Development model learning device problem solving material arithmetic sequence learners SMA State Kakas

V Kindangen*, V Sulangi and I W Damai
Mathematics Education Masters Study Program P Ps Unima, Manado, Indonesia

*valentinekindangen943 @ gmail.com

Abstract. This study aims to produce mathematics learning instruments on the Arithmetic Sequence lesson using problem-solving learning with a realistic mathematics approach to the 11th graders at SMA Negeri 1 Kakas that meets the criteria of validity, practicality, and effectiveness. The method of this study applies a modified 4-D model of research and development to design a lesson plan, student worksheet, and learning outcome test. Results find out that at the design phase, the lesson plan, student worksheets, and evaluation of learning outcomes were modified and revised. The results of field trials show that some aspects of learning are effective, and revisions are carried out by revising learning tools to produce final tools, the evaluation of learning outcomes seen from the index of validity and reliability is feasible without any significant revisions. The developed learning instrument by using problem-solving learning with a realistic mathematics approach was effective in teaching the Arithmetic Sequence lesson.

1. Introduction
Long life education. Education is a process that goes on continuously, not stopping. In this educational process, the nobility of human dignity is held closely because humans (who are involved in this education) are the subject of education.

Because it is a subject in education, a responsibility is required in order to achieve a good educational outcome. Examples of good educational outcomes include changes in behavior, attitudes, knowledge, and skills.

Based on research conducted by Putra [1], one of the efforts that can be made to improve human resources is to improve the quality of education which focuses on developing students' thinking abilities. Meanwhile, critical, creative, systematic, and logical thinking can be developed through mathematics education.

This is very possible because mathematics has a structure with strong and clear linkages with one another and has a mindset [2]. The progress of a nation is determined by the ability of its educators to change the character of its future generations.

A teacher is required to transfer knowledge to students. Therefore, the quality of a teacher is very important. There are 3 important interrelated components that must be possessed by a teacher, namely learning management, professional development, and academic mastery.

To support the success of education, a professional attitude of a teacher is needed. One of the competencies that a teacher must have is to prepare learning tools as a guide and to achieve success in education.
Learning tools make it easier and help a teacher in the learning process, because with learning tools a teacher can be more focused in teaching. Some examples of learning tools that must be prepared by a teacher are the Learning Implementation Plan (RPP), Student Worksheet (LKPD), and Learning Outcomes Evaluation (EHB).

According Peppermint No mor 22 of 2006, in Mathematics should be given to all learners from primary schools to equip students with the ability to think logically, analytical, systematic, critical, and creative, as well as the ability to cooperate.

One of the characteristics of mathematics is having an abstract object. This abstract nature causes many students to experience difficulties in mathematics. From the results of observations at SMA Negeri 1 Kakas, it was found that the curriculum used was the 2013 Curriculum.

The evaluation of learning outcomes still shows that the average value of students has not reached the KKM, namely 65. Learning activities are still focused on teachers, even though they have used RPP Curriculum 2013, even though in this curriculum students are required to be more active. The LKPD used also turned out to be considered less attractive by students, so that learning activities did not take place effectively.

Some of the advantages of the Problem Solving learning model are helping students to develop new knowledge and be responsible for the learning they will do. as well as challenging the ability of students so as to provide satisfaction to find new knowledge for students [3].

So the authors chose this learning model to foster self-confidence and help students to dare to show what they have obtained. Learning Devices Is a tool or equipment that must be prepared by the teacher.

There are several components in learning tools, in this case writing will only develop lesson plans, student worksheet, and EHB. Based on the background of the problem, the researcher wants to conduct research on the development of learning tools which include lesson plans, student worksheet, EHB on Arithmetic Sequences material using the Problem Solving learning model in class XI SMA Negeri 1 Kakas.

2. Formulation of the problem
How are the results of the development of learning tools for Arithmetic Sequences and Series using Problem Solving that meet the criteria of being valid, practical and effective?

3. Research methods
Research and development (Research and Development). Based on the research questions that have been stated previously, what was developed in this research is a learning tool. The learning tools developed were RPP, EHB and LKPD.

4. Results and discussion

4.1. Descriptions of results from the defining stage

4.1.1. Final preliminary analysis. At this stage, the researcher found that so far the learning process that is usually carried out by most teachers, including researchers, is one of which is the learning process that tends to go in one direction. For example, the teacher explains the material only with lectures and students take notes.

Likewise, in solving practice questions, the teacher dominates in providing instructions for the solution. Very less giving opportunities for students to complete themselves. The student handbooks are books published by the Ministry of Education and Culture which are considered mandatory and sufficient enough to be used in the learning process and students at home.

Teachers also do not always prepare learning plans in teaching and learning activities to determine learning approaches and methods that are considered appropriate to use. The Student Activity Sheet used is only a collection of questions that must be answered by students according to the instructions in accordance with what can be constructed from the student activity sheet.
To overcome the above problems, in line with the challenges and demands of future learning that require learning to be more learner-centered, the role of the teacher is more as a facilitator and the students’ own exploration of knowledge. So as an alternative, researchers design high school mathematics learning devices, especially on the subject of Arithmetic Sequences and Series to be used as an alternative for field teachers.

The learning device is oriented towards problem solving with the help of a mini laboratory. At this stage, a review of the 2013 curriculum and various relevant learning theories is carried out in such a way as to obtain a description of learning patterns that are considered the most appropriate or more striking.

4.1.2. Analysis of students. This analysis is carried out to examine the characteristics of students that are in accordance with the design and development, which includes the initial abilities of students (learners’ experiences), both as individuals and groups. According to Kemp [4] that at the beginning of planning it is very important to pay attention to the characteristics, abilities and experiences of students both as a group and individually. So that the analysis of students is intended to identify knowledge (learning experiences) and cognitive development of students.

Based on Piaget's level of development, high school students aged 15 years and over, their intellectual development is included in the formal operation stage. Piaget also argues that it is still difficult for high school age children to grasp an abstract idea if it is not described in a concrete picture [4].

This is supported by the results of the researchers’ observations of students in class XI of SMA Negeri 1 Kakas of preliminary observations, only a small proportion of students can show the diagonal of space and the diagonal plane of a space that affects Arithmetic Sequences and Series, especially space diagonals and diagonal planes that have never been obtained by participants. students. However, students are familiar with building the Arithmetic Line and Series room at the elementary school level.

Based on the general nature of the subject matter of Arithmetic Sequences and Series to be discussed, concrete objects are still needed in the learning process of the subject matter of Arithmetic Sequences and Series which are manifested in Arithmetic Line and Series Media activities. The characteristics examined in the analysis of students include background knowledge and cognitive development of students.

4.2. Results description design stage

4.2.1. Preparation of tests. In preparing the learning outcome evaluation tool, it begins with the preparation of the test grid. The test grid is a reference or guide that must be followed by each compiler of the evaluation of learning outcomes.

The learning outcome evaluation grid is arranged based on the specifications of learning objectives, which includes a map of the distribution of the prepared questions so that the question items can be determined precisely the level of achievement of a student's material mastery based on the specifications of learning objectives, validation by experts and field trials. The evaluation of learning outcomes produced in this study is only a product test.

4.2.2. Initial design. The initial design is a design of learning tools designed, which involves the activities of teachers and students. The learning tools arranged are RPP, LKPD, and evaluation of learning outcomes. The learning plan is structured oriented to Problem Solving learning, which consists of SK, KD, prerequisite materials, and learning activities including approaches, methods, facilities and implementation.

The lesson plan (RPP) and student activity sheets (LKPD) are each compiled as many as 3 pieces. Each RP is accompanied by an appropriate LKPD for one meeting with the following categories: (1) RPP-1 is accompanied by LKPD-1, (2) RPP-2 is accompanied by LKPD-2, (3) RPP-3 is accompanied by LKPD-3. This initial design is the first draft of the developed learning tools.
4.3. Description of the Development Stage Results

4.3.1. Expert validation. One of the main criteria for determining whether a learning device is used is the result of validation by an expert. Based on the expert's assessment, the researcher revised the lesson plans, LKPD, and evaluation of learning outcomes in draft I which was the initial design of the learning device design into draft II.

To validate the evaluation of learning outcomes the researcher did not abort learning outcome evaluation items, but test items that did not meet the requirements were revised and the revised results were consulted with experts. Expert judgment is generally in the form of small notes on areas that need improvement.

The names of the validators can be seen in the attachment table. The instrument RP validation sheet, LKPD validation sheet and validation sheet evaluation of learning outcomes can be seen in the attachment. The revised section, validator notes and follow-ups based on expert assessments of the lesson plan (RPP), student activity sheets (LKPD), and evaluation of learning outcomes (EHB) are as follows.

4.3.2. Learning implementation plan (RPP)
The aspects that are considered in validating the learning plan are: the subject matter, the material presented, the language used, the time, and the method of presentation. In general, expert judgment, this lesson plan is good and can be used with minor revisions. The revised section, notes of all validators and their follow-ups can be seen in the attachment table.

4.3.3. Student activity sheet. The aspects that are considered in validating the student activity sheet in outline are the introduction, the explanation of material, procedures, and questions. The results of the expert's assessment in general, the student activity sheet (LKPD) is good and can be used with minor revisions. The revised section of the LKPD, validator notes and their follow-up can be seen in the Appendix Table.

4.3.4. Evaluation of learning outcomes. The aspects that are considered in validating the evaluation of learning outcomes are: learning materials, construction, and the language used. The experts' assessment of the evaluation of learning outcomes shows that the evaluation of learning outcomes has all assessment criteria indicators. The revised part of the evaluation of learning outcomes, notes of all validators and their follow-ups can be seen in the Appendix Table.

4.3.5. Field trials. Field trials aim to obtain direct input from the field on learning tools in the form of learning implementation plans (RPP), LKPD, and EHB. In this trial, the activities of students, the management of learning by the teacher, the cooperative skills of students, and the responses of students to learning were recorded.

In this case, the student activity instrument, the management of learning by the teacher, the observation of cooperative skills and the student response questionnaire using instruments that have been developed by previous researchers and have been considered standard with slight modifications. While the results of field trials on the evaluation of learning outcomes are calculated for validity, reliability, and sensitivity.

The results of field trials are used to revise and perfect draft II to draft III (final draft). Descriptive analysis of observing student activity, management of learning by teachers, cooperative skills, and evaluation of learning outcomes are as follows:

4.3.6. Analysis of the activity description of Learners during the Activity. Observation of the activities of students during learning activities using the instruments in the attachment. The results of observations on the activities of students during the Problem Solving learning activities are shown in the attachment table, it can be seen that the dominant activity carried out by students in cooperative learning is working
using the Arithmetic Line and Series material media or working on 44.92% quiz questions, while the 5th aspect discussing or asking among fellow students only 10.14%.

Based on the ideal time criteria limit set in chapter III, for the working aspect using Arithmetic Line and Series material media, namely working on quiz questions, the ideal time limit is 35% - 45% and the aspect of discussing or asking questions between fellow students is 15% - 25%. This shows that in cooperative learning students use a lot of time when working using Arithmetic Series and Series material media due to the density of activities that students must do that are listed in the LKPD.

The low percentage of discussion between students is caused by a lack of interaction between students, so that teachers need to motivate students more to develop cooperative skills. The results of this analysis indicate that there is a need to improve LKPD and lesson plans both in terms of content and time allocation, so that the time planned in the RPP in accordance with the allocation of time to work on LKPD. The revised sections of the RPP and LKPD are shown in the Table in the attachment.

4.3.7. Analysis of the description of teacher learning management. Observation of the management of learning by the teacher during the activity using the instruments in the appendix. The management of learning by the teacher during field trials is observed by an observer. The results of the observation of learning management in general are shown in the appendix, showing that the average result of the assessment of the teacher's ability to manage time is good, namely 3.33 in the Fairly good category.

4.3.8. Analysis of student response descriptions. To get an overview of the opinions of students regarding learning activities, subject matter, LKPD, how to learn, how to teach teachers. As well as a description of the interest, understanding of the LKPD, and the students' interest in the views on the LKPD using a questionnaire.

Based on the student response questionnaire in the attachment, the results of student responses were obtained in the form of frequency and percentage of happy, unhappy, new, not new, interest, disinterested, interested, and uninterested subject matter, LKPD, how to learn, and the way teachers teach.

Based on the results of the student response questionnaire in the attachment, the students' response is said to be good if the percentage of each aspect is greater or equal to 75%, so it can be concluded: The response of students about the teaching component is all good. The response of students to follow the next lesson as it was followed, readability / understanding of the LKPD, and interest in the LKPD used were good.

4.3.9. Evaluation of learning outcomes. Before being tested, first the evaluation of learning outcomes is validated by experts to determine the validity of its content. Based on input from the validator, revisions and improvements are made to the evaluation of learning outcomes. The results of the revised evaluation of learning outcomes can be seen in the attachment.

Analysis of field trial results data on the evaluation of learning outcomes on the subject of Arithmetic Sequences and Series can be seen in the attachment. Based on the data from the field trial results, it was obtained:

4.3.10. Validity. The calculation of the validity of the test items can be seen in the appendix. Based on the product moment correlation formula, the validation of each test item is obtained as follows.

| Question Number | 1   | 2   | 3   | 4   | 5   |
|-----------------|-----|-----|-----|-----|-----|
| $r_{xy}$        | 0.809 | 0.773 | 0.756 | 0.497 | 0.739 |

Based on the table above, using the criteria for interpretation of the validation coefficient in chapter III, the validation of each item is categorized as follows: item number 1 has very high validation and questions number 2, number 3, and number 5 have high validation, while questions number 4 has
sufficient validation. Thus, in general, the validation of each test item is considered suitable for use without revision.

4.3.11. Reliability. Based on the test reliability formula, the reliability coefficient of the test was obtained $\alpha = 0.754$. The calculation of test reliability can be seen in appendix 14. Referring to the criteria for interpretation of the validation coefficient in chapter III, it shows that the evaluation of learning outcomes developed has high reliability, so that the evaluation of learning outcomes can be used to measure students' mastery of the Arithmetic Sequence and Series material.

4.3.12. Sensitivity. The calculation of the sensitivity of the test items can be seen in appendix 15. The results of the calculation of the sensitivity value of each test item are as follows:

Table 2. Test item sensitivity calculation results.

| Question Number | 1   | 2   | 3   | 4   | 5   |
|-----------------|-----|-----|-----|-----|-----|
| Sensitivity Index | 0.328 | 0.385 | 0.538 | 0.713 | 0.424 |

Based on the criteria, the test item is said to be good if the sensitivity of the test item is between 0 and 1 and an item is said to be sensitive to learning if the sensitivity is greater than or equal to 0.30 (S≥0.30). This means that all items of evaluation of learning outcomes developed are considered sensitive to learning. By this shall all items worth learning outcome evaluation used without revision.

5. Conclusion
- At the design stage of the learning instruments produced in the form of 3 RPP, 3 LKPD, and evaluation of learning outcomes;
- The validation and observation instruments use instruments that have been developed by previous researchers with minor modifications
- The development stage through the expert validation stage and field trials for RPP and LKPD were shown to be quite good and could be used with minor revisions, while the evaluation of learning outcomes had included all indicators of assessment criteria, the results of field trials showed some aspects of learning that were observed were ineffective, and improvements were made by means of revising RPP1, LKPD1, the results of revisions are adjusted to RPP 2, LKPD 2, and so on, until the trial phase 3;
- While the evaluation of learning outcomes is seen from the validity, sensitivity and reliability index obtained which is quite feasible to use without revision.
- Learning tools for Arithmetic Sequences and Series that are oriented towards Problem Solving learning, Arithmetic Sequences and Series materials produce learning tools consisting of learning implementation plans (RPP), student activity sheets (LKPD), and evaluation of learning outcomes (EHB) The results of the development of learning tools seen from the validity and reliability index are feasible to use without significant revisions.

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