

Study of Momentum and Impulse by Setting NHT Cooperative Model with Worksheet Based RGM for Senior High School

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Abstract:

This article studies on the momentum and impulse learning using NHT cooperative model with worksheet based RGM. This study aims to describe how to teach momentum and impulse using NHT cooperative models with worksheet based RGM. The data of study was collected trough descriptive method by describing data in the form of qualitative research studies that have been written by experts from variety sources. The sources of information are obtained by observation data, journals, text book, proceeding or scientific article. Data that has been obtained so will be analyzed as a classifying proces and collecting data. The result showed that momentum and impulse learning using NHT cooperative model with worksheet based RGM could make the learning process becomes more effective because the student participated directly on the learning process so they could improve their learning outcomes (cognitive and affective)

Keywords: NHT; Worksheet; RGM; Momentum Impulse

1. Introduction

Education is a complex process through various stages in building individual behavior and takes a relatively long time (Indrawati and Sutarto, 2013:17). Learning is a process interaction between children with children, children with a source of learning , and child with educator (Majid , 2014: 15). Komalasari (2014: 3) stated that learning can defined as a system or process of educating students / learner planned or designed , carried out , and evaluated systematically that subject / learner students to meet mdg targets learning effectively and efficiently.

According to Abidin (2014: 1) lessons learned from the point of view of behavioristic is the process of changing behavior students via optimally environment as a source of a stimulus learning. While lessons learned from another point of view is the learning process built by teachers to develop creativity think that would improve students ability in construction new knowledge as an effort to increase mastery who good against matter learning. According to Posser (Musfiqon, 2012:6) is a good learning is learning that brings the student in understanding. To improve the quality of national education, the Government has been doing improvements in the education system is one that is curriculum.

Permendikbud no.69 2013 about senior high school curriculum (permendikbud, 2013: 2) said that

2013 curriculum developed with modification of the mindset that the learning centered on teachers be a lesson centered on school tuition, masses of one direction be a lesson interactive, and masses of active to find (teaching active looking for the strengthened by learning scientific approach model). Physics is part natural sciences is the science which born and developing through measures observation

, the formulation of problems , the preparation of hypothesis , the testing of hypotheses through experiment , the withdrawal of conclusion , and the discovery of the theory and concept (trianto , 2011: 63). Physics is part of the science, namely of science that studies about nature and symptoms, consisting of the process and products. The process is the process of scientific, namely process that the steps using procedure and scientific method. The science which referred to products is knowledge of the fact that can be, the concept, the principle, procedure, the theory, or laws (Indrawati and Sutarto, 2013: 59). Learning physics not emphasize on the theory , matter and a formula taught , but also understanding the concept so the students developed a way of thinking as well as play an active role in learning activities in the class. Majid (2014:16) stated that the learning process is not just memorizing concepts or facts, but are linking concepts for generating understanding intact so that the concepts studied will be understood well and is not easily forgotten.

Learning to remain of model and material is worksheet. Learning model is a plan that can be used to form the curriculum (education planning) long term, designing materials of learning, and guide the act of / the teachers (Ahmadi and Amri, 2014: 56). Learning model is the skeleton conceptual who paints a procedure systematically in organizes learning experience to achieve a purpose learn certain, and serve as guidance to designers learning and educators in planning and executing activity learning (Indrawati and Sutarto, 2013: 21). While Joyce & Weil (in Rusman, 2012: 133) see that learning model is a plan or pattern that can be used to form curriculum (education planning long-term), design materials learning, and guide their experiences in the class or the other. Joyce, et al (in Indrawati and Sutarto, 2013: 22-25) said that every learning model having elements as follows:

1. Sintakmatik
Sintakmatik is the pattern describing the order a groove, hence activities needs to be done in implementing a learning model. 1.
2. A social system
A social system is situation or the atmosphere and norm apply in a learning model. 2.
3. The principle reaction
The principle reaction is the pattern activities teachers in treat or to respond toward the students. 3.
4. The support system
The support system is all facilities, materials and instrument necessary to support the implementation of the learning model. 6.
5. The impact of instructional and counterpoint
The impact of instructional is study results achieved direct in a way directed the students on a hoped-for goal. While the impact counterpoint is study results other produced by a process of learning, as a result the creation of the atmosphere learning experienced directly by the students without briefing directly from teachers.

Ibid. (in Faturrahman, 2015: 30) said the characteristics of learning model is:

- a. rational, theoretical, and logical
 - b. having thinking base of strong about the purpose of learning to be achieved;
 - c. behavior teaching are required so that the model was able to do ensure the success; and learning environment conducive are required so that the purpose of learning can be achieved.
- An example of learning model is learning model cooperative type NHT. Learning model numbered

heads developed by Spencer Kagan. NHT is a model learning put forward to students in search of activity, process, and reported information from various sources that eventually presented in front of a class (Kagan in Faturrahman, 2015: 82).

According to Faturrahman (2015: 82) learning model cooperative type NHT is part of learning model cooperative structural, who insists on the structures special designed to influence pattern interaction students. Most of the activity of learning centered on students, the studies the subject matter and discuss to solve the problem. Shoimin (2014: 108) said that learning model cooperative type NHT is a learning model which every clusters of members of his group responsible for duty his group, until there is no the separation between students who one and other students in a group of to give and take mutually to each other.

According to Komalasari (2014: 62-63) steps in learning model cooperative type NHT is:

1. students divided in the group, each student in each group have number.
2. teachers give an assignment and each group done so.
3. group discuss the right answer and make sure every member can do / know the answer.
4. teachers call any of a number of students number and who called report the result of cooperation with them.
5. a response from friend, then teachers designating which another number.
6. conclusion.

According to Shoimin (2014: 108-109) the advantages and disadvantages of of learning model cooperative type NHT is as follows:

excess:

1. each student be ready. do not discussions with earnest. students who was can teach students who less smart. occurring interaction in an intense manner the students. no students who dominated in the group because there is number limit.
2. deficiency: not too suitable to be applied in the number of students who many as requiring a long time. shall not all members of a group called by teachers because of possible a limited time.

Worksheet is a print of material original on paper contains material, summary, and guidance implementation of the tasks learning to do by students (Prastowo, 2014: 204). Understanding worksheet also expressed by Damayanti, Nur Ngazizah & Eko Setyadi (2013: 58) that worksheet is one material packed in such a way that students

expected to study the matter teaching independently. While Mahardika (2012: 24) said that sheets of a task to be undertaken by students.

According to Amri (2013: 101) election matter of learning must provide an activity that is centered on the kids who packed in the form of worksheets students. Prastowo (2014: 208) said worksheet consisting of six element that is the title, learning a clue, basic competence, subject matter, duty or step work, and judgment. Rustam (in Majid, 2014: 208) said the characteristics of worksheet as follows:

- a) which contains all the instructions needed student;
- b) guidance written in the form of simple with short sentences and vocabulary according to age and the ability the user;
- c) contains questions which is to be filled by students;
- d) the empty space to wrote and discovery students;
- e) give whose note is clear for students about what they have done;
- f) loading images simple.

Worksheet serves to igniting and help students to perform the activities of learning to controls a understanding, skill, or attitude. In addition, the use of worksheet can help guide learning so it is more effective and efficient (Majid, 2014: 371). Profit the worksheet is ease teachers in learning, for students can motivate students for independent study and learn understand and do a task written (Mahardika, 2012: 24-25). Amri (2013: 101-103) said worksheet have a purpose as follows:

- a) worksheet can help students find a concept;
- b) worksheet can help students apply and integrate various the concept of which have been found;
- c) worksheet that serves as a guide to learning;
- d) worksheet that serves as strengthening;
- e) worksheet that serves as guidance lab work.

In general, worksheet in learning physics there are four representation in make it clear that is verbal representation, a picture, mathematical, and charts. The representation is a configuration able to illustrate, represent or typify something in the manner of a (Goldin in Mahardika, 2012: 37). According to Jones and Knuth (in Sabirin, 2014: 33) of the representation of is models or forms in lieu of a situation matter used to find a solution. For example, a problem can be represented with the object, a picture, words, or mathematical symbols.

Representation is creativity involving disclosure or pengekspresian ideas and feeling and the use of various ways to do and beetlestone (in Farhan and Retnawati, 2014: 229). Mahardika (2013: 216) said that representations is one of the methods good and is being developed to infuse understanding the physics. However

, worksheet that will be made more emphasis on RGM (representation of an image and mathematical) alone would have but not necessarily do not use a verbal representation and charts.

Mathematical representation, to completing administrative problems quantitative, representation math indispensable. The use of representation math many determined its success by the use of representation qualitative good. In this process it appears that students should not memorize all formula math.

Representation of an image, a concept it will become clearer when can be represented with a picture. Pictures can be help visualize something is still in abstract. According to weidenmann (in Mahardika, 2012: 27) by looking at a photograph of a picture / higher than the interpretation of it read it or hear. High school student also has entered the operational during the preparatory phase of formal (11/12-18 year).

According to Piaget (in Komalasari, 2014: 20) the development of basic features at this stage is the the child has been capable of being thought abstract and logical by using mindset "the possibility". Model scientific thinking with type hipothetico-deductive inductive and have already started to possessed child, to the ability of draw any conclusions, interpret and develop a hypothesis. It is expected that students can understand the process scene through photographs that are found on worksheet. corresponding author only.

Methodology

The data of study was collected trough descriptive method by describing data in the form of qualitative research studies that have been written by experts from variety sources. The sources of information are obtained by observation data, journals, text book, proceeding or scientific article. Data that has been obtained so will be analyzed as a classifying proces and collecting data.

Results and Discussion

- a. The results of assessment research that deals with learning cooperative model type NHT

Table1. The results of assessment research that deals with learning cooperative model type NHT

Year	Results and Researcher
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No.	Learning Model Cooperative Type NHT
1	Teachers as the facilitator and motivator
2	The concept of found by students
3	Students think independently
4	Students are required active for learning
5	Conclusion taken by students and teachers only help students in make inferences

2014	Study results class his experiments (x-e) are not equal with study results class control (x-g). Daya Rotul Laili dan Henrim Budiningarti
2015	The influence of learning cooperative type numbered heads together (NHT) of the results of learn math students X MIA SMAN 1 Bangun years lessons 2014 / 2015 namely the average study results a class of mathematical experiment in a nht different is best compared with an average study results a class of mathematical control that uses conventional. Asnawiyah, Lusi Eka Afri, dan Arcat.
2014	There are significant impact the use of learning model type NHT accompanied the experimental methods of the results of student learning subjects physics class VII SMPN 2 Gambiran. Singgih Bektiarso, Lailatul Hanayah, dan Sri Wahyuni

- b. The results of assessment research that deals with worksheet

Table2. The results of assessment research that

deals with worksheet

Year	Results and Researcher
2016	Skill the process of science students in good to a presentation of 87,28 % and there is a difference in significant at study results students use learning model inkuiri accompanied worksheet based multirepresentasi by using learning unconventional in learning physics in high school. Himmatul Hasanah, I Ketut Mahardika, dan Bambang Supriadi
2015	The average the results of the score activity class experiment higher than class control and the average study results students experiment higher than class control. Yuniari Nur Laili, I Ketut Mahardika, dan Agus Abdul Ghani
2016	Model discovery learning with animation macromedia flash accompanied worksheet that is integrated with multirepresentasi significant on the activities of student learning, study results students, and retention study results in physics public SMA 4 Jember. Silvia Qaulina Damayanti, I Ketut mahardika, dan Indrawati

The findings of the study about learning model cooperative type NHT

Learning model cooperative type NHT is centered to their students (student centered) so that this model requires students to play an active role in the process of learning. The use of learning model cooperative type NHT will be accompanied by worksheet based RGM. Worksheet based RGM is a teaching materials that contains matter (was focused on representation of an image and mathematical), sample problem , and guidelines duty (exercise about) to help students in carry out a process learning.

Table3. The findings of the study about learning model cooperative type NHT

- d. The application of learning model cooperative type nht accompanied worksheet based RGM

Learning model cooperative type NHT accompanied worksheet based RGM demanding students to play an active role in learning. The use of learning model cooperative type NHT will be accompanied by worksheet based RGM. Model cooperative type NHT accompanied worksheet based RGM can train students in working with members of the group to write the result discussion of (question and lab work in worksheet.

During the process discussion, all members of a group must understand the answer to the results of the discussion because after discussion process will be conducted stage presentation where teachers will call at random membership number. This indirectly will train domain cognitive and domain affective students. Scenario of learning in general is as follows:

Teacher's Activity	Student's Activity
Teacher explained matter briefly and teachers ask questions	Students listen and answer questions from teachers. Students also understand categorized based representation of images and mathematically. If there are any that are not yet understood can be asked to the teacher
Teachers form groups and give membership number	Students gathered with members of his group
Teacher guiding discussions or practice	Students have discussions about the equation/did practical work is categorized in existing
Teachers guiding the presentation and integration	Students doing presentations and faqs
Teachers help students in drawing a conclusion	Students make conclusion from matter of learning

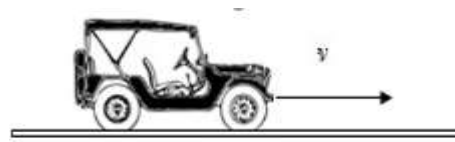


Figure1. Cars moving with celerity v

Can be written in metematis as follows

$$p = mv$$

Information: m = mass (kg)

v = speed objects (m / s)

Chase of momentum

$$\Delta p = mv_2 - mv_1$$

$$\Delta p = m(v_2 - v_1)$$

$$\Delta p = m\Delta v$$

Information: v_1 = speed early

v_2 = speed the end

Impulse

Impulses was the forces acting in a a short time period

.An example of impulses is when someone kicking the ball as in a picture below.



Figure2. Someone kicked the ball

At the time of kicking a ball , the person giving style to the ball in such a short time.

Mathematically can be rendered as follows:

$$I = F\Delta t$$

Information : F = force (N)

Δt = time (s)

$$F = m \cdot a$$

$$F \cdot \Delta t = m \cdot \Delta v$$

$$I = \Delta p$$

e. Momentum and Impulse

1. Momentum

Any inanimate object that has mass m and move with celerity v must have momentum. Example of the momentum of is a moving car with speed v as in a picture below.

3. The law of conservation of momentum

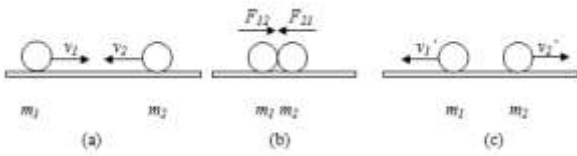


Figure3.The law of conservation of momentum Figure (a) a ball and b before impact , (b) when a ball and b impact , and (c) after a ball and a ball b impact

$$\Delta P_1 = -\Delta P_2$$

$$(m_1v_1' - m_1v_1) = -(m_2v_2' - m_2v_2)$$

$$m_1v_1' - m_1v_1 = -m_2v_2' + m_2v_2$$

$$m_1v_1 + m_2v_2 = m_1v_1' + m_2v_2'$$

$$P_1 + P_2 = P_1' + P_2'$$

The collision

a. The collision of elastic perfect

In the collision perfect elastic applicable:

- law of conservation of momentum
- law of conservation of the kinetic energy

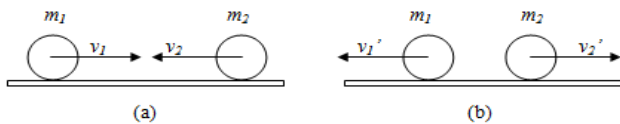


Figure4. Figure (a) before the a and b impact and (b) after a ball and a ball b impact

$$m_1v_1 + m_2v_2 = m_1v_1' + m_2v_2'$$

or

$$m_1(v_1 - v_1') = -m_2(v_2 - v_2')$$

Law of conservation of the kinetic energy to m_1 and m_2 is

$$\frac{1}{2} m_1v_1^2 + \frac{1}{2} m_2v_2^2 = \frac{1}{2} m_1v_1'^2 + \frac{1}{2} m_2v_2'^2$$

$$m_1(v_1^2 - v_1'^2) = -m_2(v_2^2 - v_2'^2)$$

$$m_1(v_1 - v_1')(v_1 + v_1') = -m_2(v_2 - v_2')(v_2 + v_2')$$

so

$$v_1 + v_1' = v_2 + v_2'$$

$$e = -(v_2' - v_1') / v_2 - v_1$$

5. The collision not elastic at all

On the collision of restitution not altogether only apply conservation of momentum. This is because after the collision happens then the lost motion power cannot be retrieved again.



Figure5. (a) before coaches impact and (b) after coaches impact

$$m_1v_1 + m_2v_2 = (m_1 + m_2)v$$

$$v_1' = v_2'$$

So

$$e = 0$$

6. The collision part of restitution

In the collision of elastic a part only is the law of eternity momentum , because after the process of the collision of will happen large kinetic energy after the collision of smaller than the kinetic energy before the collision .

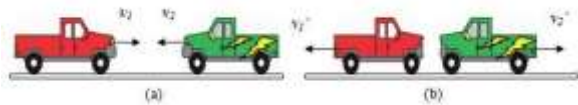


Figure6. (a) before the a and b impact and (b) after a ball and a ball b impact

$$-m_2(v_2^2 - v_2'^2) < m_1(v_1^2 - v_1'^2)$$

$$-(v_1' - v_2') < (v_1 - v_2)$$

Restitution on the coefficient of the collision of elastic is partly $0 < e < 1$

Conclusions

The result showed that momentum and impulse learning using NHT cooperative model with worksheet based RGM could make the learning process becomes more effective because the student participated directly on the learning process so they could improve their learning outcomes (cognitive and affective)

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