EFFECTIVENESS OF ASSESSMENT INSTRUMENTS HIGHER ORDER THINKING SKILLS TO GROW SELF REGULATED LEARNING STUDENTS JUNIOR HIGH SCHOOL

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ABSTRACT
Self-regulated learning (SRL) is indispensable for students to help transform mental skills into academic skills and strategies. Students who study with SRL can more easily build on successful academic achievement. This study aims to determine the effectiveness of the application of higher-order thinking skills (HOTS) assessment instruments in growing SRL of students Junior High School, especially on the basic competence of the human circulatory system. The design of the study was quasi-experimental. Research subjects include two groups students of grade eight at Junior High School in Bandar Lampung at Lampung Province, Indonesia with random sampling technique. The subjects of the study were experimental class 1 and experiment class 2. The research data was collected using an SRL scale instrument. Data analysis technique through statistical test parametric independent sample t-test. The result of data analysis shows the application of HOTS assessment instrument to effectively grow SRL of students Junior High School especially on the basic competence of human circulation system.
Key Words: higher order thinking skills, self-regulated learning, assessment for learning, feedback.

INTRODUCTION

Science develops scientific understanding through various research activities so that students are able to analyze, evaluate, and build scientific knowledge independently (Duschl, et al., 2007). Science not only covers the content but also involves a number of scientific skills and attitudes gained through the learning process of science. For students learning science can be implicated in physical and mental activity and includes hands-on and minds-on activities (NRC, 2003). However, the quality of science learning in some countries of the world at this time is still experiencing various obstacles (Tjalla, 2010).

The low quality of science learning in some countries of the world is reflected through the results of the analysis of students' achievement in several international studies such as TIMSS (Trends in International Mathematics and Science Study) and PISA (Program for International Students Assessment). Based on data analysis of TIMSS mapping 2015, there are 15 out of 47 participating countries are in a position below the average international score that is below the score of 500 (IEA, 2016). Furthermore, the results of the 2015 PISA analysis mapping study still contain 49 of the 72 participating countries also have an average science achievement score below the international average score that is below the 501 score (OECD, 2016).

Achievement of science achievement is classified as low, among others, caused by the development of self-regulated learning (SRL) students who have not maximized. Fundamentally SRL is an individual form of learning that relies heavily on student learning motivation (Pintrich & De Groot, 1990). Motivation is an internal factor affecting student SRL (Cobb, 2003). Motivation to learn can bring students feel more competence, confidence, and independence (Zimmerman, 2002). Motivation guides students into self-regulated learners who are able to build learning goals, regulate and control cognition, and evaluate objectives (Valle, et al., 2008). One of the causes of the low ability of student SRL is that teachers' habits present more-oriented learning assessments measuring lower order thinking skills (LOTS) rather than developing higher order thinking skills (HOTS).

The Cognitive domain of remembering (C1), understanding (C2), and applying (C3) in Taxonomy Bloom revised is used to measure LOT skills whereas HOT skills development fundamentals use cognitive sphere analyzes (C4), evaluate (C5), and create (C6) (Narayanan & Adithan, 2015). Students who are often trained in HOTS level also have the ability to solve the LOTS level problem (Jensen, et al., 2014). Students who are often tested using HOTS

have a habit of thinking HOTS as well (Saido, et al., 2015). Thinking HOTS invites students to be able to apply their knowledge and skills in a new context (Brookhart, 2010).

HOTS thinking includes complex thinking that goes beyond basic fact-finding skills so as to enable students to store information and apply solutions to real-world problem solving (Ramos, et al., 2013). HOTS thinking invites students to apply new information or prior knowledge and "manipulate" information to reach possible answers in new situations (Heong, et al., 2011). HOTS thinking encourages students to think deeply about the subject matter and is able to stimulate the development of higher-order thinking skills (Barnett & Francis, 2012). The development of HOTS thinking facilitates the transition process of knowledge and enhances the responsibilities and functions of students in society in the future (Zoller, 2001). In an effort to determine the level of ability to think, help improve and improve students' thinking skills should be assessed ongoing learning assessment by applying assessment for learning (Indrastoeti, 2012).

Assessment for learning is an interactive assessment between teachers and students undertaken during the learning process to obtain information on the strengths and weaknesses of learning and then use the information to improve, modify or modify learning to be more effective, and improve students' learning competencies (Brookhart, 2014). However, to improve the effectiveness of the assessment for learning implementation, teachers must use various assessment strategies (Pachler, et al., 2011).

One of the strategies that teachers can develop when conducting the assessment for learning is through the provision of feedback (Assessment Reform Group, 2002). In the learning of giving feedback can increase academic engagement between teacher and student (Carless, 2011). Feedback can help teachers and students to know the success rate of completed tasks and build development goals at a later stage (Brown, 2004). Even the student's SRL capability is highly dependent on the frequency of feedback in learning (Cakir, et al., 2016).

The main focus of the HOTS assessment instrument in this study is to act as an assessment for learning the instrument with feedback. This study aims to determine the effectiveness of the application of HOTS assessment instruments in grow SRL of students junior high school students, especially on the basic competence of the human circulatory system.

THEORITICAL BACKGROUND

Assessment of Higher Order Thinking Skills

Based on the revised bloom taxonomy, thinking skills in the cognitive domain are divided into six levels: memory, understanding, application, analysis, evaluation, and creation (Anderson & Krathwohl, 2001). According to Narayanan & Adithan (2015) that the cognitive aspects of memory, understanding, and application are classified into lower order thinking skills (LOTS) while the cognitive domain of analysis, evaluation, and creation includes higher order thinking skills (HOTS).

Anderson & Krathwohl (2001) describe the cognitive domain of high-order thinking skills (1) to analyze the material or concept into parts, to determine the relationships between parts or part relations to the structure or objectives as a whole, (2) to evaluate make judgments based on criteria and standards through examination and criticism, and (3) creating that includes elements to form a coherent or functional entity or reorganizing elements into new patterns or structures through the process of generating, planning or producing.

Furthermore, Brookhart (2010) asserts that higher order thinking skills include the ability of students to apply the knowledge and skills that have been developed during the learning of the concept application that has not been previously thought and the ability to apply and connect learning with new things that have never been taught.

Problem HOTS can be designed using operational verbs that fit the cognitive domain. For example, to test the cognitive domain of student analysis, teachers can make problems using operational verbs that include the cognitive domain of analysis, such as analyzing, detecting, measuring, or reviewing (BSNP, 2006). Referring to the revised bloom taxonomy, operational verbs of the HOTS cognitive domain are shown in Table 1.

Table 1 Operational Speeches of Cognitive Spheres HOTS Revised Bloom's Taxonomy

Analyze (C4)	Evaluating (C5)	Creating (C6)
Train	Prove	Blending
Blending	Choose	Build
Maximizing	Separate	Limiting
Divide	Monitor	Shaping
Distinguish	Clarify	Make
Creating structure	Maintain	Make a draft
Solve	Predict	Facilitate
Govern	Projecting	Clarify
Focus	Decide	Produce
Choose	Validating	Bring up
Organize	Interpret	Showing
Brighten	Support	Tackling
Detecting	Directing	Create
Diagnose	Check	Dictate
Diagramming	Test	Find
Affirmed	Coordinate	Abstracting
Reviewing	Criticize	Animate
Define traits	Criticize	Compose
Associating	Test	Set
Analyze	Measure	Combine
Attribute	Rate	Generalize
Auditing	Weigh	Produce work
Editing	Assign	Connect
Correlate	Detailing	Remind
Organize	Justify	Categorize
Test	Blame	Encoding
Describe		Combine
Explore		Creating

(Source: BSNP, 2006)

According to Haladyna, et al. (2002); Devi & Widjajanto (2011) there are several ways that can be used as a guide in writing about HOTS, the questioned material is measured using behavior in the cognitive domain of HOTS level of analysis, evaluation, and create then each question is given stimulus in the form of source/reading material such as text, paragraphs, cases, images, graphics, photographs, formulas, tables, lists of words/symbols, samples, movies or sound recordings. Furthermore, according to Resnick (1987) that HOTS has non-algorithmic characteristics, is complex, implements many solutions, involves variations of decision making and interpretation, applies many criteria, and requires a lot of effort.

Assessment For Learning

Assessment is an integral part of the overall learning process (Brown, 2004). National Research Council (1996) describes the assessment of learning should lead to (1) knowledge, understanding of matter and application, (2) critical thinking habits, creative thinking, and self-regulation, and (3) high-order thinking skills. Assessment for learning is the process of seeking and interpreting evidence for students and teachers to use in determining student positions after learning, what to do next by teachers and students, and how to achieve goals (Stiggins & Chappuis, 2006).

Assessment for learning activities are not focused on the results of the assessment, but rather address the students' understanding of something, knowledge, and applications doing something and understanding how learning and achieving learning objectives (Assessment Reform Group, 2002). Assessment for learning is an interactive assessment between teachers and students undertaken during the learning process to obtain information on the strengths and weaknesses of learning and use the information to improve, modify or modify learning to be more effective, and improve student learning competence (Shepard, 2005).

Feedback

If the assessment is an integral part of learning, feedback serves as the "heart" of learning (Brown, 2004). Feedback is a key element in assessment for learning (Sadler, 1989). Students need feedback when they have done something right, feedback helps students to know the level of success of the completed task and build the development of

the next goal (Brown, 2004). Giving feedback as part of the assessment for learning helps students realize the difference in the gap between goal achievement and student knowledge, understanding, and skills. Giving feedback leads the students to act toward the goal (Rushton, 2005).

Self-regulated learning (SRL)

In addition to the feedback mechanism, the success of the assessment for learning is also determined by the students' ability to regulate the behavior and learning environment. Understanding the concept of SRL has an important role for the development of learning ability and self-initiative actions that include goal setting and regulatory efforts to achieve goals, time management, and regulation of physical and social learning environments (Zimmerman & Risemberg, 1997). SRL refers to careful planning and monitoring of the cognitive and affective processes covered in the completion of academic tasks. SRL is the ability to control behavior independently through self-observation, decision, and self-response (Bandura, 1977).

To provide evidence that the SRL is really happening there needs to be an instrument developed to assess the process of SRL (Higgins, 2000). One of the instruments that can be used in assessing SRL is the components of self-regulated learning (SRLIS), the instrument developed by Zimmerman & Martinez Pons (Cobb, 2003). SRLIS is one of the most widely used interview procedures to measure SRL (Zimmerman & Pons, 1988). The main objective of SRLIS is to measure the strategy of SRL, while the secondary objective of the SRLIS is to determine whether there is a correlation between the use of the SRL strategy with the trace of student achievement. Zimmerman & Martinez Pons describe 15 indicators of SRL strategies incorporated in SRLIS as labeled in Table 2.

Table 2 SRL Strategic Indicators in SRLIS

Strategic Indicators	**Description**
Self-evaluation (1)	The statement indicates the evaluation that the student submits to the quality or progress of the work
Organizing (2) and transforming information (3)	Re-arrangement clearly or vaguely on learning materials
Preparation (4) and goal planning (5)	Preparation of objectives and sub-goals and planning steps, time, and completion of activities related to the objectives
Search information (6)	Enterprises get information from non-social sources
Custody records (7) and monitoring (8)	Attempts to record/record events or results
Environment formation (9)	Choosing or arranging a physical state to make learning easier
Self consequences (10)	A reward or punishment plan for success or failure
Training (11) and memorization (12) (rehearsing and memorizing)	The attempt to memorize the material with a clear or vague practice
Search for social assistance (13)	Ask for help from peers, teachers, and adults
Review (14)	Re-read tests, notes or textbooks for preparation for future classes or tests
Other (15)	Learning behaviors posed by others such as teachers or parents and all verbal answers are not clear

(Source: Cobb, 2003)

METHODS

The design of this research is a quasi-experimental type nonequivalent control group. The research was conducted in February 2017 at Junior High School in Bandar Lampung at Lampung Province, Indonesia, involving two groups students of grade eight with random sampling technique. One group of students acts as experimental class 1 and one other group as experiment class 2. The two experimental classes in this study apply 20 items of HOTS as assessment for learning applied to the student worksheet and 20 items about HOTS as the assessment of learning. In addition, in order to help improve the quality of learning process optimally, then in this study also provides diktat teaching materials for students. Implementation of the learning process implemented by applying the model discovery learning.

The HOTS assessment instrument used in the research is the result of independent development by researchers with research design model of education research and development (R & D) which refers to Gall, et al., (2003). The HOTS assessment instrument has gone through a series of theoretical validity and empirical validity

processes. Theoretical validity involves 2 validator experts on a material, construction, and language aspects. Empirical validity through a trial involving 174 students of grade nine at Junior High School in Bandar Lampung at Lampung Province, Indonesia. Based on the result of quantitative and qualitative data analysis revealed that HOTS assessment instrument of development result has been declared eligible to be used as the assessment for learning.

The research data was collected using an SRL scale instrument adapted from Zimmerman (2002). This SRL scale instrument contains 14 likert scale SRL questions. Instrument scale SRL is given to students when at the beginning of learning as a pretest and end of learning as a posttest with a frequency of 5 times face-to-face meetings. The way students use the scale of the SRL instrument is to provide a checklist (√) on the choice of answers then the researchers do the conversion of student choice answers (Table 3).

Table 3 Conversion of Student Answers in Instrument Scale SRL

Answer Options	**Value Conversions**	
	Item Favorable	**Item Unfavorable**
Never	1	5
Rarely	2	4
Sometimes	3	3
Often	4	2
Always	5	1

The data analysis technique begins by calculating the percentage of the ability of the experimental class 1 and experimental 1 experimental students and then determining the students' ability of the students' ability by comparing the percentage of students' ability score and the tendency interval of SRL (Arikunto, 2011). The interval of the tendency of SRL (Table 4).

Table 4 Criteria for Student's SRL Ability

Interval Trend	**Criteria Student SRL**
81,00 – 100,00	Very High
61,00 – 80,00	High
41,00 – 60,00	Medium
21,00 – 40,00	Low
00,00 – 20,00	Very Low

(Source: Arikunto, 2011)

Continue to calculate the score of N-gain of the students' ability to experiment 1 and experiment 2 using the Hake N-gain formula and then interpret the N-gain score with N-gain Hake (Hake, 2002). As shown in Table 5.

Table 5 N-Gain Hake Score Criteria

N-Gain	**Criteria**
N-gain > 0,70	High
0,30 ≤ N-gain ≤ 0,70	Medium
N-gain ≤ 0,30	Low

(Source: Hake, 2002)

Furthermore, the analysis on the effectiveness of the HOTS assessment instrument was conducted by the inferential statistical test of independent parametric sample t-test (t-test). Then as supporting data of research result, hence the qualitative aspect of student response in learning also measured that is by using questionnaire which applied by the technique of focus group interview.

RESULTS

Recapitulation result of data analysis of pretest and posttest ability of student's SRL on experiment class 1 and experiment 2 (Table 6).

Table 6 Recapitulation of Pretest and Posttest Analysis of Student SRL

Experiment Class	Pretest SRL (%)	Criteria Pretest SRL	Posttest SRL (%)	Criteria Posttest SRL
1	39,52	Low	92,00	Very High
2	38,67	Low	90,76	Very High
Average (%)	**39,09**	**Low**	**91,38**	**Very High**

Based on Table 6 it can be seen that students in experimental class 1 and experimental 2 at the beginning of the lesson (pretest) have the ability of "low" category of SRL while at the end of learning (posttest) that is after the teacher apply HOTS assessment instrument showed improvement of the ability of SRL with criteria "very high "(Arikunto, 2011).

Facts related to the improvement of students' learning ability after the application of HOTS assessment instruments in the learning were supported also by the recapitulation of N-gain analysis and t-test (Table 7).

Table 7 Recapitulation of N-gain Analysis and t-Test of Student SRL Ability

Class Experiment	Average			t-Test
	Pretest (x ± sd)	Posttest (x ± sd)	N-gain	
1	27,67 ± 2,006	64,40 ± 2,283	0,87 (High)	0,000*
2	27,07 ± 2,116	63,53 ± 2,460	0,85 (High)	

*with $\alpha < 0,05$

Based on the results of the data analysis in Table 7 it was revealed that the application of the HOTS assessment instrument was effective in fostering the ability of the student's SRL in the experimental class 1 and experiment 2. This can be seen from the N-gain in both classes of experiments that are categorized as "high" (Hake, 2002). In addition to independent statistical test sample t-test in both experimental class also obtained sig value (2-tailed = 0,000) means HOTS assessment instrument can be declared effectively grow student SRL.

DISCUSSION

Predicting factors have influenced the development of students' ability in organizing behavioral and learning environment between before and after learning in this study related to the assessment instruments used during the learning. The study was conducted by applying HOTS assessment instruments in the learning process. This means that during the learning process students are often trained HOTS problems so that over time the ability to think HOTS students develop the better. HOTS thinking invites students to be at a much higher level of thought than to memorizing facts or data, remembering something (recall) or explaining events exactly as the teacher exposes. As confirmed by Brookhart (2010) that HOTS thinking invites students to be in the realm of knowledge C4 (analyze), C5 (evaluate), and C6 (create).

The HOTS issue encourages students to think broadly and deeply about the subject matter, guide the linking between the materials in the lesson and use the information previously learned. It is as Newmann (1990) suggests, that HOTS thinking is an activity that challenges students to interpret, analyze or manipulate information. Further, according to Budsankom, et al., (2015) that HOTS involves various forms of thought processes. This is in line with Salbiah's statement, et al., (2015) that HOTS involves critical thinking processes, creative, logical, reflective, problem-solving skills, and metacognition.

When solving the HOTS problem students are required to have persistence, knowledge insight, reasoning strategies, expertise, and high creativity. Such learning climate facts are able to challenge students to continuously develop cognitive abilities and be more responsible for the learning process, so that students are personally active in regulating behavior and learning environment or self-regulated learning both in a classroom and home learning. Gradually students have a brilliant academic achievement so that they are increasingly motivated to be able to regulate anymore individually. This is in line with the opinion of Zimmerman (2002) that SRL emphasizes the importance of personal responsibility of students and controls the knowledge and skills acquired through the learning process. This fact is in line with the results of Noer's (2014) research that the provision of HOTS mathematics instruments (MHOTS) can improve the ability of junior high school student SRL. Further Kramarski,

B. & Gutman, M (2005) asserted that the application of metacognitive questioning as part of thinking HOTS is able to support the development of student SRL.

Another thing that allegedly influenced the development of students' SRL capability in this research is the items characteristic presented in the HOTS assessment instrument. Characteristics of items about HOTS assessment instruments in this study is contextual, meaning the item is related to solving real problems in everyday life. Characteristics of such items make learning more meaningful and more enjoyable for students. As a result, students feel challenged to be able to play an active role in the problem-solving process. This fact is consistent with the results of Lee & Yang (2014) study that the combination of environment-based learning and the setting of learning activities has an effect on the advancement of the student SRL. As Parma (2009) argues that realistic contextual learning makes students feel challenged to identify facts, formulate problems, create and express ideas, construct possible realistic solutions, and apply in various aspects of life. Finally over time students feel happy and become someone who wants to solve problems and diligently face learning difficulties. This is as supported by Zimmerman (2002) that the achievement of academic achievement is closely related to the students' personal ability and learning pleasure. In addition, Glynn, et al., (2005) also explains that academic skills and desire control are integral components of the SRL that comes from within the student. Further, Yang (1993) emphasized that students who study with SRL tend to be more successful than learning through program control.

Further suspected to affect the student's ability to improve students' skills is the discovery learning model used in the learning process. Discovery learning invites students accustomed to finding the source of learning information, find understanding of learning, and conduct learning activities based on regularity and awareness independently. Through the habit of finding yourself to make students have the knowledge and be responsible for themselves. This is in line with Schunk & Zimmerman's (2003) opinion that self-directed learning has implications for the capacity of students in self-regulation during learning.

In order for the independent learning process to take place well, students need to set goals, make plans, choose strategies, monitor the process, evaluate results, and suppress various learning disorders. This learning fact is supported by Hosnan (2014) statement that discovery learning can maximize students' ability to think systematically, critically, logically, and analytically. This is in line with the results of research by Roll & Winne (2015) that learning analytics in the discovery learning model is revealed to help students understand, evaluate and support self-regulated learning in individually.

In addition, the next factor that predicted to affect the ability of student SRL in this research is the application of assessment for learning with feedback strategy. Through the assessment of learning that is carried out during the learning can be known strengths and weaknesses of learning, both by teachers and students. With learning weakness information, teachers can perform various corrective action measures and students know the gap between learning achievement and learning objectives. This is as revealed by Young (2005) that assessment for learning is able to function as a vehicle that can provide information to students related to mistakes made during the learning. Further, according to Assessment Reform Group (2002) that assessment for learning activities are not focused on the results of the assessment, but rather aimed at students' understanding of knowledge, application of things, understanding of ways and achievement of learning objectives.

In the assessment for learning when students make mistakes in achieving learning objectives, teachers can provide feedback directly so that the feelings arise in the students. Similarly, when students do the learning process correctly also requires feedback, so feel appreciated and able to increase self-confidence (self-efficacious) which ultimately has implications for the achievement of self-competence. As Brown (2004) emphasized that feedback is the "heart" of the learning process. Sadler (1989) further stated that feedback is a key element of assessment for learning. This fact is in harmony with the results of Nicol & Dick (2006) research that the strategy of giving feedback in the assessment for learning helps students control the way learning becomes self-regulated learners.

The emergence of learning facts such as feelings of attention, appreciated, and confidence in self-competence proved able to improve student's learning motivation. With the motivation of students able to eliminate various pressures or learning disorders, willing to take action and dare to be responsible for the learning activities undertaken so that ultimately can develop the ability of SRL. As confirmed Winne & Nesbit (2010) that motivation is the most important dimension in developing SRL. Further Smith (2001) made it clear that motivation is central to self-regulated learning. The habit of self-regulation in learning is able to transform students into self-regulated learners (Zimmerman & Pons, 1986).

Furthermore, when referring to the results of focus group interviews with students that basically revealed the fact that there is a linear relationship between students' responses in learning with the ability of SRL. For example, student A of the experimental class 1 suggests that:

"At first, I really do not like learning to use the questions that invite thinking hard, this is because there is feeling dizzy and lazy to learn. But over time I feel comfortable after learning using HOTS questions. I can absorb the

lessons well. The HOTS questions invite me to think critically so I have to be more diligent to read books anymore. Besides, there is a problem that has made me fooled so that I can find out where the error and spur to think more broadly."

In line with the above statement is student B of experiment class 2 reveals that:

"The problems in learning are not easy, so I become more motivated and more active at home. The problems can not be solved by thinking once but by thinking over and over again. If I do not understand learning then I cannot answer correctly. So I have to read a lot of books and dare to ask if I do not understand."

CONCLUSION

Based on the above description, it can generally be argued that after the application of the HOTS assessment instrument as assessment for learning the students have a very high ability of SRL in managing the behavior and learning environment both at school and at home so that it can be concluded the application of HOTS assessment instrument is effective in growing the SRL Junior High School students especially in Basic Competency of human circulation system.

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