



# Journal of Educational Sciences

Journal homepage: <https://jes.ejournal.unri.ac.id/index.php/JES>



P-ISSN  
2581-1657

E-ISSN  
2581-2203

## Developing Learning Tools with Cooperative Learning Model of Numbered Head Together (NHT) Structural Approach on Sequence and Series Material

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### ARTICLE INFO

#### Article history:

Received: 17 Aug 2020

Revised: 09 Jan 2021

Accepted: 10 Jan 2021

Published online: 24 Jan 2021

#### Keywords:

Learning Tools

Cooperative Learning

Numbered Head Together

Sequence and Series

### ABSTRACT

This research was underlined by the few availability of Mathematics learning tools as the teacher's guidance in implementing the learning and the low Mathematics achievement of the students. This research aims to produce valid, practical, and effective learning tools by using cooperative learning models of Numbered Head Together (NHT) structural approach on sequence and series material. This research and development was conducted by adapting a 4-D development model by Thiagarajan. The stages of this research consisted of Define, Design, Development, and Dissemination. The validation results of the learning tools consisting of syllabus, Lesson Plan, and LKPD that are 92%, 92,07%, and 94,33% with extremely valid criteria. The practicality result on small group trial is 93,99%, big group trial is 93,42% and teacher's response 93,88% with extremely practical criteria. The effectiveness result shows that the students' learning achievement increases by using the developed learning tools.

## 1. Introduction

The applicable curriculum in the Indonesia Education System is the 2013 curriculum. Based on the 2013 curriculum, teachers must compile their own learning tools. The 2013 curriculum for schools recently requires teachers to prepare learning tools for learning activities to encourage student activities in the learning and teaching process as reported by Atika et al (2020). Learning tools must be at the student's center and improve students' participation actively in learning. The availability of learning tools is a factor that can support the learning process to be carried out with either as reported by Kurniawati (in Susanti et al., 2017). Therefore, it is necessary to arrange learning tools so that learning can be running well. Learning tools is a tools of tools or component used in the learning process that consists of syllabus, lesson plans, teaching materials, and test results of learning (Zulfah et al., 2018). The form of learning tools can be syllabus, lesson

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Doi: <https://doi.org/10.31258/jes.5.1.p.80-88>

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plans and student worksheets (LKPD). These learning tools must be prepared by the teacher before the learning process starts.

In fact, there are still many teachers who have barriers in preparing, compiling and developing learning tools. Teachers are hard to prepare the curriculum-based learning tools 2013 as reported by Heleni et al (2017). In fact there are still many teachers who are not optimal in preparing lesson plans as reported by Rianti (2020). In the learning process teachers rarely develop learning tools to achieve learning goals as reported by Armis et al (2017). Moreover, the learning tools by teachers such as the lesson plans that not refer to the lesson plans components as Permendikbud No. 22 of 2016 (Kartika et al., 2020). Furthermore, the learning tools made by the teachers still have weaknesses that must be repaired (Putri et al., 2020). Based on interviews with some mathematics teachers at high schools in Pekanbaru, it was found that some teachers only used learning tools, especially syllabus and lesson plans, which were obtained from other sources such as peers, the internet, etc.

Moreover, teachers also experience difficulties in the formulation of indicators and learning objectives and a lack of mastery of technology makes it difficult for the teachers to make learning tools. Therefore, it is necessary to develop learning tools, especially syllabus, lesson plans and LKPD. Based on experience, many students have difficulty in learning mathematics. This results in low learning outcomes obtained by students. There are problems in the learning process, namely the low learning outcomes of students as reported by Yustika et al (2019). One of the factors that affect the low learning achievement of students is the fear of students against mathematics (Marfuah et al., 2014). Researchers also made observations during learning, it was found that only a handful of students asked the teacher while the others were silent and asked their friends. In addition, students often move their seats with the excuse that they want to study with their friends. This shows that students are more comfortable in groups.

Therefore, group learning is suitable, especially for material that contains contextual problems because it can facilitate learning discussions. The cooperative learning with the numbered head together (NHT) structural approach is one of the lessons approach that can facilitate the learning discussions. The NHT structural approach is one of the types of cooperative learning that can be applied to increase students' mathematics learning activities and outcomes as reported by Firdaus (2016). One of the characteristics of this NHT structural approach cooperative learning is there is one of the students who represents his group but was not previously told who would represent the group (Slavin., 2015). Therefore, students are more responsible for their group, students work together to complete their tasks that are given by the teacher in their respective groups. Sequences and series are one of the things that are close to everyday life and are rarely realized. A simple example of making house and hotel room numbers.

Furthermore, sequences and series are used in calculating interest, growth and decay as well as calculating annuities in banking The material of arithmetic sequences and series are material that is tested in university tests or to apply for a

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job vacancy as reported by Febriliyani et al (2018). The difficulty of students with this material when given problems in the form of story questions. They have difficulty changing story problems into correct math sentences. Therefore, we need a teaching material that can bridge formulas with daily problems in the material of sequences and series. Based on the description above, the researcher is interested in developing mathematics learning tools on the materials of sequences and series using the NHT structural approach cooperative learning model. The learning tools developed by syllabus, lesson plans and student worksheets. The development of learning tools with the cooperative model of the NHT structural approach on the material of sequences and series that can meet the criteria of validity, practicality and effectiveness.

## **2. Methodology**

This research was a development research adapted from the 4-D development model by Thiagarajan. Thiagarajan said that the 4-D research and development steps consist of four development stages such as define, design, development and dissemination (Sugiyono, 2015). The research was conducted in eleventh grade at SMAN 5 Pekanbaru.

### ***Define Stage***

At the define stage, 5 things were conducted, including front-end analysis, learner analysis, task analysis, concept analysis and formulation of learning objectives (specifying instructional objectives).

### ***Design Stage***

In the design stage, the initial design of the learning tools was carried out. Based on syllabus, learning tools were based on the steps of the NHT structural approach cooperative learning model. The lesson plan was designed according to the previous syllabus design and was designed for six meetings. Based on lesson plans, the LKPD was also designed for six meetings and each LKPD was completed with NHT question sheets.

### ***Development Stage***

At this stage, validation and small group trials were carried out. Validation was done by asking the opinion of experts as a validator to provide an assessment and input on the learning tools development. In this case the researcher asked for an assessment from 2 Mathematics lecturers and 1 Mathematics teacher. After the learning tools were declared valid by the validator, a small group trial was carried out. This trial was conducted on three groups of students consisting of 15 class XI students of SMAN 5 Pekanbaru.

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### *Dissemination stage*

At this stage, a large group trial was carried out to see the practicality and effectiveness of learning tools with the NHT structural approach cooperative learning model. This trial was conducted in class XI MIPA 7 which consisted of 36 students. The practicality test was carried out through observation, and filling out a questionnaire given to students and teachers who have used LKPD in the learning process to obtain practical criteria. The effectiveness test was carried out using a learning outcome test instrument consisting of a pretest and posttest. The results obtained from the pretest and posttest tested for normality, homogeneity, and the two mean similarity test (t-test).

### **3. Results and Discussion**

The development of the learning tool is a learning tool with a cooperative model of the NHT structural approach to the material of sequences and series. This learning tool consists of a syllabus, lesson plan and LKPD for six meetings. This development research consists of the stages of *define*, *design*, *development* and *dissemination*. At the design stage, a front-end analysis was first performed. Researchers conducted interviews with several high school teachers in Pekanbaru. It is known that teachers experience difficulties in making learning tools, including difficulties in formulating learning indicators and objectives, learning activities on lesson plans that are still unclear, and LKPD used instead of self-made LKPDs that have not been able to improve students' understanding of the material being taught. Second, a learner analysis was performed. Researchers make observations during learning. Students are less active in learning and more comfortable in groups. NHT structural approach cooperative learning is expected to overcome this.

Third, a task analysis was carried out. At this stage, an analysis of core competencies and basic competencies is carried out. The explanation of KI and KD is carried out in indicators that can measure competency attainment. The results of this analysis are used as a reference in determining the subject / material being developed. Fourth, a concept analysis is carried out. At this stage, identification of sequence and series material is carried out and arranges them in a relevant and systematic form. In this case, the material of sequences and series is arranged into arithmetic sequences and series, geometric sequences and series, infinite geometric series, single and compound interest, growth and decay, and annuities.

Finally, the learning objectives are formulated. The results of the formulation of learning objectives obtained are adjusted to the 2013 KI and KD curriculum. At the design stage, the learning tools design is carried out based on the results at the define stage. The syllabus and lesson plans components contain components in accordance with Permendikbud No. 22 of 2016 (Kemendikbud., 2016).

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The learning activities contained in the lesson plan are adjusted to the cooperative learning model of the NHT structural approach which has the stages of numbering, asking questions, thinking together and answering. The LKPD which is designed is adapted to the cooperative learning of the NHT structural approach in the material for the XI class of SMA. The activities at the LKPD are arranged in detail, so that they can guide and motivate students to find concepts independently. The LKPD cover section is designed to contain the title, student identity, learning objectives, instructions, motivation and supporting images according to the material being studied to make it more interesting (Figure 1).

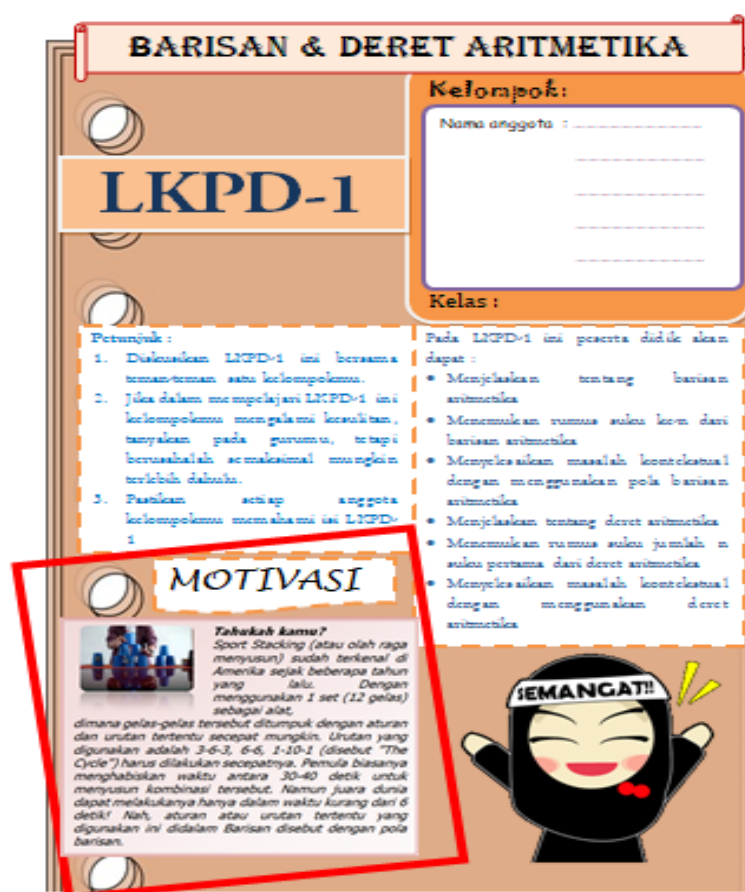


Figure 1. Example of LKPD cover

The LKPD which is designed uses the cooperative learning model of the NHT structural approach which has the characteristic of an NHT question sheet (Figure 2). Even though each student in the group is given a different number in completing the NHT question sheet, all students must be able to understand LKPD and be able to do all. Students are given a blank section under each question to write down the solution of the questions given.

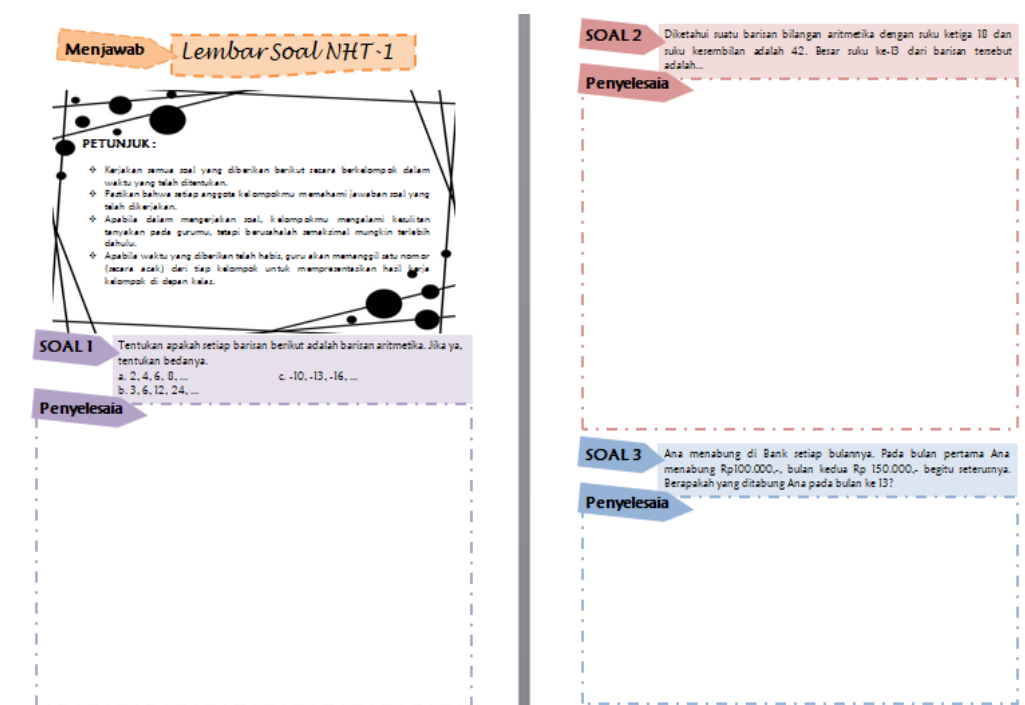


Figure 2. Example of NHT Questionsheets

At the development stage, validation of the learning tools developed is carried out. The results of validation are used as a guide for revising and improving learning tools. The validity of learning tools consists of a syllabus, lesson plans and student worksheet. The following results of the validation of learning tools are presented in Table 1.

Table 1. Results of Validation of Learning Tools

	<b>Syllabus</b>	<b>Lesson Plan</b>	<b>LKPD</b>
Average Score	92%	92,07%	94,33%

From the table above, it is found that the overall average for the syllabus assessment is 92%. The overall average for the lesson plans assessment is 92.07% and the overall average for the LKPD assessment is 94.33%. Based on this data, it can be concluded that the learning tools are in the very valid category and are revised according to the validator's suggestions and comments. After the revision based on the validation results, a practicality test was conducted for 36 students. Practicality testing was conducted through observations of the implementation of learning activities, student response questionnaires and teacher response questionnaires.

Based on observations, it is known that most of the learning activities contained in the lesson plans were carried out well. The average practicality value on the teacher's response was 93.88%. The average practicality value on the response of students was 93.42%. Based on the results of this practicality test, it means that the learning tools meet the practical criteria. Furthermore, the effectiveness test

was carried out on the learning tools. This effectiveness test is carried out by testing learning tools in the experimental class (using developed learning tools) and the control class (using conventional learning tools). Furthermore, both classes were given a pretest to find out the students' initial scores about the previous material.

Table 2. Results of the Two-Mean Similarity Test (t-test) of the pretest experimental class and control class

Class	N	Mean	Standard Deviation	Sig. (2-tailed)	Conclusion
Experiment	36	57,78	16,944	0,477	$H_0$ accepted
Control	36	54,78	18,633		

Based on Table 2, for the pretest data for the experimental class and control class, the significance level is obtained  $p < \alpha = 0,05$ ., so it can be concluded that  $H_0$  is accepted. This shows that there is no significant difference between the pretest scores of the experimental class and the control class, so post-test data is used to determine whether or not there is a difference in learning result between students who use developed learning tools and students who do not use the developed learning tools.

Table 3. Results of the Two-Mean Similarity Test (t-test) Post-test for the Experimental Class and the Control Class

Class	N	Mean	Standard Deviation	Sig. (2-tailed)	Conclusion
Experiment	36	80,78	9,087	0,00	$H_0$ rejected
Control	36	72,36	10,359		

Based on Table 3, the post-test data for the experimental class and control class conducted significant level of  $p < \alpha = 0,05$ . Therefore, it can be concluded that  $H_0$  is rejected or there is a difference on the post-test results of the experimental class and the control class. Therefore, differences in learning result between students who use developed learning tools and students who do not use them.

#### 4. Conclusion

This research and development produced a product in the form of learning tools with cooperative learning model of NHT structural approach on sequence and series material. The learning tools have fulfilled the validity, practicality, and effectiveness criteria. In conclusion, the learning tools can improve students' learning achievement.

#### Acknowledgement

We would like to thank Mr. Selamat, S.Pd as the principal of SMAN 5 Pekanbaru who has given permission to conduct research at SMAN 5 Pekanbaru. We also

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would like to thank Mrs. Dr. Putri Yuanita, M.Ed, Mrs. Dr. Maimunah, M.Si and Mrs. Ridarty, S.Pd as validators who have provided assessments and input on the products.

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How to cite this article:

Rahman, M. R., Murni, A., & Zulkarnain. (2021). Developing Learning Tools with Cooperative Learning Model of Numbered Head Together (NHT) Structural Approach on Sequence and Series Material. *Journal of Educational Sciences*, 5(1), 80-88.

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