Review Study of Physical and Cognitive Activities in Physics Active Learning: Model of Numbered Heads Together (NHT)

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Abstract

This research aims to examine the proportion of physical activities and cognitive activities in the physics learning that using NHT as a learning model. The research is descriptive qualitative. There are three samples used in this research. Two of them are lesson plans. The other one is a video of physics learning that applicate NHT model. The result shows that in sample 1 which is RPP 1 shows that proportion of physical activities and cognitive activities is 6.6% and 93.4% respectively, then in sample 2 which is RPP 2 shows that physical activities and cognitive activities proportion is 5.5% and 94.5% respectively, and the third sample which is the video shows that physical activities and cognitive activities proportion is 13.3% and 86.7% respectively. Based on the considerable study of percentage that done in the RPP and the learning video shows that cognitive activities are more dominant than physical activities, this result is already accord with purpose of physics learning according to taxonomy bloom but this result also not accord with the basic idea of cooperative learning which is constructivism because in three sample student are not push to get the knowledge by their work. Based on that research finding it is suggested that in the learning activity that using NHT teacher use a drive questions so the cognitive activity in the learning can be accord with the target of basic idea from the NHT which is constructivism

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INTRODUCTION

The learning activity is a basic in humanity and that activity always on until the end of their life. This learning activity happens in automatic because it is a need and with learning human can comprehend and develop information that happens in the environment and the result from that learning can help human to produce works that benefit for humanity. Learning happens because of the stimulus from the environment.

Human is a social creature that lives in a society form based on that, learning activity and teaching activity in society take form as an education program, by this program learning activity in society can be more systematic and can be monitored. One of this education programs is school education where there is a teacher as a facilitator and student as the creator of their knowledge. In the society, this education program arranged in the system call curriculum that is planning system and arranges system about the content and the material that is used as the manual for an educational institution for example school or university.

An Education system is a dynamic system that is always changing to make the system better. This changing or development can be caused by the environment or from inside of education systems itself. One of the inside caused of the changing is the changing paradigm from teacher centered to student-centered learning (SCL). In this SCL active, creative, and independence are demand for student, based on that education expert make a various development in education method in class like instructional media, this media can be used as tools to activate student during the learning activities and according to Kristiyanto (2017) the media also can activate the cognitive side of student, other development that expert make are invention of cooperative learning model this method based on social interaction of student as a respond to comprehend a knowledge trough a little group discussion, this model also based on the constructivism theory. Cooperative learning model had many types, and one of it is Numbered Heads Together (NHT). In NHT student will be divided into several groups usually 4 group, and then each group member will get a number in their head and teacher will call a student based on this number to answer a question. NHT had four syntaxes which are numeration, giving a question, thinking together, and answering.

Application of NHT in a learning process in school had been giving a good impact on student even in a matter that student thinks hard such as physics. Parsiti (2016) showed that the use of NHT model in the subject matter of parabolic and circle motion can improve students' activities. In phase I, student activity is only 67.74% then in the phase II student activities improve to 78.87%. Siregar, F. A. (2012) also shows in her research that by using NHT model in the learning with the subject matter is solid and liquid pressure the activities of student improve from 57.85% to 76.96%. The application of NHT model in physics learning also can improve a good learning result for student and this is shows from the research that done by Widodo (2011) and also Mahrir (2016).

The research that is shown before relating to NHT model had been showed us a good result in the improvement of student activities, but that improvement is it already appropriate or proportional with the planning that had been made for example a teacher planning to improve a cognitive in a learning process by using NHT model, but when NHT applicate the result is physical activities are more dominant thank cognitive

Based on that problem this research aims to study and review the proportion of physical activities and cognitive activities in the learning process and also its appropriation with the learning planning that teachers make. This research can be taken as information, reference, and as the suggestion in using NHT model.

METHODS

The method that uses in this research is qualitative analysis with descriptive analysis. This research performs by collect a lesson plan (RPP) from teachers that use NHT model in their learning and also by collecting video of application NHT model. RPP that use in this research is specific to only in physics. Some sample RPP use in this research as data is two and one video. Data analyses were done by review and make a percentage the proportion of physical activities and cognitive activities in the RPP dan video that is already placed on a table. Activities percentage was done in two parts in RPP that is in the indicator and the core activities. Physical and cognitive activities corresponding assessment in the RPP did by comparing the percentage of physical activities and cognitive activities in the indicator of the percentage in the core activities.

RESULTS AND DISCUSSION

RPP and video sample that is already reviewed is shown in Table 1, 2, and 3. Table 1 shows reviewed the result of physical and cognitive activities in sample 1 which is RPP 1 with learning material pressure. Table 2 shows reviewed the result of physical and cognitive activities in sample 2 which is RPP 2 with learning material dynamic fluid. Table 3 shows reviewed the result of physical and cognitive activities from learning video that applicant NHT model in the learning material sound wave.

Table 1. Review of physical and cognitive activities in RPP 1 with learning material pressure.

Syntax of NHT	Activities Description	Possibility of Student Activities	Conformity with Indicator	Activities		Explanation
				Cognitive	Physical	
Phase 1: Numbering	• Student guide by teacher to sit in a group then random numbering them	Student Form a group	No indicator that is corresponding to the activity	√	-	Cognitive: In making a group involve dominant cognitive activity
		A numbered hats pair by a student to each of their friend in their group	No indicator that was corresponding to the activity	√	-	Cognitive: Dominant brain activity involves in pair a numbered hats
	• Teacher giving an explanation about the subconcept of pressure	Student pay attention to the teacher explanation	No indicator that was corresponding to the activity	√	-	Cognitive: Dominant brain activity involves when student pay attention in explanation
		Student noted the information that gave by teacher	No indicator that was corresponding to the activity	√	-	Cognitive: Dominant brain activity involved when student

						noted
		Student processing the information from teacher	No indicator that was corresponding to the activity	√	-	Cognitive: Processing involves dominant brain activity
	• Student ask by teacher to describe pressure	Student processing information to describe pressure	No indicator that was corresponding to the activity	√	-	Cognitive: Information processing involves dominant brain activity
		Student describe pressure by speak	This activity corresponds to indicator part describe pressure	√	-	Cognitive: Dominant brain activity involves when student describe pressure
	• Student ask by teacher to describe absolute pressure	Student processing information to describe absolute pressure	No indicator that was corresponding to the activity	√	-	Cognitive: Information processing involves dominant brain activity
		Student describe absolute pressure by speak	This activity is already correspond with the indicator part describing the meaning of absolute pressure	√	-	Cognitive: Dominant brain activity involves when student describe absolute pressure
Phase 2: Questioning	• Teacher distribute LKS to each group	Student open the LKS	No indicator that was corresponding to the activity	-	√	Physical: Open LKS involve dominant hand muscle activity
Phase 3: Thinking together	• Teacher guide student in work the LKS	Student listen and pay attention teacher guide	No indicator that was corresponding to the activity	√	-	Cognitive: Dominant brain activity involves when student listen and pay attention to teacher guide
		Student	No indicator	√	-	Cognitive:

	processing teacher guide	that was corresponding to the activity			Processing teacher guide involve brain activity
	Student processing problems in LKS to solve	No indicator that was corresponding to the activity	√	-	Cognitive: Processing problem to solve involve brain activity
• Student by teacher guide identify and formulate the problem based on the experiment purpose that is in LKS	Student listens to teacher guide	No indicator that was corresponding to the activity	√	-	Cognitive: Dominant brain activity involves listening activity
	Student processing teacher guide	No indicator that was corresponding to the activity	√	-	Cognitive: Processing teacher guidance involve brain activity
	Student identify and formulate the problems	Formulate problem activity is correspond with indicator in formulate problem	√	-	Cognitive: Identify and formulate problems involve brain activity
• Teacher asks students to discuss for making a hypothesis before doing the experiment	Student planning the experiment using the guidance in LKS	No indicator that was corresponding with the activity	√	-	Cognitive: Planning activity involves brain activity
	Student make a hypothesis	Making hypothesis activity is correspond with indicator that is making hypothesis	√	-	Cognitive: Making hypothesis involve dominant brain activity
• Teacher facilitate each group to identify variables in the experiment	Student identify and to change variables that involve the experiment	Student activity in identify variables is correspond with indicator identify quantities that	√	-	Cognitive: Variable identification activity involve dominant brain activity

		involve in the experiment			
	Student do the experiment	No indicator that was corresponding to the activity	-	√	Physical: Doing the experiment involve dominant physical activity
	Student observe the experiment	No indicator that was corresponding to the activity	√	-	Cognitive: Observe activity involve dominant brain activity
	Student noted the experiment results	No indicator that was corresponding to the activity	√	-	Cognitive: Noted the experimental results involve dominant brain activity
• With the teacher monitor, student in each group arrange the experiment result in a table	Student write the experiment result into a table	No indicator that was corresponding to the activity	√	-	Cognitive: Write the experiment results into a table involve dominant brain activity
Teacher guide each group to analyze experiment data	Student listening and processing teacher guidance)	No indicator that was corresponding to the activity	√	-	Cognitive: In listening and processing teacher guidance involve dominant brain activity
	Student analyze data from experiment	Analysis activity by the student corresponds to indicator part analyzing experiment results	√	-	Cognitive: Analysis activity involve dominant brain activity
Teacher guide student to	Student making a conclusion	Concluding is correspond	√	-	Cognitive: Concluding

	conclude the experiment results about hydrostatic pressure		with indicator part conclusion			involve dominant brain activity
Phase 4: Answering	Teacher calls a number and the student with that number raise and answer the question that is in LKS	Student processing the question from the LKS to answer	No indicator that was corresponding to the activity	√	-	Cognitive: Processing question to answer involve dominant brain activity
		Student write the answer from the question in the whiteboard	No indicator that was corresponding to the activity	√	-	Cognitive: Write the answer on whiteboard involve dominant brain activity
	Teacher calls the same number with the student that answer the question to giving a comment	Student processing information for giving the comment	No indicator that was corresponding to the activity	√	-	Cognitive: Processing information involve dominant brain activity
		Student giving the comment	No indicator that was corresponding to the activity	√	-	Cognitive: Commenting involving dominant brain activity
				$\sum C = 28$	$\sum P = 2$	

Percentage of Cognitive & Physical activity based in the indicator.

$\sum$Cognivite Activity = 6

$\sum$ Physical Activity = 3

$$\% \text{ Cognitive} = \frac{\sum Cognitive\ activity}{\sum Physical\ activity + \sum Cognitive\ activity} \times 100\% = \frac{6}{6+3} \times 100\% = \frac{6}{9} \times 100\% = 66\%$$

$$\% \text{ Physical} = \frac{\sum Physical\ activity}{\sum Physical\ activity + \sum Cognitive\ activity} \times 100\% = \frac{3}{6+3} \times 100\% = \frac{3}{9} \times 100\% = 33\%$$

Percentage of physical and cognitive activity in the learning core activities that use NHT model:

$$\% \text{ Cognitive} = \frac{\sum Cognitive\ activity}{\sum Physical\ activity + \sum Cognitive\ activity} \times 100\% = \frac{28}{28+2} \times 100\% = \frac{28}{30} \times 100\% = 0.933 \times 100\% = 93,4\%$$

$$\% \text{ Physical} = \frac{\sum Physical\ activity}{\sum Physical\ activity + \sum Cognitive\ activity} \times 100\% = \frac{2}{28+2} \times 100\% = \frac{2}{30} \times 100\% = 0.066 \times 100\% = 6,6\%$$

The review proportion results in physical and cognitive activities for sample 1 in table 1 shows that the percentage of physical and cognitive activities in the learning core that use NHT model is 6.6%

and 93.4% respectively. The percentage shows that in the applicate of NHT model during learning activities student are more active in the cognitive than physical, and the indicator also shows that the dominant activities are cognitive than the physical activities which are 66% and 33% respectively, this show that lesson core with the using of NHT model correspond with the indicator.

Table 2. Review of physical and cognitive activities in RPP 2 with subject matter dynamic fluid

Syntax of NHT	Activities Description	Possibility of Student Activities	Conformity with Indicator	Activities		Explanation
				Cognitive	Physical	
Phase 1: Numbering	• Students form groups and receive numbered hats from teacher, then doing a discussion about dynamical fluid concept with the use of NHT model	Students form groups	No indicator that was corresponding to the activity	√	-	Cognitive: Forms groups involve dominant brain activity
		Student share and set the numbered hats	No indicator that was corresponding to the activity	-	√	Physical: Share and set the numbered hats involve dominant hands
		Student discuss dynamical fluid	No indicator that was corresponding to the activity	√	-	Cognitive: Discussion activity involve dominant brain activity
Phase 2: Questioning	Giving a question is form of group work sheet about the subject matter: Find a few example of where the ideal fluid concept can be applicated in real life	Student read the questions on the work sheet	No indicator that was corresponding to the activity	√	-	Cognitive: Read involve dominant brain activity
		Student processing information to answer the question on the work sheet	No indicator that was corresponding to the activity	√	-	Cognitive: Processing information involve dominant brain activity
		Student in their group discussing the example of ideal fluid concept that can be applicated in real life	No indicator that was corresponding to the activity	√	-	Cognitive: Discussion activity involve dominant brain activity
Phase 3: Thinking	Differentiate types of fluid	Student pay attention to	No indicator that was	√	-	Cognitive: Pay attention

Together	that is compressible, turbulence, stationer, and not thick fluid	the teacher that explains the subject matter	corresponding to the activity			to involve dominant brain activity
		Student processing information from teacher	No indicator that was corresponding to the activity	√	-	Cognitive: Processing information involve dominant brain activity
		Student noted the information that teacher give	No indicator that was corresponding to the activity	√	-	Cognitive: Noted information from teacher involve dominant brain activity
		Student asking about the turbulent fluid, stationer, and not thick fluid	No indicator that was corresponding to the activity	√	-	Cognitive: Asking teacher involve dominant brain activity
	Determine the rate of flow a. Q = V/Δt b. Q = (A v t)/t c. Q = A •V	Student pay attention in teacher explanation	No indicator that was corresponding to the activity	√	-	Cognitive: Pay attention to involve dominant brain activity
		Student processing teacher explanation	No indicator that was corresponding to the activity	√	-	Cognitive: Processing teacher explanation involve dominant brain activity
		Student by teacher guide formulate the rate of flow	Student activity to formulate the rate of flow is has corresponded with indicator part formulate basic law of dynamic fluid	√	-	Cognitive: Formulate the rate of flow involve dominant brain activity
	Determine the fluid flow velocity $\rho_1 \cdot A_1 \cdot v_1 = \rho_2 \cdot A_2 \cdot v_2$	Student pay attention to the teacher explanation	No indicator that was corresponding to the activity	√	-	Cognitive: Pay attention to involve dominant brain activity

		Student processing teacher explanation	No indicator that was corresponding to the activity	√	-	Cognitive: Processing explanation involve dominant brain activity
	and the comparison between fluid velocity with the cross-sectional area $\frac{v_1}{v_2} = \frac{A_2}{A_1}$	Student by teacher guide formulate the fluid flow velocity and the comparison between fluid flow velocity with cross-sectional area equation	Student activity in formulating has corresponded with the indicator part formulate the basic law of dynamic fluid	√	-	Cognitive: Formulate involve dominant brain activity
Phase 4: Answering	Solve the questions remain question in the work sheet	Student read the remain question in work sheet	No indicator that was corresponding to the activity	√	-	Cognitive: Read involve dominant brain activity
		Student processing information to answer the questions	No indicator that was corresponding to the activity	√	-	Cognitive: Processing information to answer the question involve dominant brain activity
				$\sum C = 17$	$\sum P = 1$	

Percentage of Cognitive & Physical activity based in the indicator.

∑Cognivite Activity = 2

∑ Physical Activity = 0

$$\% \text{ Cognitive} = \frac{\sum Cognitive\ activity}{\sum Physical\ activity + \sum Cognitive\ activity} \times 100\% = \frac{2}{2+0} \times 100\% = \frac{2}{2} \times 100\% = 100\%$$

$$\% \text{ Physical} = \frac{\sum Physical\ activity}{\sum Physical\ activity + \sum Cognitive\ activity} \times 100\% = \frac{2}{2+2} \times 100\% = \frac{2}{2} \times 100\% = 0\%$$

Percentage of physical and cognitive activity in the learning core activities that use NHT model:

$$\% \text{ Cognitive} = \frac{\sum Cognitive\ activity}{\sum physical\ activity + \sum Cognitive\ activity} \times 100\% = \frac{17}{17+1} \times 100\% = \frac{17}{18} \times 100\% = 0.944 \times 100\% = 94,5\%$$

$$\% \text{ Physical} = \frac{\sum Physical\ activity}{\sum Physical\ activity + \sum Cognitive\ activity} \times 100\% = \frac{3}{15+3} \times 100\% = \frac{3}{18} \times 100\% = 0.055 \times 100\% = 5,5\%$$

Table 2 shows the proportion review of physical and cognitive activities in sample 2 which is RPP 2. Physical and cognitive percentage in the learning core that using NHT is 5.5% and 94.5% respectively, if this results compare with the percentage of physical and cognitive activities percentage in the indicator which is 0% for physical and 100% for cognitive it is show that there is corresponding wherein the indicator dominant activity is cognitive and in the learning core cognitive activity also the dominant one.

Physics are the knowledge that emphasizes conceptual understanding and mathematical calculation because of that it is more important in physics learning that the cognitive aspect is more emphasized. Triatmono (2010) in his book says that as recorded in the taxonomy bloom that IPA learning can give cognitive knowledge as the main purpose of the learning. RPP that reviewed in table 1 and two had been fulfilled the physics learning principle based on the taxonomy bloom that is cognitive activity is more emphasized.

Active learning is based on the student-centered learning (SCL) curriculum this concept is a result of the paradigm changing that is teacher center to student center learning. In the SCL student are more emphasize to be active in the learning process, and also the student is accentuated to be autonomous in build a knowledge and concept of the subject matter during the learning activity. Cooperative learning is based on the constructivism theory that says learning process has to be done with the purpose to guide student in find and make a various experience or even a new knowledge in order to fix, to complete, or develop the old knowledge that student has, it is shown that active learning and cooperative learning has a same role and purpose which is to activate the student. According to Kristiyato (2016), active learning that is activate thingking can be done by using questions herding, the cognitive domination that shows in table 1 and 2 for sample RPP 1 and 2 is still in general form not specific and based on the constructivism theory that is the basic ideo of cooperative learning the cognitive dominance is not appropriate because of the lack questions herding that uses by teacher, it is important that teaher use this questions herding because by use it student can find the idea, knowledge, and even make a concept by their self.

Table 3. Review of physical and cognitive activities in video that applicate NHT model in physics learning with subject matter sound wave

Syntax of NHT	Activities Description	Observed Student Activities	Activity		Explanation
			Cognitive	Physical	
Fase 1: Numbering	A student separated by the teacher into six different groups where each group contain 4-5 student. Teacher assign one student in each group to make a numbering for all of the members	Student pay attention to teacher guide and processing it	√	-	Cognitive: Pay attention and processing information to involve dominant brain activity
		Form a group	√	-	Cognitive: Form a group involve dominant brain activity
		one student in each group share a numbered hats from teacher to the group member	-	√	Physical: Share activity involve dominant physical hand movement

Fase 2: Questioning	Teacher share a handout of discussion sheet for all student	Student listening teacher guidance and processing it	√	-	Cognitive: Listening and processing involve dominant brain activity
		Student read the handout of discussion sheet	√	-	Cognitive: Reading activity involve dominant brain activities
		Student processing information/question that is on the discussion sheet	√	-	Cognitive: Processing involves dominant brain activity
Fase 3: Thinking Together	Students discussing to answer the question on the discussion sheet	Student exchange an opinion	√	-	Cognitive: Exchange opinions involve dominant brain activity
		Student read the question in the question on the discussion sheet	√	-	Cognitive: Read the question on the discussion sheet involve dominant brain activity
		Student exchange opinion to examine each of their answers	√	-	Cognitive: Exchange opinion and examine each answer involve dominant brain activity
Fase 4: Answering	In this activity student doing some game which is passing a ballpoint to the next friend while teacher playing a song, when the song stops the last student that holds the pen will stand up to answer a question and another student that has the same number will also stand to	Student pay attention to the teacher guidance	√	-	Cognitive: Pay attention to teacher guidance involve dominant brain activity
		Student processing teacher instruction	√	-	Cognitive: Processing instruction involve dominant brain activities

comment on the answer	Student playing the passing pen game	-	√	Physical: Playing passing pen game involve dominant physical activity
	Student stand up and read the answer from the discussion result	√	-	Cognitive: Read the answer involve dominant brain activity
	Other students commentate the answer	√	-	Cognitive: To comment involve dominant brain activity
	Student making a conclusion from the group's discussion result	√	-	Cognitive: Making a conclusion involves dominant brain activity
		$\sum C = 13$	$\sum P = 2$	

Percentage of physical and cognitive activity in the learning core activities that use NHT model:

$$\% \text{ Cognitive} = \frac{\sum Cognitive\ activity}{\sum physical\ activity + \sum Cognitive\ activity} \times 100\% = \frac{13}{13+2} \times 100\% = \frac{13}{15} \times 100\% = 0.866 \times 100\% = 86,7\%$$

$$\% \text{ Physical} = \frac{\sum Physical\ activity}{\sum physical\ activity + \sum Cognitive\ activity} \times 100\% = \frac{2}{13+2} \times 100\% = \frac{2}{15} \times 100\% = 0.133 \times 100\% = 13,3\%$$

Review results of physical and cognitive activities from the learning video that applicant NHT model with the subject matter sound wave in table 3 shows that the dominant activity is cognitive activity with percentage 86.7% while the physical activity is 13.3%. Based on the purpose physics learning that is in taxonomi bloom the cognitive dominant is already fulfil that purpose, but in the concructivism the cognitive dominant is not appropriate because of the lack to push the student to find and make the knowledge, or concept by their work (Priyambodo, 2017) this is shows in the activity description where student just follows the instruction to read, play, etc. the interaction between student and teacher where the teacher plays the role to guide the student to build the knowledge by their self is lack and also the question herding is not used at all only instruction order is apply. Siswati, H. A. (2012) and Rahono, D. (2014) showed that experiment and demonstration have significant effect when it uses in teaching activity. The subject matter about the sound wave also can be tech by using a demonstration or experiment this can help students to build the knowledge about the sound wave, but in the video, the student just orders to read the discussion sheet.

Each three sample in table 1, 2, and 3 show the same results in the dominant activity that is cognitive and in the sense of the corresponding to physics learning purpose in the taxonomy bloom the three sample also have the same results that are dominant cognitive activity dominant correspond with

that purpose, but this cognitive dominant is not correspond with constructivism theory that is the basis of NHT model because the emphasizing lack of teacher in herd the student to discover and produce their knowledge based on the teacher guidance.

CONCLUSION

Based on the analysis and discussion about the review of physical and cognitive activities proportion for the three sample that is two RPP physics learning that use NHT model and one video of the application NHT model in the physis learning can conclude that physics and cognitive activities that happen is already corresponding with the purpose of physics learning that is recorded in the taxonomi bloom, but according to constructivism theory that is the basis of NHT model the cognitive activity is not appropriate because in the constructivism student have to more active, creative, and independent in the learning process in order to fix, to complete, and to improve their knowledge that they already have, but in the research results show that student does not guide to discover, improve, and complete the knownedge in independent this is show with the lack of herd questions that used by teacher in order to herd the student to discover the knowledge in independent way.

The results and discussion shows that there is a shortage of herd questions from the teacher in the physics learning activity that is use NHT model whether it is in the RPP or video to activate the student to think independently in order to discover the knowledge, because of that it is suggested that teacher use herd questions in the learning activity when using NHT model.

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