

Development of Learning Devices through Cooperative Learning Model Type of Group Investigation Based on Batak Culture to Improve Physics' Problem Solving Skills and Student's Teamwork

Elfina S. Nasution* Nurdin Bukit Derlina

Department of Physics Education, Post Graduate Program, State University of Medan, Jl. Willem Iskandar Pasar V Medan Estate, Kode Pos 20221, Indonesia

Abstract

The purposes of this study were to describe the validities, practicities and effectivities of learning devices through cooperative learning model type of group investigation based on Batak culture and to analyze the improvement of problem solving skills of physics and student's teamwork by applying learning devices through cooperative type group investigation based on Batak culture. This research is Research and Development (R & D) by using 4-D model included of define, design, develop, and disseminate stages proposed by Thiagarajan. Learning devices are developed in the form of Learning Implementation Plan (RPP), Student Worksheet (LKS), student's book, teacher's book and problem solving skill of physics instrument on geometric optical materials and optical instruments and questionnaire of students' teamwork. The subjects in this study were students of class X MIA-1 SMA Negeri 6 Padangsidempuan. The results of these research shows that the learning devices through cooperative learning model type of group investigation based on Batak culture are validity, practical and effective and the problem solving skills of physics and student's teamwork by applying the learning devices using cooperative learning model type of group investigation based on Batak culture are increase.

Keywords: learning devices, cooperative learning model type of group investigation, Batak culture, problem solving skills, teamwork.

1. Introduction

Education for Indonesia is an integral part of national development and one of the determining factors of the successful of development in all fields. One proof of the government's efforts to improve the quality of education is by applying the 2013 curriculum. The 2013 curriculum is a curriculum based on competence through constructivist learning by putting culture as one of the components that can be developed from elementary to high school level. According to Akbar (2013) the implementation of the curriculum is determined by the abilities of teachers in developing learning tools. Physics learning device is a tool that guides the teachers in implementing the learning process in the classroom. Trianto (2010) adds that the devices used in the learning process are absolutely required by a teacher on manage the learning system.

Based on the above explanation, it showed that the learning device has an important act in the success of the learning process. But the facts in SMA Negeri 6 Padangsidempuan there are problems about this learning device, where the completeness of teacher learning tools basically has been complete, but the teachers still tend to use the same Learning Plan (RPP) for several years of learning that implicate the use of learning model keep repeating regardless of educational demands and changing the students characteristics. Teachers also tend to use teaching materials from publishers as the only one source of learning in the classroom and have not developed LKS in accordance with the learning objectives and learning models used. The impact of the preparation of learning tools that have not maximized automatically give some impact on the process of learning in the classroom. Physics learning should emphasize the process, learning that is more emphasis on the way of thinking science to be able to solve physics problems. If simplified, learning the physics of the essence is to recognize the natural surroundings and then create a product formula of formulas and correct attitudes toward these phenomena (Sadia *et al* 2013).

The facts in the field of physics learning only encourage students to memorize the concept and are unable to use the concept if it encounters real life problems. Furthermore, students are unable to understand and there is no interaction that demonstrates student cooperation in identifying problems, formulating problems and defining solutions to solve new problems or situations encountered. Though problem-solving skills is very important to be improved in learning. According to Padjono & Wardaya (2009) During the problem solving students get experience in the way of thinking process, try hypotheses and if it successful to solve problems then the students get something new.

Responding to these problems required a means of learning devices through learning models that are able to grow teamwork among students through group discussions to solve problems. Because to get the success of finding answers, students need group discussion to be easily in solving problems. This is in accordance with Permendikbud No. 20 of 2016 states that the Graduate Competency Standards (SKL) covers aspects of attitude,

knowledge and skills. Attitudinal aspects of teamwork among students can be trained through the group discussions. Aspects of attitude can be trained through the phases in the learning process. So it is necessary to apply a model that has phases that can train attitude of student's teamwork. Of course, in the learning of students must be required to be able to build their own knowledge with an active role in teaching and learning process.

Learning model that able to train problem solving skills and support the students to behave scientifically through cooperation and train students to do scientific method is cooperative learning model type of group investigation. According to Joyce & Weill (2003) cooperative learning model of group investigation type is a learning model that teach the students to develop moral and social problems, students are organized by doing join research. This learning model approaches the steps of scientists to find the concept of physics (Istikomah 2010). As Oh & Shin (2005) study also stated that group investigation learning model can make the students become community of inquiry. However, group investigation learning model will be difficult if students are not familiar with this model, so when planning the investigation students need to coordinate group members in the discussions. Therefore it takes the social interaction of students to build shared knowledge. Good social interaction can be realized through the culture that students have. Just as Vygotsky (1978) also argues that higher mental functions contain social (cultural-influenced) and pseudo-social elements are natural.

Learning devices through cooperative learning model type of group investigation that is integrated with cultural elements can be used as a solution in creating contextual and meaningful learning for students. As Wahyudi (2003) conducted a study about the importance of student culture that affects to learning process in school. Coupled with Sardjiyo & Pannen (2005) also stated that culture-based learning is a strategy for creating learning environments and designing learning experiences that integrate culture as part of the learning process. The culture to be integrated in the learning device must be in accordance with the culture owned by the students. Choosing Batak culture, especially in North Sumatera region which mostly consists of Batak ethnic can be used as a supporter of learning process that can be used as a hope in fostering students interest to learn physics. As previous research Sinaga (2007) stated that by applying a model of learning through problem solving that comes from facts and Batak culture environment, by applying social interaction pattern *Dalihan Na Tolu* as learning strategy can improve student's learning outcomes. And Hutagalung (2016) also conducted a study that the ability to understand students' concepts can be improved by developing learning tools based on Batak Toba culture.

Many things that can be developed from the Batak culture include the cultural system of *Dalihan Na Tolu* flavors that can be applied in learning through group discussion by dividing the group into 3 subgroups consisting of *kahanggi*, *mora* and *anak boru* who works together in solving the problem. Values or suggestions that exist in the Batak culture can also be used as motivation and role model. For example Batak ancestors advised parents in guiding the child, that is "*ias ni topung dang alani balga ni andalu alai alani ososan ni pitik nitik ni boras i do*". When associated with learning then this advice means that the maximum ability possessed students should not solely depend on the ability of teachers but achieved through interaction between fellow students through cooperation with other students and the environment. This is in line with the opinion of Lie, Anita (2004) who argued that cooperative learning also provides opportunities for students to work with fellow students in structured tasks.

Based on the above description of the background, this study aims to: (1) produce learning device through cooperative learning model type of group investigation based on Batak culture that is valid, practical and effective; (2) to analyze the improvement of problem solving ability of physics and student's teamwork by applying learning device through cooperative learning model type of group investigation based on Batak culture.

2. Literature

2.1 Problem Solving Skills

In general, a problem occurs when a person realizes there is a gap between hope and reality and there is a desire to resolve but not knowing what action should take. In other side the defines of problem as the difference between the results to be achieved with the existing reality. This explains that the problem is something new to him even if the process or knowledge he has had can be used as an experience to solve it. In more detail, a problem is defined as a situation where one solves a problem that has not been worked out yet and do not understand how to solve it self (Jonassen 2004).

The skills of a person to solve a problem in this case problems related to the subject of physics is determined by his understanding of the problem first. Just as Anderson (2001) adds if the problem is known then problem solving is a sequence of cognitive processes directed to finding the right solution. Indicators of problem solving skills used are steps proposed by Heller *et al* (2010) namely, (1) Problem Visualization; (2) Describe the problem in terms of physics; (3) Planning solutions; (4) Implement of the solution plan and (5) Evaluate the solution.

2.2 Student's Teamwork

Hughes (2011) teamwork is a set of skills that individuals use to motivate the success of a group. A reliable

advantage in team is the emergence of synergistic solutions from various individuals who are members of the team. As well as group collaboration including the interactive, interpersonal, problem-solving and communication skills required by a group of people working on joint tasks, in complementary roles, toward a common goal whose outcomes are greater than those made possible by one who works Independent (Smith 2011). The indicators used in this study are indicators presented by Arends (2007) namely, (1) Interdependensi; (2) sharing skills; (3) Participation skills and (4) Communication skills.

2.3 Cooperative Learning Model Type Of Group Investigation Based On Batak Culture

Integrating cooperative learning models of group investigation and Batak culture types in the learning process will create a meaningful learning atmosphere. It is very reasonable because the success of the learning process is strongly influenced by the cultural environment of students. Just as Rohaeti (2011) states that in order for students to feel that the material they are learning is part of themselves, the learning must begin with a contextual learning of the culture in which the student is located. Then Sinaga (2007) argues that student activity is the information processing that is active and born in a social matrix, where the way of thinking, perceiving, and acting is influenced By culture, environment and Others around him.

Therefore cooperative learning model type of investigative group based on Batak culture is a learning model that teaches students to face academic, moral and social problems, so students are organized by doing joint research or cooperative inquiry through discussion group learning Dalihan Na Tolu integrated with Batak culture value In solving problems related to physics learning.

3. Research Methodology

This research was the development by using 4-D model of development Thiagarajan, Semmel, and Semmel (1974) ich consists of four stages, namely stage define, design, develop and disseminate.

3.1 Subject and Object

Subjects in this study were students of class X SMA Negeri 6 Padangsidimpuan academic year 2016/2017, where as the object of this research is the learning devices through cooperative learning model type of investigation based on Batak culture on the geometric optical materials and optical instruments, problem solving skills of physics and student cooperation. The first trial was conducted in classes XI MIA-1 and second trial is done in class X MIA-1.

3.2 Instruments of Data Collection

The Instruments of data collection in this study are validation sheet, observation sheet, test, and questionnaires. The validation sheet is used to collect the review result data from the validator. Observation sheets are used to determine the implementation of learning, assessing the competence of attitudes, skills, and activities. Filling the questionnaires are to obtain data needs and performance analysis. The improvement of problem solving skills and student's teamwork using the N-Gain by Hake (1999). For more details can be seen in Table 1.

Table 1. Instruments of Data Collection

Rated Aspect	Instruments	The Observed Data	Respondents
Cooperative Learning Model Type of Group Investigation based on Batak Culture Validity Device	Validation Sheet	RPP validity, BS, BG, LKS, Problem solving skills test and student's teamwork questionnaire	Expert/Specialist
Practicality Cooperative Learning Model Type of Group Investigation based on Batak Culture Device	Validation Sheet	RPP Practicality, BS, BG, LKS Problem solving skills test and student cooperation questionnaire	Expert/Specialist
	Observation Sheet	Improvement of Cooperative Learning Model Type of Group Investigation based on Batak Culture Device	Observer
Effectiveness of Cooperative Learning Model Type of Group Investigation based on Batak Culture Device	Test	Physics' Problem Solving Skills	Subject test
	Observation Sheet	Students Activities	Observer
	Questionnaire	Response of students	Subject test

4. Results

The result of the research is the product of learning device through cooperative learning model type of group investigation based on Batak culture on geometric optical material and optical equipment. The results of research and discussion as follows:

4.1 The define stage

The define stage is performed to define and define requirements in the learning process. This stage consists of the beginning-end analysis, student analysis, concept analysis, task analysis, and objectives specifications of learning. The result of the preliminary analysis concludes that instructional tool is needed based on cooperative learning model of group investigation type by integrating 4 aspects of Batak culture in learning device development. The result of student's analysis is obtained that the student's academic ability is still low and the background of the dominant tribe of Batak students makes the cooperative learning tool type of investigation based on Batak culture can be applied. The result of task analysis obtained refers to concept analysis and learning objectives based on Core Competence (KI) and Basic Competence (KD) that have been established in accordance with the 2013 curriculum.

4.2 The design stage

Design stage is done through preparation of tests and non-tests, format selection, media selection and initial design of learning tools. The result of the tests compiled in this study is a test of problem solving skills of physics and non-test compiled is a questionnaire that shows student cooperation in learning. The results of the election format in this study adjusted to the 2013 curriculum. Results of media selection or learning aids used visual media in the form of images of physical Batak culture and optical kits. The results of initial design in the form of RPP, Textbook, Student Book and LKS for 3 meetings as well as tests of problem-solving skills and cooperation questionnaires. All these devices are called draft I.

4.3 The develop stage

Develop stage aims to modify and develop learning tools that have been made in the previous stage of define and design. After the device is designed in the form of draft I, then at this stage tested the validity by expert validator and field trials. Validation test of learning device through cooperative learning model of type of investigation group based on Batak culture in the form of RPP, LKS, Teacher's Book, and Student's Book is done by validator experts.

Table 2. Validation Result by Expert of Validator

Learning Devices	Average of Value	Category
RPP	4,34	Good
LKS	4,45	Good
Student's Book	4,41	Good
Teacher's Book	4,44	Good

Table 2 gives the conclusion that the learning tools in draft I with various revisions have been used for trial. In addition, the problem solving test instrument and the teamwork questionnaire have been validated by the expert and declared valid with various revisions. The design of learning tools in the revised draft I is called draft II. This learning tool is ready to be tested in the field. Field trials were conducted twice, namely trial I and trial II. The trials are conducted to determine the practicality and effectiveness of the learning tools developed. Learning devices are said to be practical if there is an expert statement that the device is worthy of use and the value of the implementation of learning using the device is good or very good (Nieveen 2007; Akker 2009; Herman 2012). While the effectiveness of learning tools seen from the students' learning completeness in the classical, student activities and responses given to the learning device students (Nieveen 2007; Akker 2009; Herman 2012; Suyitno *et al* 2013; Slavin 2006, Reiguluth 2000).

Trial I of learning device through cooperative learning model type of investigation-based culture of Batak done on 12 students of class XI MIA I SMAN 1 Padangsidimpuan. This experiment was conducted by the researcher as a teacher and two observers to observe the implementation of learning and student activities. The researcher has obtained the authorized consent from the expert to use the learning tool in the second draft, then the learning implementation in the first test obtained an average of 2.97 and it is still in enough category ($2 < P \leq 3$).

Student's learning completeness in class I tested at 58%, where the limit of effective criterion fulfillment is 75% of students complete (Herman 2012). Student activity increases at each meeting.

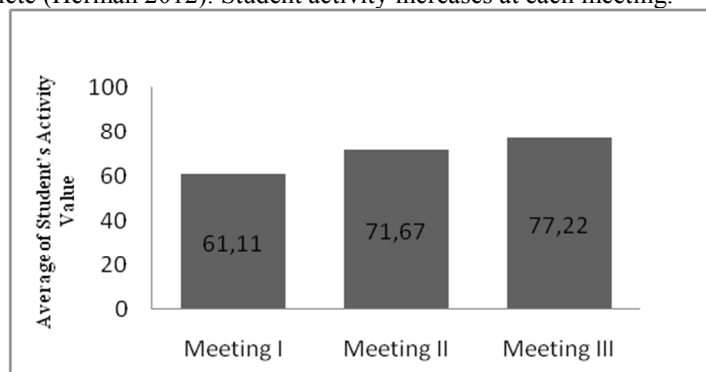


Figure 1. Student's Activity Trial I

Figure 1 gives the conclusion that on average the overall activity of the student is still in enough category. Positive student response to learning device in trial I was 92.52% where the effectiveness limit of 80% of students gave a positive response. Based on the above description it can be concluded that the device in draft II is not practical yet and has not been effective. So, it needs a revision based on analysis from trial I. The revised learning device is called draft III. Draft III is the final draft that will be in trial II.

Trial II was conducted in class X MIA-1 SMAN 6 Padangsidimpuan with total of 30 students. Trial II was conducted to measure draft III as a learning tool through a cooperative type based culture-based model of investigation that meets all the established and practical criteria. Result of trial II which have been done can be concluded that learning device through cooperative learning model type of group investigation based on Batak culture developed has fulfilled all the practical and effective criteria specified. The practicality of instructional tools as measured by the validity and implementation of learning devices has been better than I trial.

Table 3. Score of Implementation of Learning Devices Trial I

Average Every Meet			Total Average	Category
1	2	3		
4,13	4,30	4,35	4,26	Very High

The overall learning tool implementation in trial II is 4.26, which, when referenced to the predefined learning device learning criteria, then the average value of 4.26 is in very high category ($4 < P \leq 5$).

The effectiveness of learning tools through cooperative learning model of type of investigation group based

on Batak culture developed has fulfilled all criteria and can be said to be effective.

Table 4. Level of Students' Complete Learning by Classical Trial II

Category	Problem Solving Skills	
	The Number of Student	Percentage
Complete	26	87%
Not Complete	4	13%
Amount	30	100%

If it is referenced in classical student completeness criterion, that is minimum 80%, hence can be concluded that postes result of problem solving ability in trial II have fulfilled effective criteria that is 87,5% student have finished in pursuit of completeness in classical. And the students' response gives the average of the total positive response of the students in the second trial that is equal to 94,94%. If the results of this analysis are referred to the defined criteria then it is concluded that the student's response to the components and learning activities is positive. Furthermore, student activity during the learning process through cooperative learning model type of investigation based on Batak culture is done by observation.

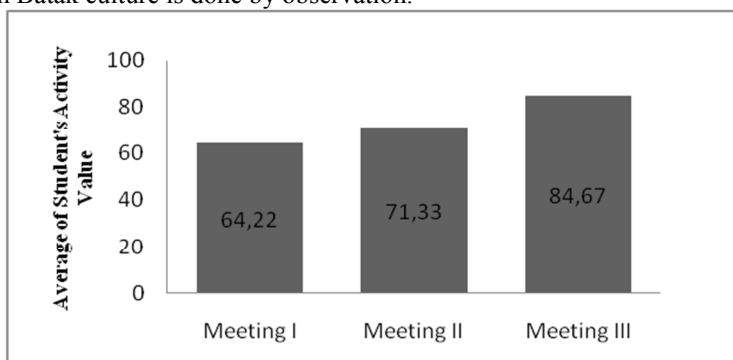


Figure 2. Student's Activity Trial II

Overall the average student activity has been increased. Thus it can be concluded that the learning device through cooperative learning model type of group investigation based on Batak culture developed effectively in terms of student activity that has achieved improvement. Based on the analysis of trial II data, it is known that learning device through cooperative learning model of type of investigation group based on Batak culture developed has fulfilled all valid, practical and effective criteria. So there is no revision of draft III on instructional device developed through cooperative learning model of type nvestigation group based on Batak culture on geometric optical material and optical equipment after trial II.

4.4 The disseminate stage

Disseminate stage is the final stage in the 4-D development model. At this stage, learning tools that have been piloted in the research class will be re-tested by comparing the developed learning devices (experimental class) with the device used by physics subject teachers in SMA Negeri 6 Padangsidimpuan (control class). However, this stage is not carried out by researchers, due to time, cost and energy constraints so that this stage is not discussed in depth.

Indicator of problem solving ability used is troubleshooting steps proposed by Heller, et al (2010:63) namely, (1) Problem visualization; (2) Describe the problem in terms of physics; (3) Planning solutions; (4) Implement the solution plan and (5) Evaluate the solution. Data obtained from posttest result of problem solving ability of student on trial II was analyzed to know the improvement of student problem solving skill by comparing mean score of student obtained from result of posttest problem solving skill of student each meeting on trial II.

Table 5. N-Gain of Problem Solving Skill

Meet	N-gain	Category
I	0,29	Low
II	0,42	Medium
III	0,62	Medium

Based on Table 5, the problem solving skills of students at each meeting has increased so that it can be concluded that the application of learning devices through cooperative learning model type of group investigation based on Batak culture can improve students' problem solving skills.

Student's teamwork data was obtained based on the increase of students' teamwork value in posttest and pretest which is assessed based on student's teamwork indicator.

Table 6. Improvement Student's Teamwork

Pretest' Average	Posttest' Average	N-Gain	Category
63,76	77,40	0,37	Medium

Tabel 7. Improvement Student's Teamwork Every Indicators

No	Indicators	Pretest	Posttest
1	Interdependence: Self-involvement in groups	3,21	4,01
2	Sharing skills	3,31	3,77
3	Participation / contribution skills	3,17	3,71
4	Communication skills	3,08	3,99

Based on Table 6 and Table 7 above, it can be concluded that the average of questionnaire results of students' teamwork increased from pretest to posttest result in trial II. Improvement of student's teamwork in every aspect of indicators after the treatment of learning devices through cooperative learning model type of group investigation based on Batak culture.

5. Conclusion

Based on the results of the analysis and discussion in this study, it can be concluded that: 1) Validity of learning devices through cooperative learning model type of group investigation based on Batak culture has valid for use with average total validity RPP = 4,34, Student's Book = 4,41, Teacher's Books = 4.44, LKS = 4.45, as well as test-solving skills and teamwork questionnaire devices have also been valid based on the assessment by expert validators; 2) The practicality of learning devices through cooperative learning model type of group investigation based on Batak culture has been easy to use in learning. This is based on the assessment of experts and observation of the implementation of learning with good category; 3) The effectiveness of learning devices using cooperative learning model type of group investigation based on Batak culture has been said to be effective for use in learning. This is based on the completeness of learning has classically exceeded the minimum limit of 87% and student response has also been positive with a percentage of 94.94%. 4) There is improvement of students' physics problem solving skills after applying learning device using Batak culture based model of learning on the geometric optical materials and optical instruments; And 5) There is an increase of students' teamwork by applying learning devices using cooperative learning model type of group investigation based on Batak culture that is 0.37 with medium category.

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