sangat Baik

Based on the results of the analysis and student response questionnaires, the percentage results for each category were more than 80%, so the student response was positive. Based on the results of the analysis of student response data and the teacher's ability to manage learning, it can be concluded that learning tools meet practical criteria.

Analysis of the Effectiveness of Learning Devices: The following presents the results of the completeness analysis of the evaluation of learning outcomes.

Table 3.6: Analysis of Completeness Evaluation of Learning Outcomes

Jumlah Peserta Didik	Jumlah Peserta Didik Yang Tuntas	Presentase Ketuntasan	Jumlah Peserta Didik Yang Tidak Tuntas	Presentase Ketidaktuntasan
28	24	85,71%	4	14,28%

Based on the research results, the learning materials (RPP, LKPD, and EHB) produced are of high quality and meet eligibility in terms of validity, practicality, and

effectiveness. The procedures carried out in developing and producing learning tools that are valid, practical and effective go through several stages, starting from the stages of defining (Define), Design (Design) and Development (Develop). The material chosen for the learning tools developed is Geometry Sequences and Series. The test results show that the topic of Geometry Sequences and Series is suitable and very well taught with the NHT model. During the trial, many students actively expressed their opinions, occasionally students asked questions they did not understand. Students become enthusiastic in learning because the implementation of learning activities with the NHT model is carried out by involving problems that are worked on together or in groups so that students are more active in making activity reports. In addition, students also try to think critically in solving the problems given. In other words, the use of NHT can increase students' understanding of what they are learning. Based on the trial results, it can be concluded that NHT makes learning more meaningful. Students will remember learning material longer when learning becomes meaningful and useful. In addition, students who learn based on things that are often encountered in everyday life will help them remember learning material related to this. Students who find learning materials and concepts together/in groups will remember the concepts they have built longer. Based on the description above, learning tools with the Numbered Head Together (NHT) model can be used by teachers in learning not only on the topic of Arithmetic Sequences but also on other topics according to the circumstances so that the achievement of learning objectives is obtained optimally.

4. Conclusions and Suggestions

Based on the research objectives and the research process for the development of learning devices, the following results were obtained: (1) The development of learning devices for Sequences and Geometry Series Materials with the Numbered Head Together Model was developed based on the 4 - D development procedure which was modified through 3 stages, namely the definition stage (define), design and development, (2) The resulting learning tools consist of lesson plans, LKPD, and EHB, (3) lesson plans, LKPD and EHB are suitable for use in terms of validity, practicality, and effectiveness. The validity of the developed learning tools (RPP, LKPD, and EHB) is reviewed from the results of the assessment by the validator. RPP development results with an average rating score of 4.23, LKPD development results with an average rating score of 4.21 and EHB with an average rating score of 4.20. The practicality of using mathematics learning tools is seen from the observations of the teacher's ability to manage learning and filling out student response questionnaires. The results showed that the teacher's ability to manage learning at the first meeting was in very good criteria with an average rating score of 4.4 and at the second meeting the criteria were very good with an average rating score of 4.5 and students' responses to the device and implementation positive learning with categories above 80%. The effectiveness of the use of mathematics learning tools is measured by the percentage of learning completeness and the average value of evaluating learning outcomes. Based on the results of the EHB, it shows that the percentage of

learning completeness for Class XI SMA Negeri 1 Motoling is 85.70% and the average EHB score for all students is 82.71. Thus it can be concluded that lesson plans, LKPD, and EHB are used in effective learning. The resulting learning tools in the form of RPP, LKPD, and EHB have met the assessment criteria based on validity, practicality, and effectiveness aspects so that they can be used as alternative sources used by teachers to support learning activities. The mathematics learning tools developed in this study are still limited to the topic of Geometry Sequences and Series, so it is possible for other researchers to develop mathematics learning tools with other topics. In addition, the learning tools developed in this study can be used as reference material in the development of mathematics learning tools on other topics.

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