

IMPROVING OF THE STUDENT LEARNING IN LECTURES OF GENERAL PHYSICS I BY COLLABORATIVE LEARNING MODEL BASED ON SAINTIFIC APPROACH

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ABSTRACT

This research aim is improving the learning outcomes of the students on General Physics course I. This research was done at Physics Department, Faculty of Mathematics and Natural Sciences, Universitas Negeri Medan. The Collaborative Learning Model is based on a Scientific Approach. There are three subject matters: Kinematics, Dynamics, Effort and Energy. A set of 20 multiple choice questions was used in each cycle as the instrument to measure the student's learning outcomes which had been predictively validated. Based on SPSS 17.0 analysis result, this instrument was declared valid and has had high reliability. For each cycle a pre-test and post-test were implemented. The result shows that there is a significant increase of student learning outcomes for each cycle in respect to the value of normalized gain.

ABSTRAK

Penelitian ini bertujuan meningkatkan hasil belajar mahasiswa pada perkuliahan Fisika Umum I. Penelitian ini dilaksanakan di Jurusan Fisika FMIPA Univesitas Negeri Medan, dengan jenis penelitian tindakan kelas. Tindakan dilakukan dengan Model Pembelajaran Kolaboratif berbasis Pendekatan Saintifik. Ada tiga siklus dalam penelitian ini, dengan materi pokok kinematika, dinamika, usaha dan energi. Alat pengumpul data adalah instrumen hasil belajar mahasiswa dengan jenis pilihan ganda dan merupakan soal terpilih dari hasil ujicoba terhadap sekelompok mahasiswa pendidikan fisika yang diolah menggunakan aplikasi SPSS 17.0 dengan hasil dinyatakan valid dan memiliki reliabilitas tinggi. Sebelum pelaksanaan tindakan, dilakukan pretes untuk mendapatkan data kemampuan awal mahasiswa. Setelah tindakan selesai pada tiap siklus, selanjutnya dilakukan postes. Hasil penelitian menunjukkan bahwa nilai gain ternormalisasi hasil belajar mahasiswa meningkat setiap siklus. Sehingga dapat disimpulkan terdapat peningkatan hasil belajar mahasiswa pada perkuliahan Fisika Umum I dengan Model Pembelajaran Kolaboratif berbasis Pendekatan Saintifik.

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Keywords: Collaborative Learning Model; Class Action Research; Results Learning; Scientific Learning

INTRODUCTION

General Physics course I is a very important lecture to understand the courses at Physics Major Matematics and Natural Sciences Department, Universitas negeri Medan (Unimed). The success of the students in General Physics course determines their success in advanced physics courses. Therefore, all factors supporting this lecture should be a synergy

to improve student results in General Physics course I.

The preliminary result of the study on General Physics course I showed that students are still lack of the ability to understand the material. It can be seen from the results obtained by students studying in the first semester of 2014/2015 ago, still unsatisfactory that students who received grades A total of 21.8 to 75%, the value of B as much as 71.87 5%, and the value of C as much as 6.25% with the number of 32 students in one class. This situation is due to students' mastery of physics concepts are ge-

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nerally low when they was in high school and learning still has not maximized cognitive abilities of students in solving physics problems so that the results of the General Physics course I is still low. (Panggabean & Irfandi, 2015). From the implementation of basic Mathematics and Natural Sciences (MNS) joint exam for General Physics course I, which is done once a semester at the Faculty of Mathematics and Natural Science (FMNS) Medan State University showed results have not been satisfactory. Values obtained by students between 20-75 scale of 100 (FMNS, 2013). Therefore, it is necessary to improve student learning outcomes through the synergy of all components that support increased student learning outcomes in General Physics course I.

During this time, implemented learning is still limited to one direction i.e. lecture learning, use of the media is rarely used. While the demands of KTSP (Unit Level Curriculum) curriculum and 2013 curriculum mandate learning of *Student Centered Learning*. As a result, students' interest, motivation and learning outcomes become very low and tend to be passive. Therefore, it is necessary to develop a collaborative model that is appropriate to the material characteristics and students characteristics as learners. (Lisiswanti & Oktadoni, 2015)

One of the external factors that can affect the cognitive development of students is a lecturer. This is consistent with that proposed by Slameto (2003), ie, teacher (lecturer) plays an important role in improving the quality of students (students) in the learning and lecturers should really pay attention, think and simultaneously plan the learning process interesting for students, so that students are interested and enthusiastic in learning and willing to be involved in teaching and learning process, so that teaching become effective. In an effort to improve the quality of education, it requires various breakthroughs, both in curriculum development, learning innovation, and fulfillment of educational facilities and infrastructure so that students are interested and challenged to learn.

Addressing the above issues, it is necessary to make efforts for the lecturers using teaching strategies that make students more interested in General Physics I material. One of them is by using collaborative learning. The results of Clark & Baker's (2007) study show that collaborative learning outcomes in diverse groups provide positive results in learning.

Collaborative learning is an inovative

learning which combining various kind of learning models that is be adapted with course material characteristics. Kind of various learning model used are; *first*, the cooperative learning, (Slavin, 2005). A small groups learning model collaboratively with members consist of 4-6 students with heterogeneous structure (Slavin, 2005). Coopertive learning model is characterized by the precence of the task structure, purpose and structure of award which is diferent with an individualistic or competitive learning model. Task structure refers to the way of learning done by students in the classroom (Hollowarni, Erviyenni, Zulhelmi, Herdina, 2008). The goal structure in cooperative learning are called cooperative goal structure, characterized by positive interdependence among students. This means that the success of a student only and if the other students in his group also successfully. (Ibrahim, 2000).

The second, inquiry learning. Steps in inquiry learning namely: orientation, define problems, formulate hypotheses, formulating the data, testing hypotheses, and drawing conclusions (Sanjaya, 2009). *Third, the problem-based learning.* According to Arend, problem-based teaching is a learning approach where students work on authentic problems with the purpose of regulating their own knowledge, develop inquiry and thinking skills, develop independence, and confident (Trianto, 2009). *Fourth, Project Based Learning (PJBL).* According to *Buck Institute for Educaton (BIE)* (Khamdi, 2007) The PJBL is learning model which involve students in problem-solving activity and give opportunities to students work autonomously construct their own learning.

Collaborative learning model above is applied with scientific approach as required by the Ministry of Education (2013) in Permendikbud no. 65 of 2013 on education standards with a scientific approach. Through scientific approach students are trained to be able to think logically, in sequence and systematically using higher level thinking capacity (*high order thinking*) (Sudrajat, 2008)

Specifically Mitnik, Recabarren, Nussbaum, and Soto (2009), describes the collaborative learning based on the model with the knowledge can be created in a population with members actively interact by sharing experience and take the role of asymmetry (different). In other words, collaborative learning refers to environment and methodology activities of students performing common tasks in which each individual depends on and is responsible for

one another through conversations with face-to-face (Chiu, 2008). Based on theory, that the application of collaborative learning based on scientific approach at General Physics course I can improve student learning outcomes on Physical Education Program. This research aimed to improve students learning outcomes on General Physics course 1.

METHOD

This research was conducted at the Department of Physics Medan State University in the first semester of the academic year 2016/2017. The samples in this study were all students of physical education courses in grade A class of 2016 took a General Physics I courses.

This research is a type of class action, which lasted for three cycles and the plot is done by adapting the flow of classroom action research (Kemmis, Taggart & Nixon, 2014) The flow of this research as in Figure 1

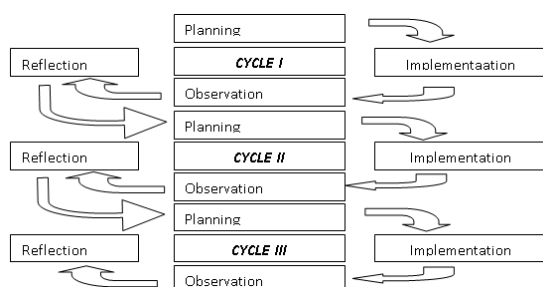


Figure 1. Action Research Cycle (adapted from Kemmis, et al., 2014).

In this study, there are three cycles with each cycle consisting of the stages of planning, implementation, observation and reflection with the following description.

Planning

In the planning stage, the researchers held several meetings to discuss technical implementation of classroom action research, recorded and identified the contents of text books in all the libraries in Medan State University which can be used to support the course of General Physics I, made questionnaires or observation formats, made media of learning, made lesson plan in accordance with learning innovation that will be used in this research.

Action

At this stage, the researchers taught General Physics I courses to students by imple-

menting a collaborative learning model (cooperative learning, *inquiry* learning, problem-based learning, project-based learning) and using the library as a reference source. The lecture is integrated with the adoption of practices directly related to General Physics I lecture material that is being discussed with the scientific approach.

Observations

Observations made by researchers in the classroom during teaching and learning activities take place. Observations were made to the results of students learning both during face to face and the things that happened during the learning process and group discussion. The number of observer in each meeting amounted to one person. The instruments used were observation sheet format developed by stages in the scientific approach and indicators in accordance with the competence General Physics course I to be achieved.

Reflection

Before doing reflection, data obtained through observation student results, is analyzed to obtain an overview of the implementation of each cycle. The results of this analysis are used for improvement in the next cycle. Reflection is done based on the results of observational data analysis conducted. The result of data analysis is an ingredient in determining corrective action for planning phase in the next cycle. In a reflection activity studied the link between observations with the implementation of collaborative learning in each cycle, and to describe the development of each cycle progress made, obstacles encountered, and mitigation efforts in the next cycle.

As for how to perform data analysis of learning outcomes during the course of General Physics I of the observation sheet for each cycle by adding up the scores obtained for each learning outcome then the total score was converted into a percentage with assessment criteria:

Very good	= 85% - 100%
Good	= 75% - 84%
Pretty good	= 65% - 74%
Not good	= ≤ 64%

Improved student learning outcomes is calculated using the Gain Ternormalisasi (Hake, 2007)

$$g = \frac{(\text{posttest score} - \text{pretest score})}{(\text{maximum score} - \text{pretest score})}$$

RESULTS AND DISCUSSION

This study begins with the implementation of the pre-test using test instruments, each of it consists of 20 multiple choice questions on the subject matter of kinematics, dynamics, work and energy. Giving pretest aims to obtain preliminary information about the ability of students physical education grade A class of 2016 before implementation of collaborative learning. The results of the pretest in the subject matter of kinematics, dynamics, work and energy will be compared with the results of post-test at the end of learning to get information about the impact of collaborative learning implementation which is applied to General Physics course I with the subject matter of kinematics, dynamics, and the effort and energy on every cycle. After the learning completed, it has done post-test to get data result of action implementation. The pre-test and post-test results obtained in the subject matter of kinematics, dynamics, work and energy as shown in Table 1.

From Table 1 can be seen that the average student results before action is still very low in the material kinematics, dynamics, work and energy. It is necessary for doing action to improve the achievement of student results on the material kinematics, dynamics, work and energy by applying a scientific approach based collaborative learning.

Cycle I

Actions taken in the first cycle consists of two sessions, the first meeting of the submateri motion in one dimension and the second meeting of motion in two dimensions. Lecture activities in cycle I is done in accordance with the unit of lecture I and unit of lecture II. Class begins with the delivery of learning objectives, so that students know the competencies to be achieved in the learning process and given the opportunity to work on the issue of selection physics contained in the modules in groups outside of lecture hours associated with the

material to be covered for presented during lectures take place.

Implementation of learning by using this learning is emphasized on efforts to make students active in answering questions and express opinions. This is done in an effort to improve student results in the course of General Physics I. The learning steps of each cycle as a whole include: 1). Delivering purpose and motivation of students. 2). Delivering presentation of information in the form of demonstrations or through reading materials. Students activities observed demonstration of irregular straight motion object (ISM) to identify physical quantities contained in the objects that perform MSCR. Furthermore, students are asked to create and ask questions about the information that has not been understood so happened debriefing and discussion. 3). Organizing students into groups. Students were divided into six groups to do RSM (regular straight motion) experiment and ISM (irregular straight motion). From this activity the students collect data of experimental results conducted. 4) Guiding group work and study. At this step, students processed and analyzed data have been obtained from experiments and associate the phenomena that can be seen from the experiment of RSM (regular straight motion) and ISM (irregular straight motion) then make a conclusion from the results obtained. In addition to processing experimental data, students are also given the physics issues to be solved in their groups. 5). Assessment of what has been learned so that each group presented their work. In this section, students' group communicate the results of their work using the projector in front of the class. 6). Give appreciation both in groups and individuals. After all groups present the results obtained, the lecturer announces the group with the best results and performance. The best group is given praise and appreciation in the form of additional value. At the end of the meeting in first cycle, students are given the test on kinematics mate-

Table 1. Results of pre-test and post-test

	Kinematics		Dynamics		Effort & Energy	
	Pre-tes	Post-tes	Pre-tes	Post-tes	Pre-tes	Post-tes
Mean	37.08	73,33	38.13	76.88	38.75	82,71
Std. Deviation	6,903	7,173	5,863	6.395	6,124	5,894
Variance	47,645	51,449	34.375	40,897	37,500	34.737
Minimum	25	60	30	65	30	70
Maximum	50	85	50	90	50	95

rial consisting of 20 multiple choice questions to determine students' mastery of material has discussed. Students' Minimum Completeness Criteria that must be achieved from the implementation of the test is i.e minimum grade of graduation that must be obtained by students applied in Medan State University.

Then post-test result in the first cycle is compared with the results obtained on pre-test before the action undertaken to obtain data increase student learning outcomes are achieved by calculating the value of *Gain* Ternormalisasi (Hake, 2007)

Cycle Reflection I

Based on post-test 1 result in the first cycle, the average value of student results on the first post-test gain is 73.33 and student learning outcomes have been increased in the medium category with a value of 0.57. However, from the observation of the research team to the students when the lecture has not been as expected because the students have not been fully active when the lecture took place. This can be seen from the fact that some groups can not present in front of the class because the group does not solve the physics problem that belongs to the group. In addition, in some groups also seen the domination by one person from the members of his group while the other members are still hesitant and do not dare to appear in front of the class or comment on the matter raised. Therefore, the provision of action still needs to be done and it has expected that the results in cycle II not only there is an increase in learning outcomes but also student activeness during the lecture also increased from before. The obstacles encountered in the implementation of the learning process in cycle I and it should be improved on the next action are: overall students are not confident to present the results of the completion of the group and still less daring in asking questions, students are still not entirely active in the discussion group both in participation to solve problems, give answers and give opinions. To overcome the obstacles in the first cycle and to improve student learning outcomes, it is necessary to continue on the second cycle by improving student activity by researcher giving motivations and awards both in the form of praise and additional value to the students to stimulate courage and student confidence.

Cycle II

Action implementation on the second

cycle consists of two meetings. The first meeting encounter of submission of Newton's laws of motion and styles. While second meeting on Newton's laws application. Similarly, in cycle I, in cycle II begins with the delivery of learning objectives, so that students know the competencies to be achieved in the learning process and given the opportunity to work out physics problems in groups outside the class hours related to the material that will be discussed to be presented at the time of lectures take place.

Implementation of action performed in cycle II is a continuation of cycle I. The learning steps in cycle II are generally the same as the learning steps in cycle I. The only difference being the subject matter discussed, namely Dynamics and make improvements to things that are still not good in the first cycle were obtained based on the reflection of the action on the first cycle to be increased in the second cycle.

The action done on the second cycle, the researchers provide an explanation of the scope of dynamics. Furthermore, students who had been in each group were directed to conduct experiments and discuss Newton's Law up the issue of the dynamics in the group, then presented the results of experimental data analysis and solving problem of dynamics. Students are motivated to actively participate in the learning process. Students are also requested in turn to present the results of the troubleshooting that has been created, ask questions, opinions, and evaluate problem-solving group that is being performed.

After the action is completed, at the end of the meeting, researcher given post-test of dynamic materials to obtain information on the impact of the implementation of the action using a collaborative learning model based on a scientific approach. Based on Table 1 students' average results increased from the first cycle in the amount of 73.33 into 76.88 in the cycle II. Further improvement of student learning outcomes achieved in the cycle II is calculated using the normalized gain. From the calculation of the gain value learning outcomes of each student, then it is performed calculating an average gain value of 0.62. This value has an increase of 0.05 of the cycle I.

Cycle II Reflection

Based on the result of post-test 2 in cycle II, the average score of the class of 76,88 and the gain value of the students learning achievement increase from the value in cycle I although still in the medium category. Lecture

atmosphere is also more active when compared to cycle I. This is evident from researchers observation, overall students in the groups have had the courage to present the results of their work even though the results have not been right. This shows that students have been able to demonstrate the fifth step in the scientific approach of communicating. However, from the observation of the research team to the students on the lecture, there are some students who hesitate to comment and give opinions. To dispel doubts on some students then the researchers feel the need to continue giving the next action in cycle III, in the hope that students who are still in doubt will arise their confidence to give their opinion.

Cycle III

Implementation of action in cycle III consists of 1 meeting with material Effort, Energy, and Power. Similarly, in cycle I and II, in cycle III begins with the delivery of learning objectives, so that students know the competence to be achieved in the learning process and given the opportunity to work on physics problems in groups outside the hours of the course related to the material that will be discussed to be presented at the courses. Implementation of action carried out in cycle III is a continuation of cycle II. The learning steps in cycle III are generally the same as the learning steps in cycle I and II. What distinguishes only on the subject matter discussed is Effort and Energy and make improvements to the things that are still not good in cycle II obtained based on the reflection results of action in cycle II to be increased in cycle III.

The action done on the third cycle, the researchers provide an explanation of the scope of effort materials, energy and power. Furthermore, students who have been in their groups are directed to present problem solving related to the material being discussed. Students are motivated by researchers to actively participate in the learning process especially in giving opinions. Students are also asked in turn to present the completed problem solving results, ask questions, opinions, and evaluate the problem solving of the group that is performing. Once the action is completed, at the end of the meeting, the researcher given postes on effort and energy materials to get the information the impact of implementation using collaborative learning model based on a scientific approach.

From Table 1, students average results increased compared to cycle II in the amount of 76.88 into 82.71 in cycle III. This means that

the action given in cycle III has been able to improve student learning outcomes better than the previous cycle. Then, improvement of learning outcomes achieved by students calculated using normalized gain. From the calculation of the gain value learning outcomes of each student then it is calculated average gain of 0.72 higher category. When compared with the average gain value in cycle II of 0.62, the average gain value of cycle III shows an increase of 0.10 from the previous cycle.

Cycle Reflection III

Based on the evaluation conducted through post-test 3, students' learning outcomes have improved as expected. Through the results of competency tests III analysis and researchers observation in the third cycle obtained the results that actions taken on this cycle has been successful in increasing student activity and learning outcomes by scientific approach. From the observations made by the researcher it is seen that all the students have been active in the lecture. Student activity continues to increase when compared from cycle I, cycle II until cycle III. In addition, the improvement is also seen in student learning outcomes that have successfully reached the established students' Minimum Completeness Criteria. From the results of the cycle III test obtained the average value of student learning outcomes 82.71 and entirely get the value ≥ 70 . In cycle III the gain value also increased from cycle II to 0.72 with high category.

From the three post-test data analysis of pre-test data can be displayed students data gain normalized results on the course of General Physics I as in Table 2. Table 2 shows the improvement of student learning outcomes at the course General Physics I with the subject matter of kinematics, dynamics, effort and energy.

Based on the results of data analysis showed that the implementation of collaborative learning model with the scientific approach has improved students learning outcomes in the course of General Physics I. Improved student learning outcomes at the course General Physics I happen due to collaborative learning has six characteristics, namely (1) the team share the task to achieve the learning objectives, (2) among team members give inputs to better understand the problems encountered, (3) team members ask each other for more in-depth understanding, (4) each team member empowers the other to speak and provide in-

Table 2. Increased Learning Results of Cycle I, II, and III

	Kinematics		Dynamics		Effort & Energy	
	Pre-tes	Post-tes	Pre-tes	Post-tes	Pre-tes	Post-tes
Mean	37.08	73,33	38.13	76.88	38.75	82,71
Gain	0.57		0.62		0.72	
Interpretation	Medium		Medium		High	

put, (5) teamwork accountable to others, and accountable to themselves, and (6) among team members there is interdependence (Myers, 1991). Collaborative learning activities vary widely, but the overall focus is on the exploration of learners, rather than simple educational explanations or detailed explanations (Smith & Mac Gregor, 1992).

Collaborative learning is done based on a scientific approach. Lecture activities conducted through the process of observing, asking, trying/collect data, associate/reasoning, and communicating through group presentation in front of the class. These things have positive impact on the improvement of students' abilities and skills ranging from dare to ask, dare to express opinions, and confidence in presenting the results of the group.

Collaborative learning application using cooperative model in the learning process can cause the effect of increasing students participation in the class (Herrmann, 2013) and they can communicate their arguments. From perspective of constructivist learning, dialogue and argument are valuable learning opportunities for students (Biggs & Tang, 2011; Pritchard & Woollard, 2010), and from this perspective, the interventions carried out in part successful.

Cooperative learning is suitable for applying the principles of KKN curriculum implementation since if it is seen the impact of learning as a whole is to increase the students confidence and think more critically where Slavin (2005), Davidson & Worsham (1992), have proved their research that the positive impact of learning cooperative learning are : (1) achievement of learning outcomes that can be accounted for, (2) develop a high mindset, (3) develop student self-confidence, (4) improve inter-group relationships, (5) develop student social skills, (6) accept the perspective of others. Cooperative learning often interpreted as part of a collaborative *learning*.

Furthermore, other learning improving student learning outcomes at the course General Physics I is giving project task through Project Based Learning. Project-Based Learning

is designed to be used on complex issues that learners need in investigating and understanding it. Project-Based Learning provides students with the opportunity to explore material using various means that are meaningful to themselves, and conduct collaborative experiments.

Inquiry learning through the completion of the questions contained in the module General Physics I and that presents a problem-based learning contextual issues that stimulate students to develop skills / creativity of high-level thinking (HOTS). This is because the problem-based learning model has several advantages such as that stated by Riyanto (2010), among others: (1) Students better understand the concepts taught because they themselves find the concept. (2) Demand high-order thinking skills to solve problems. (3) Knowledge is embedded based on schemata owned by students so that learning is more meaningful. (4) Students can feel the benefits of learning because the problems studied are the problems encountered in real life. (5) Making students become more independent and more mature, motivated, able to give aspirations and accept other people's opinions, inculcate positive social attitude among students. (6) Conditioning students in learning groups that interact with each other, both with lecturers and friends will facilitate students achieve learning mastery. The results of Panggabean, DD and Irfandi (2015) study shows enhancement in learning outcomes and student learning outcomes. Problem-based learning is learning that challenges students to "learn how to learn", to work in groups to seek solutions to real-world problems.

With the adoption of several learning models such as inquiry learning, project-based learning, cooperative learning as a form of learning innovation in the form of collaborative learning then the lecturers only have directive authority or manager to learn, on the contrary, it was students who need to be more active. In collaborative situations, students interact with empathy, respect, and accept the weakness or strengths of each others. In this way will grow

a sense of security, allowing the students to face various changes and demands of learning together. This is ultimately a positive impact in improving the learning outcomes of students, so that it can be concluded there was an increase learning outcomes of students in the course of General Physics I with collaborative learning model based on a scientific approach.

CONCLUSION

Based on the results of the study concluded that the Model Collaborative Learning based Scientific Approach improves the student learning outcomes in the course of General Physics I, with its subjects are Kinematics, Dynamics, Effort and Energy . Learning outcome can be seen from the average gain of students results that have an increasing in medium category of cycle I and II, and a high category in the third cycle .

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