The Use of Affective and Cognitive Assessment on the Learning of Mirrors and Lenses through the Inquiry Laboratory Approach

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Abstract

This study aims to examine the use of affective and cognitive assesment on the learning of mirrors and lenses with inquiry laboratory approach. The research conducted by experimental design and involved 30 students of class VIII at one of secondary high school in Samarinda, Indonesia as research subjects. Quantitative data were collected using an observation sheet for affective assessment and an essay model test instrument for cognitive assessment. Affective aspects include receiving, responding, appreciating, managing, and characterizing. Cognitive aspects for the dimensions of knowledge include factual, conceptual, and procedural, while its cognitive processes include remembering, understanding, applying, and analyzing. The learning of mirrors and lenses were taught using the inquiry laboratory approach. The approach stage of inquiry laboratory includes observation, manipulation, generalization, verification, and application. The results showed a positive correlation between affective and cognitive abilities, students with high affective abilities showed high cognitive abilities too and vice versa. The findings showed that the inquiry laboratory approach helps increase the interest and motivation and helps students to understand the concepts of mirrors and lenses.

Keywords: Affective and Cognitive Assessment, Inquiry Laboratory, Mirrors and Lenses

INTRODUCTION

Implementation of assessment in learning is a teacher activity to know the progress achieved by students. Based on the curriculum of 2013 (Kemdikbud, 2017) assessment conducted in learning includes three aspects, namely: cognitive /knowledge aspects, affective aspects/ attitude, and psychomotor/skills aspects. Most teachers do partial assessment, and generally only conduct on cognitive and psychomotor aspects only. Many teachers rarely assess the affective aspects of classroom learning. Affective assessment is important because it aims to obtain descriptive information about the behavior in terms of interest and motivation of students. The cognitive assessment is aimed to find out the intellectual progress of the students. The learning approach of inquiry laboratory used by teacher has important role to know the achieving level of students in cognitive aspect and affective aspect. The learning aim to be accessed in this research is to find out the correlation between assessment of affective aspect and cognitive aspect of class VIII students of one of secondary high school in Samarinda, Indonesia while following the learning of mirror and lens.

The target of affective aspects by Krathwohl, et al (1964) in learning is to obtain descriptive information about the interests and motivation of students which include receiving, responding, appreciating, managing, and have the character. Automatically the affective aspect appears in every learning. Along with that, the research of Qadar, et al (2015) suggests that the assessment of affective aspects shows a role to improve the learning. The target of cognitive aspects for students based on Bloom's revised taxonomy by Anderson and Krathwohl (2001) is knowing the intellectual progress consisting of a classification of knowledge and cognitive processes.

Accessing the affective and cognitive aspects integrated with optical learning by using the interactive demonstration approach has been done by Qadar, et al (2015) on physics teacher candidates. The results obtained show that the percentage of affective aspect is correspond to the interest descriptive and motivation of students. The cognitive aspect of the teacher candidates is increase in N-gain average of 0.48.

The concepts of reflection and refraction of light on mirrors and lenses need to be embedded in students. One of many approaches used in learning is the inquiry laboratory (Wenning, 2005, 2010, and 2011). The inquiry laboratory approach has five stages of learning level cycles includes observation,

manipulation, generalization, verification, and application. The learning characteristics of the inquiry laboratory approach is the question given to the students or the students to the teacher. This characteristic is a driving force because it can stimulate the students to think critically. Walsh and Sattes (2005) state that the purpose of the question in inquiry learning is to challenge the students to think about concepts and formulate their own responses. Content, concept, process, and types of thinking that are expected to be carried out by the students with full responsibility. This study was conducted to know the use of affective and cognitive assessment of the students on learning with inquiry approach, and to know the correlation between affective ability and cognitive ability of students.

METHOD

Thirty students of class VIII at one of secondary high school in Samarinda, Indonesia follow the learning with approach of inquiry laboratory. All of the students have no experience in physics science learning using the inquiry laboratory approach. Based on the learning stage of this inquiry laboratory approach, the students are asked previously to study the process of shadow formation in the mirrors and the lenses.

The concepts learning of shadow formation of mirrors and lenses used the inquiry laboratory approach. The concept of shadow formation in the mirrors consists of a flat, concave, and convex mirror. The concept of shadow formation in the lenses consists of convex and concave lenses. The inquiry laboratory approach has five stages of implementation, namely: observation, manipulation, generalization, verification, and application. Observation is conducted to encourage curiosity and generate responses from the students. Manipulation is done to get data from different variables. Generalization is done to get the conclusion based on the results of observation on manipulation activities. Verification is done to match the data obtained under the laws/theories/ principles of the literature. Applications are used to solve problems that correspond to the laws/theories/ principles that have been obtained.

Data were collected through two instruments based on affective aspects and cognitive aspects. The affective aspect instrument is an observation sheet used by the observer. Each observer observed 7-8 students. The affective aspect of the instrument consists of five affective stages: receiving, responding, appreciating, managing, and characterizing. Receiving is done to actively receive a new information and the ability to selectively respond to stimulation. Responding is done to

actively take a clear action role for learning purposes. Appreciate is done to display behaviors consistent with clear beliefs or attitudes. Managing is done to assimilate new values and make them consistent and compatible with previous learning. Having characters are performed to have a value system that has been controlled through consistent behavior and it is a character.

The five affective stages each use four verbs that are expected to appear during the lesson. Receiving has verbs: attend, watch, listen, and see. Responding has verbs: discuss, ask, answer, and participate. Respecting has verbs: define, argue, explain, and show.

To investigate the impact of assessment of affective and cognitive aspects of learning on mirrors and lenses, a qualitative and quantitative data analysis were conducted. The data analysis of cognitive aspect assessment is in the form of students' answers from the essay instrument. The data analysis of affective aspect assessment is in the form of an observation sheet consisting of 20 verbs derived from 5 affective stages. The maximum score of the two instruments is 100 if the answers to the cognitive aspects are all correct and the

Managing has verbs: organize, merge, compare, and equip. Character has verbs: change, reveal, display, and use. Each verb in the observation sheet is scored one for each occurrence.

The instrument of cognitive aspect used Bloom's taxonomy domain which consists of the dimensions of knowledge and cognitive processes. The dimensions of knowledge are factual, conceptual, and procedural. The cognitive process consists of remembering (C1), understanding (C2), applying (C3), and analyzing (C4). The cognitive aspect instrument in the form of essay questions given every learning takes place according to the material being taught. affective aspect sheet is all filled. Furthermore, both data were analyzed statistically for normality test, then correlation test was done to find the relation of both aspects of the assessment.

RESULTS AND DISCUSSION

The assessment results on affective aspects were obtained using observation sheets by observers. Minimum scores, maximum scores, average scores, standard deviations, and normality tests are shown in Table 1.

Table 1. The Achieved Score Data of The Use of Affective, Cognitive, and The Kurtosis Normalities Test

| Category | 1st Lesson | | 2nd Lesson | | 3rd Lesson | | 4th Lesson | |
| | Flat and Concave Mirrors | | Convex Mirror | | Convex Lens | | Concave Lens | |
	Affective	Cognitive	Affective	Cognitive	Affective	Cognitive	Affective	Cognitive
Minimum	50	54	40	45	45	52	45	47
Maximum	80	100	70	80	75	100	75	100
Average	66	79	53	67	56	85	54	81
The Kurtosis Normalities Test	-1.116	-0.25	-1.601	-1.235	1.869	-0.394	1.292	0.780
The Pearson's Correlation Test Sig. (2-tailed)	0.001		0.005		0.004		0.002	

Note: The correlation test stated that there is a correlation if sig. (2-tailed) < 0.05

Based on Table 1, it appears that the affective assessment conducted on the students during the lessons shows the normal category of Kurtosis Statistics with scores between -2 to +2. In the study of flat mirrors and concave mirrors, the affective aspect shown by the students has an average score of 66 with a minimum score of 50 and a maximum score of 80. The most common affective stages are the stages of receiving, responding, and appreciating. The managing and characteristic stages of the students are only visible when organizing, comparing, modifying, and displaying. Some of the students have a high enough interest and motivation to know the subject of the flat mirror and the concave mirror.

In convex mirror learning, the affective aspect shown by students has an average score of 53 with a minimum score of 40 and a maximum score of 70. The most common affective stages are the stages of receiving, responding, and appreciating. The stage of managing and character of students only appear when comparing, changing, and displaying. Many students have difficulty in combining object shadows in a flat mirror with the object's shadow in a convex mirror.

In convex lens learning, the affective aspect shown by the students has an average score of 56 with a minimum score of 45 and a maximum score of 75. The most common affective stages are the stages of receiving, responding, and appreciating. The managing and characteristic stages of the students appear only when organizing, comparing, modifying, displaying, and using. Some of the students have interest

and motivation high enough to know the material of convex lens.

In concave lens learning, the affective aspect shown by students has an average score of 54 with a minimum score of 40 and a maximum score of 75. The most common affective stages are the stages of receiving, responding, and appreciating. The stage of managing and character of students only appear when changing and displaying. Many students have difficulties in displaying shadows of objects in concave lenses because they have to be assisted with convex lenses.

The description of the affective assessment of the students during the learning of the mirror and the lens appears that the affective assessment shows interest and motivation during the learning. These results are expected to help students in improving their intellectual ability. In line with these results, Qadar, et al (2015) argue that affective assessment has a role in improving learning.

Based on Table 1, it appears that the cognitive assessment conducted on the students during the lesson showed the normal category of Kurtosis Statistics with a score between -2 to +2. In the study of flat mirror and concave mirror, the cognitive aspect shown by the students has an average score of 79 with a minimum score of 54 and a maximum score of 100. In convex mirror learning,

the cognitive aspect shown by the students has an average score of 67 with minimum score 45 and maximum score of 80. In the learning of convex lens, cognitive aspect shown by students have the average score of 85 with minimum score 52 and maximum score of 100. In learning concave lens, cognitive aspect shown by students have a flat score of 81 with a minimum score of 47 and a maximum score of 100.

The test which arranged based on cognitive processes include remembering, understanding, applying, and analyzing. In general, the type of remembering and understanding can be answered correctly. Entering the problem of applying type, the students experience a little difficulty in terms of mathematical. As for the type of analysis to look for the shadow enlargement of some of the students difficulties on the focal point distance of the concave and convex mirror and the sign of the distance of the focus point on the convex and concave lenses. Therefore, the cognitive process instrument that is displayed in every lesson, generally the students still needs to be improved by mathematical application. Mathematical application of fractions for students needs to be taught first before discussing the material of mirrors and lenses. The depiction of the shadow-forming rays of objects in the

mirror and lens in general have been understood by students.

Table 1 shows the correlation test of affective aspect data and cognitive aspects of each learning progress. The results of Pearson's correlation test of the first affective aspect with the first cognitive aspect equal to 0,001. Both aspects have statistically correlation. Based on the image of the scatter chart both show a positive correlation as seen in Figure 1.
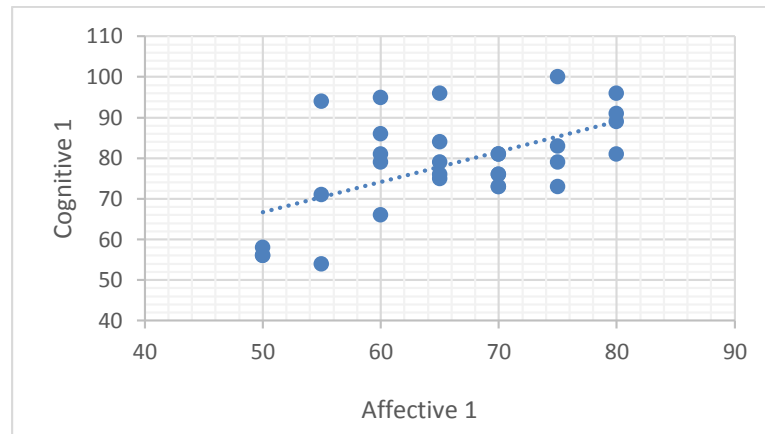

Figure 1. The Positive Correlation of the First Affective Aspect with the First Cognitive Aspect

The results of Pearson's correlation test of the second affective aspect with the the second cognitive is 0.005. Both aspects have statistically correlation. Based on the image of the scatter graph both show a positive correlation as seen in Figure 2.
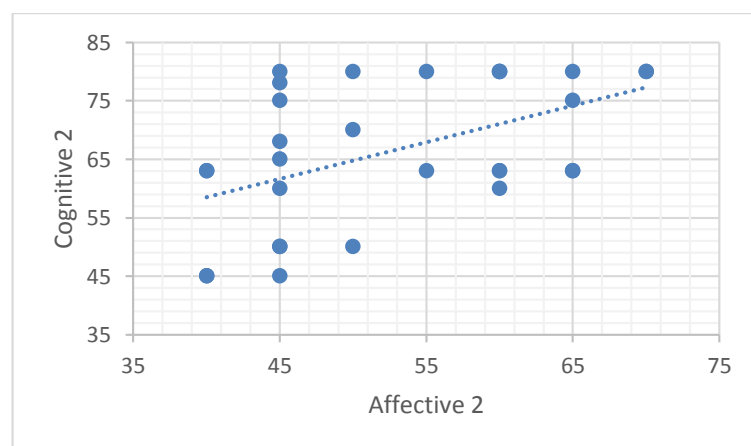

Figure 2. The Positive Correlation of the Second Affective Aspects Data with the Second Cognitive Aspects

The results of Pearson's correlation test of the third affective aspect with the the third cognitive is 0.004. Both aspects have statistically correlation. Based on the image of the scatter graph both show a positive correlation as seen in Figure 3.
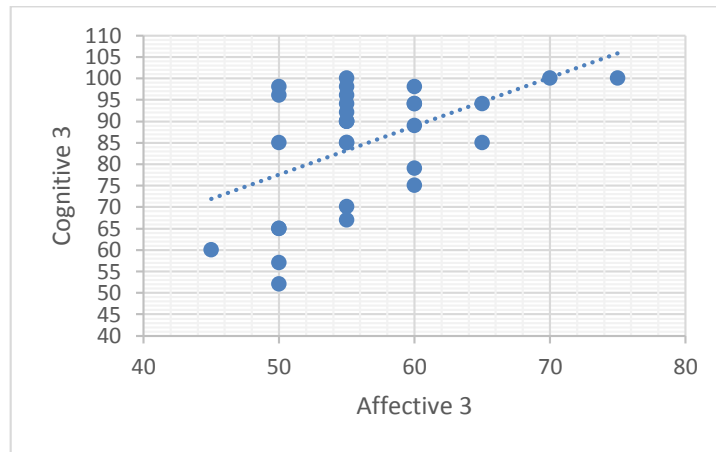

Figure 3. The Positive Correlation of the Third Affective Aspects Data with the Third Cognitive Aspects

The results of Pearson's correlation test of the fourth affective aspect with the the fourth cognitive is 0.002. Both aspects have statistically correlation. Based on the image of the scatter graph both show a positive correlation as seen in Figure 4.
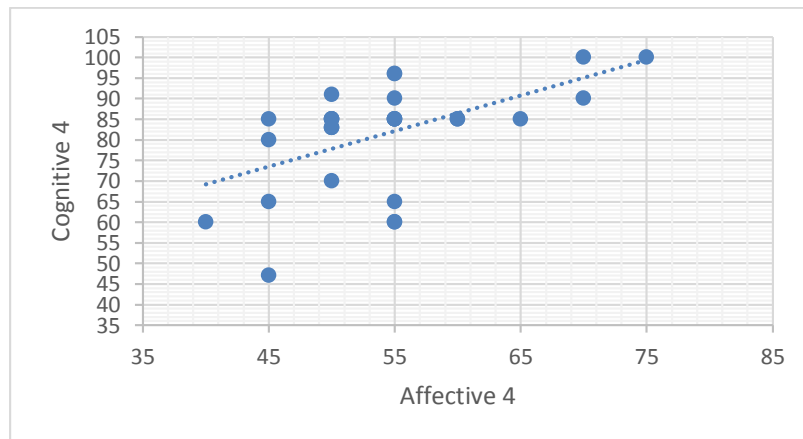

Figure 4. The Positive Correlation of The Fourth Affective Aspects Data with The Fourth Cognitive Aspects

The explanation of the affective and cognitive aspects correlation shown in Fig. 1-4 shows that the characteristics of affective aspects appear in learning related to students' interests, antuisms, attitudes, and motivations. This can help improve the learning outcomes of the cognitive aspects of the students. These

results are in line with the results presented by Olatunji (2013), revealing that affective aspects will emerge according to the cognitive aspect to be achieved in learning. Similarly, Qadar (2015) reveals that the use of the affective aspect assessment of inquiry learning of light properties shows a role to improve learning.

Physics science learning using inquiry method in this study shows the activity of students. If previous students learn by expository methods, then students are more receptive to the concepts and learning models that are centered on teachers still tend to be high. However, after the learning by inquiry method the activity of the students increases. In other words, the inquiry learning model is more centered on the students.

Based on the above descriptions, this study contributes to the curriculum of 2013. In the curriculum of 2013, primary and secondary school learning are expected to teach scientific methods based on inquiry learning and conduct assessments covering three aspects: affective, cognitive, and psychomotor. The contribution of this research to the curriculum of 2013 is the similarity of the system on the instruments of affective aspects and cognitive aspects using inquiry based method. This assessment needs to be embedded in students through inquiry-based learning methods as scientists work in the laboratory. It also improves students' insights if the assessment is integrated in the learning (Miedjensky, 2009 and Qadar, 2015). For teachers can improve the relationship of teacher's ability and trust structure to inquiry learning (Marshall and Smart, 2013).

CONCLUSION

This research reveals how to assess the affective aspect and cognitive aspect and the correlation between the two aspects on learning using inquiry laboratory method. The use of affective assessments is intended to determine the interests, attitudes, and motivations of students in inquiry learning, as well as cognitive assessment is intended to determine the learning achievement of students. The average assessment scores of affective aspect and cognitive aspect are in medium and high category. Assessment of affective aspects and cognitive aspects, both of them show a positive correlation.

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