Man In India, 96 (9) : 2627-2636

USING SCIENCE ORIENTED SELF REGULATED LEARNING TO IMPROVE STUDENT'S WRITING SKILL IN SCIENCE AND CONCEPTUAL UNDERSTANDING
(The Heat Concept in Physics as an Example)

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An experimental study was conducted to see the extent of learners' science writing skill improvement through means of Self Regulated Learning (SRL) oriented learning. This research shows that the increase in science writing skill with N_gain value on the first experiment was 0.69 and on the second experiments, the value increased to 0.84. Both increases in science writing skill are categorized as medium and high categories. SRL oriented learning, simultaneously educate the students in science processing skill as well as communication skill, in this sense, science-writing skills. Science writing skill cannot be naturally developed; rather, it needs step by step training especially in learning.

Keywords: Science, self regulated, learning, writing, skill, student.

INTRODUCTION

Writing is one of communication means used from elementary school level to higher education level (Fulwiler, 2002; Myrlshireman, 2009; Eisenberg, 2004; Chik *et. al.*, 2014). Writing is also an important aspect of science literacy and problem solving (Hand *et. al.*, 2002; Dlugokienski *et. al.*, 2008). Furthermore, writing as a part of basic literacy skill play important role in the students' literacy development as favorable as possible for the student's reading and writing capabilities (Genlott and Grönlund, 2013).

Low level of writing skills in learners goes hand in hand with the result of internationally low science literacy result (Gormally et.al, 2009; Lokan, 2000; Wiseman, 2010; OECD, 2014). Writing is important in science for learning to enable them to clarify the observed natural phenomenon and to help them develop scientific knowledge from investigation experience. Many teachers considered writing strategy in science learning as able to help learners build comprehensive understanding on the science that they are currently learning (Alsop and Hicks, 2013; Setati *et. al*, 2002).

Science writing skill, especially scientific writing in the students of elementary and secondary schools in Province Gorontalo is still considered low. This was evident in the output of scientific writing competition held by APKASI (Association

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of Districts Governments in Indonesia) for high schools students in Gorontalo in 2013. There was only one participant that was eligible to write scientific writing (APKASI, 2013). In addition, for the scientific writing competition for youth in 2015 held by LIPI for senior and junior high schools students, none of the successful participants were from Gorontalo (LIPI 2015).

On the other hand, all the subjects in 2013 curriculum include writing as the fourth competence that students have to master. Regardless, the current writing activities are heavily emphasized on Bahasa or Foreign Language subjects. Meanwhile, the ideas or the topics discussed are more on other subjects like Science or Social Science. Therefore, writing ability can be trained in other subjects such as, natural science. Specific for natural science learning, the learning experience is oriented on scientific investigation conducted independently or under guidance. In scientific investigation, students will be trained on several science processing skills such as: observation, inferential, predicting, and communicating (Kemendikbud, 2013).

In general, writing skills, especially writing that related to communicate something scientific, do not come naturally. Therefore, steps needed to be developed in order to enable students to master this skill to communicate the scientific matters. One of them is through the steps developed by the author to train the students with the skill to communicate in writing by developing the SRL oriented natural science learning model. Through SRL oriented learning, it is expected that the learners can discover the problem, investigate the solution for the problem, and explain the solution for that problem, able to evaluate their activities, and finally, students are able to communicate the whole processes in writing.

LITERATURE REVIEW

Writing is a means of communication used from elementary to higher education level (Fulwiler, 2002; Myrlshireman, 2009). Writing is also an important aspect of science literacy (Hand, Prain, & Wallace, 2002; Dlugokienski, Amy, & Sampson, 2008). Writing for learning is an activity to direct learners to produce and clarify their understanding on scientific concepts for themselves; it is not only for the teacher's evaluation but also for communication. Learners can communicate the definition of certain concepts in writing. Therefore, writing is a complex cognitive process.

Writing skills followed the steps of learners' development (Slavin, 2006). Junior high schools' learners are included in concrete operational level, hence, writing for junior high school students are focused on something that they have ever done (concrete) things. In this research, learners are trained to write something that related to the observational activities conducted in the laboratory or during the learning process. The tasks related to creating a product in writing are the appropriate tools to develop their scientific understanding due to in writing, learners have to

collect information, synthesize them, and regulate these information (BAKER, *et al.*, 2008).

Several researches on writing related to science concepts show the increase in comprehension of concepts and higher meta-cognitive ability (McDermott & Mark, 2010; Hand & Prain, 2012). In the same tone, Abell (2006) states that one of the important reasons of writing in science is to enhance the conceptual understanding. Several objectives of writing are: recalling the previous information, strengthening and review the ideas, formulate and broaden the new knowledge. Writing in science class can increase understanding and can involve the students in an assessment process. Montgomery (citied in: Turner, Thomas, & Broemmel, 2006) states that writing activities give students chance to relate their personal experience with the content.

During an investigation within a learning setting, learners are expected to show writing skills to explain the observed objects, such as: explaining the observed phenomenon, describing procedure, and describe the observation based on facts. Heuristic science writing is one of the practices to embed literacy within scientific investigation; it has helped promote the explicit and meta-cognitive explanation on conceptual understanding (Fazio & Gallagher, 2009). For most learners, writing ability does not come naturally. Therefore, it has to be systematically developed (Myrlshireman, 2009).

Several researches related to writing skills in science are developed by Dlugokienski, Amy, & Sampson (2008); McNeill & Krajcik (2008) and Wang, *et al.* (2011). Dlugokienski, Amy, & Sampson develop writing a refutation, McNeill & Krajcik develop writing scientific explanation since 2006, meanwhile, Wang, *et al*. develop written expression in science in 2011. These three strategies in science writing are focused on learners of elementary, junior high, and senior high school.

In this research, the indicators of assessment is adapted from written expression in science. The components of this written expression in science consists of understanding science vocabulary, identifying a problem to be investigated, providing evidence in responding to the question, drawing evidence-based explanations.

Self Regulated Learning (SRL)

The definition of *SRL* is put forward by Zimmerman (Shcunk, 2012) that s*elf regulation* refers to the process used by learners to focus their thought, feeling, and action systematically on achieving the target. On the other hand, Schraw, Crippen, & Hartley (2006) argues that *SRL* refers to one's ability to understand and control the learning environment. Arends argues (1997) the term self-regulated learner, which refers to those learners who can do four important things: (1) Accurately diagnose a particular learning situation; (2) Select a learning strategy to attack the learning problem posed; (3) Monitor the effectiveness of the strategy;

(4) Be sufficiently motivated to engage in the learning situation until it is accomplished. In addition, Caliskan and Selsuk (2010) say that *Self-regulated* is one's ability to control the cognitive activity that underlying the executive process related to metacognition.

According to Schunk (2012) learning theories related to SRL are behaviour theory, social cognitive, constructivism, and information processing theory. Behaviour theory emphasizes on learners to decide which behaviour to regulate, creating different stimulus in its appearance, participate in a needed learning, monitoring performance, and execute things when it meets the standard. The social cognitive thoery related to SRL emphasizes on learners to conduct learning activities with multiple objectives such as, obtianing knowledge and solving the problem. With these objectives in mind, learners will observe, asses, and react on the progress of the objectives.

Meanwhile, information processing theory emphasizes that self-regulation reflects the meta-cognitive awareness. Self-regulation requires the learners to understand the demand of the tasks, personal quality, and problem solving strategy. In addition, the constructivism theory stresses that self-regulation involve mental coordination function, such as, memory, planning, evaluating, and synthesizing. Learners use tools in their culture, for instance, language and symbols, to compose the meaning of content and situation.

Writing is part of problem solving. In order to solve a problem, conceptual ability is needed on the concept that is being written. In addition, SRL ability is also needed. Graham (Schunk, 2012) states that as of other forms of learning, writing skill development is influenced by motivation and SRL. Further, Schunk (2012) states that learners are individuals that actively process the information using the cognitive and meta-cognitive strategies during the writing process. With the understanding that writing involves language and reflects one's thought and cognitive process, writing is considered as a means to increase learning ability and increase academic achievement.

During the problems solving and tasks processes, students are not only involved in cognitive activities, such as, activating the cognitive structure or regulating new information, but learners also have to be able to set specific objectives, plan the activities, monitor the performance during the problem solving process, and evaluate the efficiency of an executed activity (Ifenthaler, 2012). Pajares (citied in Ahmad, 2012) recommends teachers to find out the extent of learners' confidence in formulating and following the SRL strategy. Teacher can try and modify the learners' perspective when needed.

Many researches in education, such as the ones conducted by Zimmerman and Risemberg (citied in Sungur & Tekkaya, 2006) show that confidence and awareness to enable learners to be free learners are closely related to the increase of academic quality. This is also backed up with the result of research conducted

by Caliscan and Selcuk (2010) that there was a significant correlation between academic achievement of learners using the SRL strategy in physics problem solving.

SRL model is based on the view that learners are agents. Agents have capacity to coordinate multiple learning skills, motivation and emotions to achieve the target. SRL implement agency when learners are involved in the main four cycles: analyze the tasks or problems in learning, set objectives, and design plans, implement strategy, and regulate learning (Woolfolk, 2007). In addition, Woolfolk describes that teacher can help or share the control on SRL with learners through giving options on the steps to be taken by the learners in solving the problems or the tasks.

Based on the theory described above, the author formulates the hypothetical model of SRL oriented learning. The stages of SRL orientation are adapted and adjusted from the problem-based learning. SRL-based natural science learning consists of five stages, namely: problem orientation, observation, description, elaboration, and science writing. All the stages have SRL-oriented scaffolding. SRL-oriented scaffolding such as teacher modelling in problem solving through observation and questionnaire format that makes the students personally inquires the activities that they have done during the learning process.

METHODOLOGY

In this research, experiment method uses the *The One Group Pretest-Posttest Design. The one-group pretest-posttest design (Fraenkel* dan *Wallen,* 2007) can be seen in Figure 1 below.

Group	Pre-Test	Treatment	Post-Test
A	O1	X	O2

Where:
O1 = Pre Test
O2 = Post Test
X = SRL Oriented Science Learning

Figure 1: Research Design

This research is conducted in one of the junior high school in Bone Bolango Regency, Province of Gorontalo. This research is conducted in to stages, the first stage is the trial test on the SRL-oriented model that has been previously validated through Focus Group Discussion (FGD). The result of this trial then revised for the second stage. The instrument used in this research is science writing test adapted and adjusted Wang *et al* (2011). Data processing is conducted by calculating the normalized gained score. The increase before and after learning is calculated using the normalized gained formula (N-Gain) by Hake (2002).

$$g = \frac{S_{post} - S_{pre}}{S_{maks} - S_{pre}} \quad (1)$$

Where : S_{post} = Post Test Score, S_{pre} = Pre Tes Score, S_{maks} = Score maximum

FINDINGS AND DISCUSSIONS

The findings show that the Gain from first science writing experiment and second science writing experiment is shown in Table 1 below.

No	*Stages*	*Average Post-Test score*	*Average Pre-Test Score*	*Average N-Gain*	*Categories Gain*
1	First Experiment	9.67	4.42	0.69	Medium
2	Second Experiment	10.45	2.13	0.84	High

Table 1 shows that the writing skills in science of the learners on the first and second experiment has experienced an increase that are evident on the gain value that categorized as medium and high. The average score in the initial writing skills in science was low both in the first and second experiments, average score ranging between 2.13 to 4.42 or 18% to 37%. This result is consistent with the initial research conducted by the researcher (Odja, Jatmiko & Supardi, 2014) which showed that the average science writing skills was only 15%. Meanwhile, the increases in the beginning and at the end of each indicators of science writing are shown in the Figure 2 and 3.

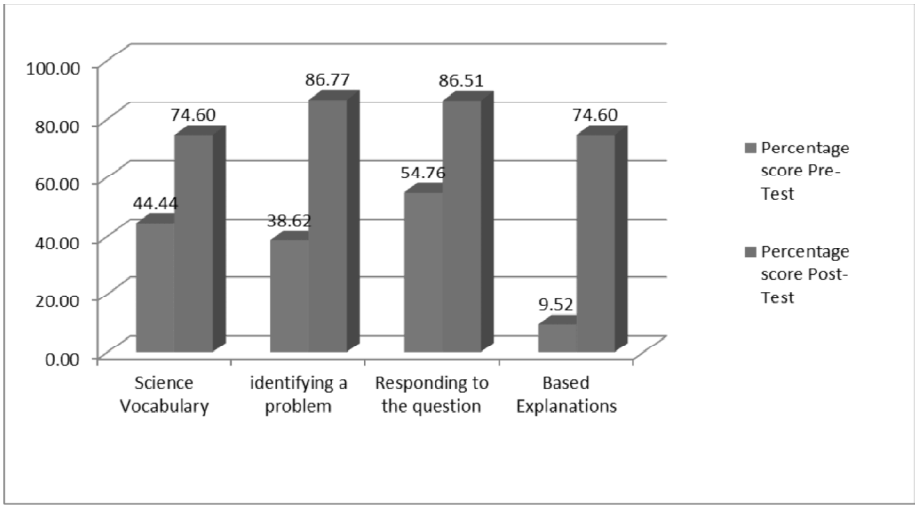

Figure 2: Average Percentage of Pre-Test and Post-Test First Experiment

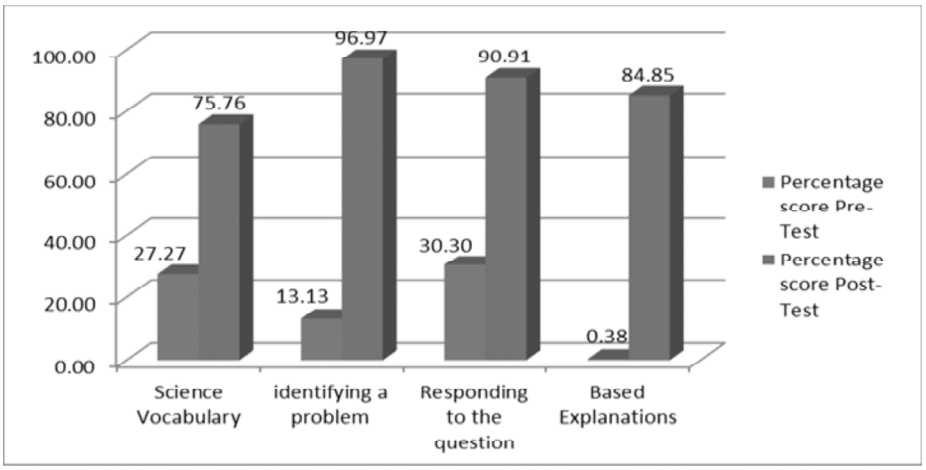

Figure 3: Percentage Average of the beginning and the end of the second experiment.

Figure 2 and 3 show the increase in science writing skill both in the first and second experiment. The increase happens across the indicators of science writing. This increase is made possible due to the stage of SRL-oriented learning activities that train the science writing indicators. The SRL-oriented learning activities that have potentials to increase the writing skills are: (1) problem orientation stage, learners write and state the problems in their daily lives; (2) observation stage, learners conduct the observation activities; starting from problem analysis, planning the procedure of the experiment, conduct the experiment; (3) explanation stage, learners explain the result of the observation stage and compare their result with other sources, like books; (4) elaboration stage, learners make correlation between the concept and the problem that they have solved with other related concepts and problems; (5) science writing, learners communicate the activities during the learning in writing.

As it has been described in the hypothetical model above, the whole process is backed up by the SRL-oriented scaffolding. Several SRL-oriented scaffolding examples implemented in this research are: before conducting the observation, the teacher guides the learners on how to use the SRL assistance that consists of: first, providing the assistance form for learners to select the strategy that can be used during the observation: (a) asking the teacher to model the problem solving through observation; (b) finding other source of information such as books printed or electronics; (c) review the experience in problem solving through observation that has been done before; (d) follow the written guideline provided by teachers through observation activities; second assistance form is provided for students to be able to self-inquire, the questions to ask are: (a) have learners understand the problem that they will observed? (b) have learners think about the observation steps? The

implementation of SRL in writing is an important thing, as Schunk (2012) states that teaching the students with SRL skill within the context of writing task can yield higher motivation and achievement.

Integration of SRL is conducted by direct learning through syntax and scaffolding that integrated within the learning steps. Through SRL-oriented learning science writing skills of the students as the object of this research has increased. One of the downside of this research is the unavailability of the control class to see the effectiveness of this model compared to other models.

CONCLUSION

Based on the data analysis it is shown that SRL-oriented natural science learning can increase the science writing skills of the learners in junior high school especially in heat concepts. This increase in science writing is categorized as medium and high increase. The increase in science writing skills is made possible in SRL-oriented natural science learning due to the learners are trained to state the problem that related to the heat concept, predict, and solve the problem through composition of procedure, explain and evaluate, and communicate the whole activities in writing.

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