PE - 10

THEORETICAL REVIEW: THE OBSERVATION FOR THINKING PROCESS BY PIAGET'S THEORY THROUGH MEDIA LEARNING PHYSICS'S ANIMATION

Wahyu Hari Kristiyanto[1,2], Prabowo[1], Soeparman Kardi[1]

[1]Surabaya State University, Surabaya
[2]Satya Wacana Christian University, Salatiga
whkris_fisika@yahoo.com

Abstract

Research on media should not be limited only to evaluating the effectiveness of animation for various domain contents, instructional contexts, and processing steps of supporting or supplementary materials. Instead, it seems to be more useful to expand this research scope to explaining this media moderating (Scheiter et. al., 2009). This paper aims to review theories on the development and implementation of an instrument for observing the thinking process while using animated or computer simulated instructional media. In so doing, Piaget's theory on thinking process was used as the theoretical framework. The review methods by literature studies and develop for the observation instrument.

The review shows that thinking process, in Piaget's theory, follows the stages of disequilibration, accommodation, assimilation, and equilibriation. The implementation results of developing the observation instrument for the thinking process shows that each thinking stage (disequilibration, accommodation, assimilation, or equilibriation)is manifested by the possible behavior and statements shown in understanding the concept of animated Physics learning media that will be used. This study recommends that detailed documentation on the student's behavior/statements is needed for further assessing the students' thinking process. Using a video camera recorder can be one option.

Key words: *Thinking process in Piaget's theory, observation instrument, learning media Physics's animation*

INTRODUCTION

Many educational practitioners realize that the use of instructional media or tools helps learning processes or activities both inside and outside the classroom, particularly in increasing the students' achievement (Munadi, 2012). Nevertheless, despite of their significant contribution to students' achievement, there are several factors interfering with the success of instructional media, namely:

1. raw input which refers to the students' conditions, both the physiological and psychological ones.
2. environmental input, both social and the natural environment.
3. instrumental input, which includes curricula, materials, infrastructures or facilities, and teachers.

There have been a lot of studies conducted on the development and effective use of instructional media. Like Munadi's study, all studies have shown that the use of the media is very effective in increasing the students' achievement above. However,

Scheiter and Gerjets (2009) state that research on media should not just be limited to evaluating the effectiveness of animation for various domains content, instructional context, and processing steps of supporting materials. Instead, it will be more useful to expand this perspective in order to be able to explain this media moderating. Besides that, Kristiyanto has found that some computer simulated animations present some inaccurate physics concepts (Kristiyanto, 2008) and then the computer simulated animation do not convince students in the accuracy of the physic concepts (Kristiyanto. et.al., 2014).

Sceiter and Gerjets (2009) propose that the research scope can be expanded to analyzing the raw input or the student factor. The analysis can focus on the psychological aspect which involves understanding the student's thinking process when processing the information presented by instructional media. This kind of analysis requires observations on the students' behavior during the learning process involving the use of instructional media. This can also be done by investigating the students' answers and their manner of answering the questions asked (Someren et al, 1994 in Kamid, 2011).

The previously mentioned observations need an observation instrument. This paper aims to describe a theoretical review on Piaget's theory of thinking processes and its implementation in developing an observation instrument to review the use of computer simulated animated based instructional media.

PIAGET'S THEORY ON THINKING PROCESSES

According to Piaget, there are two basic processes involved in the knowledge acquisition or construction process, namely assimilation and accommodation. Assimilation occurs when someone tries to incorporate new knowledge into existing prior knowledge scheme without reorganizing the previous mental structure. Accommodation, on the other hand, happens when someone tries to modify existing schemes to adapt to certain situations (Corpus, 2006).

In information processing, Bruner states that the core of learning is how people actively choose, maintain, and transform information. According to Bruner, learning activities should let students discover the meaning of everything they are learning (discovery learning). Throughout the activities, students are given the widest opportunity to play an active role in solving a problem. In this way, they are expected to be able to understand the concepts, in their own language, through the information presented by the instructional media.

According to Mayer (2009), the thinking processes consists of three (3) basic ideas, i.e., 1) thinking is a cognitive activity occurring inside a person's mind which is invisible, but is able to be inferred through the observed behavior, 2) thinking is a process that involves some knowledge manipulation in the cognitive system, and 3) the thinking activity is directed to producing solutions to problems. Thinking requires two (2) major components, namely incoming information and schemes that have been formed and stored in the individual's mental structure or mind. According Skemp (1982 in Kamid, 2011), a scheme is a mental structure or cognitive with which people intellectually adapt and coordinate with their surrounding environment.

Scheme development continuously occurs through adaptation to its environment. The process of adaptation of the schemes that have been formed with the

new information can occur through two (2) ways: assimilation and accommodation. This scheme forms a specific information structure inside individual's mind. The better the individual's scheme quality is, the better the individual's process of information integration will be.

According to Piaget, assimilation is the process of using or transforming the environment so that it can be placed in existing cognitive structures (Huitt and Hummel, 2003). Assimilation is the process of using or changing an environment so that it can be placed in an existing cognitive structure. In assimilation, information is interpreted based on the schema owned by someone. If the incoming information is in accordance with the existing schemes, one can directly respond to the information. Assimilation demonstrated the ability to explain events based on schemes. Therefore, in assimilation, to make stimuli integrable, the received information must be in accordance with the scheme owned.

Piaget stated that "accommodation is the process of changing cognitive structures in order to accept something from the environment" (Huitt and Hummel, 2003). Since information received may not be compatible with the old scheme, it is the old scheme which should be adapted or modified to suit the incoming information. If the information corresponds with the modified scheme, the individual will be able to assimilate to the incoming information. Accommodation is the process of changing a scheme or forming a new scheme in order to adjust the stimulus received. Accommodation occurs when there is no corresponding structure, so it is necessary to change the old structure or form a new structure in accordance with the stimuli received. This process is also often called restructuring.

According to Suparno (2001), accommodation is also called a radical scheme change. In order to have a radical scheme change, some conditions or circumstances are required, i.e., a) there must be a dissatisfaction with the existing schemes, b) a new scheme should be understandable, rational and able to solve problems or new phenomena, c) the new scheme should be logical, able to solve the previous problems, and is also consistent with the previous theories or the existing knowledge.

At the beginning of learning, a person is in a state of disequilibration. During the learning process to achieve a state of equilibration, the person is likely to undergo the process of assimilation and accommodation (Figure 1). Through this process, the scheme will evolve through the process of merging, converting, or the forming a new scheme until equilibrium is formed. The processes, starting from disequilibration, assimilation, accommodation, to equilibration, are the person's adaptation processes to the environment (or problem). This process will continue when the person learns or receives new information. Thus, one's thinking process is getting more and more complex (or more mature).

Furthermore, Piaget explains that a person's cognitive development has three elements, namely content, function, and structure. Content is what someone knows. Function shows the nature of intellectual activity, that is continuous assimilation and accommodation throughout cognitive development. Structure is a scheme organization. A child's cognitive structure development can only work if he assimilates and accommodates information from his environment.

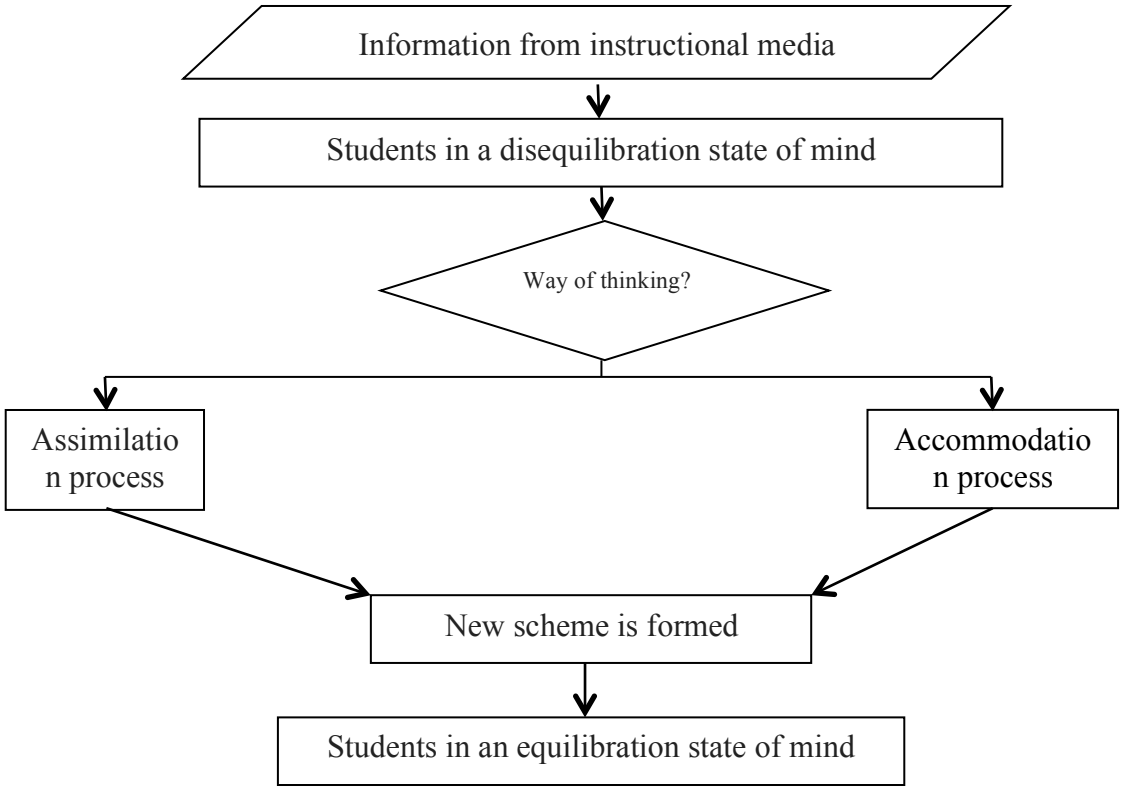

Figure 1. Diagram of Thinking Processes (developed from Kamid (2011))

Thinking process in this study refers to a mental activity in transforming information into a cognitive structure by means of assimilation and accommodation, which is observed through the behavior shown when answering questions and when solving problems.

OBSERVATION ON THINKING PROCESS ACCORDING TO PIAGET IN PHYSICS ANIMATION ASSISTED LEARNING MEDIA

The observation of thinking process is done in reference to the stages proposed Piaget, which is previously discussed. The terms relating to the thinking process have been summarized by Kamid (2011) to describe the meaning of each stage, as shown in Table 1.

Table 1. Description of terms stages of the process of thinking (adopted from Kamid (2011))

Terminology in the thinking process	Description
Disequilibration	Non-equilibration state of the cognitive structure of a person as a result of problems encountered prior to the process of assimilation and accommodation
Assimilation	Direct integration of new information into the formed scheme
Accommodation	The old scheme changing or a new scheme formation in order to adjust to the information received
Equilibration	Equilibrium state of the thinking structure and received information after the process of assimilation and accommodation

Table 1 shows a description of the thinking process stages in general according to Piaget. The observation on the thinking process according to Piaget in Physics animation assisted instructional media need to be further developed based on the characteristics of the media.

Kamid (2011) conducted a research on the students' thinking processes in solving problems with the possibility of student behavior shown when working on as described in Table 2 column 3. In his research, Kamid observed the behaviors shown by the students while they were doing their exercises. Based on the behaviors described by Kamid (2011), as shown in Table 2 column 3, an observation instrument can be developed by describing behaviors possibly shown by students in understanding Physics concept through animation assisted instructional media, as shown in Table 2 column 4.

Table 2. Instrument development for observing thinking process steps

Process Thinking Stage	Description	Possible behaviors shown while learning concepts (adopted of Kamid (2011))	Possible behavior shown in understanding Physics concept through animated instructional media
Disequilibration	Non-equilibrium state of the cognitive structure of a person as a result of problems encountered prior to the	Repeatedly digesting parts of all questions (when asked: Do you understand? They do not answer but ask for question repetition.	When receiving information on Physics through the animation media, students ask for information repetition
		When asked if they have understood the problem, they simply	When the media present information, the subjects ask what

	process of assimilation and accommodation	reply: “e ...” (keep silent for some time) or ask back: “About what? Which one?”	information is being presented
		After receiving the question / problem, they give a blank look. When asked, they are silent. It looks like their mind is a complete blank.	When the media presents information, subjects give a blank look.
Assimilation	Direct integration of new information into the formed scheme	Students directly mention what they know about the problem given to him.	Subjects directly mention what information they get from the media
		Students directly answers any questions related to the problem given	Subjects directly take notes or agree/disagree with the information from the media
		Students directly mentions the required formula	Subjects can directly mention the formula / steps presented by the media
Accommodation	the old scheme Changing or a new scheme formation to adjust to the information received	Students try to find a specific answer as the solution to their problems (if they find that their answer is wrong they revise it).	Subjects try to find a specific answer as the solution to their problems (if they find that their answer is wrong they revise it).
		Students try to plan one way to resolve the problem to be solved. For example, when asked: How? They reply: “Oh right. I must draw it first.”	Subjects try to plan one way to answer a question related to the information from the media. For example, when asked: How? They reply: “Oh right. I must draw it first.”
		After drawing it, what’s next? (ask and think) “Oh, right. I must use a formula.”	After drawing it, what’s next? (ask and think) “Oh, right. I must use a formula.”
Equilibration	Equilibration state experienced by a person	After students find the final answer, they believe its correctness as they have done	After subjects find the final answer/ the core concept, they believe its correctness as they have

	because of problems encountered are already solved after the process of assimilation and accommodation	step by step corrections.	done step by step corrections from what the media have presented.

The results of developing descriptions for observation instrument of the thinking processes shows that each stage (disequilibration, accommodation, assimilation, and equilibration) can be seen from the behaviors and statements possibly shown while learninng Physics concepts through animated instructional media used. Students' behaviors while studying which will be analyzed can be observed with or without the aid of a video recording device. These behaviors are analyzed in reference to the behaviors described in Table 2. Statements/answers produced in relation to interview questions can be recorded with or without the aid of a video/audio recording device. These statements will then be analyzed.

CONCLUSIONS AND SUGGESTIONS

The implementation results the observation instrument development for thinking process shows that each stage (disequilibrium, accommodation, assimilation, and equilibrium) can be seen from the behaviors and statements possibly shown while understanding Physics concepts through animated instructional media.

This study recommends the need for detailed documentation on the students' behaviors / statements for further assessing the students' thinking process. The documentation can use a more sophisticated device like a video camera.

REFERENCES

Corpuz, E.D. 2006. *Students' Modeling of Friction at The Microscopic Level*. Doctoral Dissertation. Manhattan : Kansas State Univerity

Kamid. 2011. *Proses Berpikir Siswa Autis Dalam Menyelesaikan Soal Matematika*. Doctoral Dissertation. Surabaya : Mathematical Education, Postgraduate, Surabaya State University

Kristiyanto, W.H. 2008. *Animasi Fisika yang Tidak Sesuai Fisika.* Proceeding of National Physics, Teaching, and This applications. National Conference Proceeding. Yogyakarta : Physics Education, Postgraduate, Ahmad Dahlan University

Kristiyanto, W.H., Prabowo, Kardi, S. 2014. *Student's Self-Confidence To Understanding The Physics Concepts Through Computer Simulated Animation*. Proceeding of the 1st International Conference on Research, Implementation and Education of Mathematics and Science. Yogyakarta : Faculty of Mathematics and Natural Science, Yogyakarta State University

Mayer, R.E. 2009. *Multimedia Learning (Prinsip-prinsip dan aplikasi)*. Yogyakarta : Pustaka Pelajar

Munadi, Y. 2012. *Media Pembelajaran (Sebuah Pendekatan Baru)*. Jakarta : Gaung Persada Press

Scheiter, K., Gerjets, P. 2011. *Cognitive and socio-motivational aspects in learning with animations : there is more to it than "do they aid learning or not"*. Springer Science+Business Media B.V 2009, online 11 November 2011

Slavin, R.E. 2009. *Psikologi Pendidikan (Teori dan Praktek, jilid 2, edisi kedelapan)*. Jakarta :

Suparno. 2001. *Teori Perkembangan Kognitif Jean Piaget.* Yogyakarta : Kanisius