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Instructional Model of Natural Science in Junior High Schools, Batu - Malang

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Abstract
The instruction of Natural Science subject in junior high schools, as regulated by 2013 Curriculum, is to be taught in an integrated way, combining Biology, Physics, and Chemistry subjects. The assessment of which is called authentic assessment. This current study described the instructional system especially the assessment system of Natural Science subject in Batu City. This study was conducted by employing descriptive-qualitative design, recruiting teachers and students as the subjects of the investigation. The data were collected by means of interview, observation, documentation, and triangulation; the researchers were the instruments themselves. The collected data were analyzed descriptively-qualitatively. The yielded results were as follows: 1) There was no teacher with relevant study discipline, bachelor in Natural Science Education, teaching the subject. Most of them were holding degree in Biology, Physics, and Chemistry Educations, as well as Industrial Engineering and Building Engineering; 2) 76.5% of the class was taught by a single teacher; while 17.6% of which was taught by means of team teaching; 3) The investigated schools were implementing 2016 school-based curriculum; 5 hours within a week were allocated for Natural Science subject: 2 hours for Biology, 3 hours for Physics, and Chemistry was taught by any available teachers. For the schools implementing 2013 Curriculum, the materials have been integrated and composed into teachers' book, but Chemistry materials were included into Biology/Physics, or even taught separately; 4) The final score of Natural Science subject was taken from the average scores of Biology, Physics, and Chemistry; the standard of assessment depended on the teachers; 5) Assessment techniques varied considerably but they have not developed meta-cognition, such as: not evaluating article analysis, study journal, self-assessment, nor student-made tests; 6) The teachers mostly assessed the aspects of C1, C2, and C3; while aspects of C4, C5, and C6 (Evaluation and Creativity), affective and psychomotor assessments were rarely administered. The other challenges were the teachers still found it hard to administer those assessments properly; this was also applicable for remedial and reinforcement.
Keywords: Natural Science, authentic assessment, meta-cognition

1. Introduction

The quality of the Natural Science subject instructional process has not fulfilled the standards yet, because the teachers who teach Natural Science do not have relevant study discipline, which is bachelor in Natural Science Education. Most of them were holding degree in Biology, Physics, and Chemistry. They are demanded to teach Natural Science subject, though it is not Integrated Natural Sciences. Biology teachers find difficulties in teaching Physics subject, and conversely; Physics teachers also find difficulties in teaching Biology subject; and Chemistry subject is taught by anyone who is available. This situation causes serious concern. Moreover, the teachers do not implement the authentic assessment system. The assessment is still dominated by cognitive domain, even just to measure low-level thinking skills (C1, C2, C3), but not high level (C4, C5, C6). Affective and psychomotor domains have not been assessed properly. Even, both these domains seemed to be separate parts of the cognitive domain. Supposedly, there are three domains in the student assessment system, so the assessment will be holistic and comprehensive.

Based on the problems above, the problems of this study is: How is the instructional and assessment system profile in Natural Science subject in junior high school in Batu City? Learning science in an integrated way is appropriate for junior high school students, considering that the junior high school students, according to Piaget's Theory of Cognitive Development, are still in transition period from concrete into formal phase, so their thinking ability is still not completely abstract. They still require a concrete and holistic instruction. In the integrated Natural Science subject instructional guidelines, it is described that the trend of Natural Science subject instructional today is that students only learn Natural Science as a product, concepts, theories, and laws through memorizing. This situation is exacerbated by learning orientation on tests/exams. As a result, science as a process, an attitude, and the application is not touched in the teaching learning activities.

Integrated Natural Science subject instructional model is recommended to be implemented in the junior high schools/Islamic junior high schools (The Regulations of The Minister of Education and Culture No. 21 Year 2016), as it has several objectives: increasing the efficiency and effectiveness of teaching learning activities; increasing interest and motivation, as well as simultaneously achieving some basic competences. Integrated science teaching models also have some strengths and benefits, namely: the incorporation of three fields of study (Physics, Chemistry and Biology) will save the time because those three subjects can be taught simultaneously (Ministry of Education, 2005).

Teacher assessment system is one of the factors that affects the quality of the instruction. Stiggins (1994) states that an effective, efficient, and productive instruction needs a good and meaningful assessment. Authentic assessment is a good evaluation, in which this evaluation influences cognitive ability, critical thinking, and creative thinking of the students (Pantiwati 2012). Assessment by teachers is an overview of how teachers are doing the learning, so that, according to the Regulations of the Minister of Education and Culture in 2013, authentic assessment also requires authentic instruction. Furthermore, it is explained that authentic assessment includes three domains of learning outcomes, namely the realm of attitudes, skills, and knowledge, so that, conceptually, authentic assessments are statistically more significant compared with standardized multiple-choice tests. Authentic assessment is one of alternative solutions in assessing students' learning progress in a more comprehensive and objective way, as well as putting more emphasis on the development of accurate assessment and measurement that can reflect what is evaluated (Hart, 1994). Comprehensive assessment means an overall assessment of all domains: cognitive, affective, and psychomotor or also called "Multi Domains". According to the results of Issac and Mary's research (2006), it describes that continuous assessment can improve student-learning outcomes quantitatively and qualitatively: quantitatively increasing the scores and qualitatively increasing motivation, interests, and learning habits.

Hart (1994) stated that authentic assessment is an assessment that is conducted through the presentation or performance by the students in the form of tasks or specific activities that directly have educational significances. Thus, authentic assessment changes the role of students in the assessment process, from passive into active participants; students actively collaborate to cooperate and participate in evaluating their progress. Authentic assessment can enable learning through many ways; while the standardized tests are exclusive and narrow. Therefore, not only is the cognitive domain assessed, but affective and psychomotor as well.

2. Methodology

This research employed survey and Focus Group Discussion (FGD) as a baseline overview of the implementation of Natural Science instruction and assessment system, the composition of the draft model, validation, and design revisions. The study was conducted to involve the junior high school students, Natural Science teachers, school principals, and related agencies in Batu City. Observations and surveys were related to the identification of Natural Science instruction and assessment system, followed by the development of 2013 Curriculum based on integrated Natural Science Multi Domain assessment model with a product design, validation, and design revisions. The data were analyzed using qualitative approach to analyze interactive model based on Milles and Huberman's opinion (1992). The taken steps comprised data reduction, data presentation, and conclusion or verification.

3. Results and Discussion

The data obtained from Natural Science instruction, supporting the profile of Junior High schools in Batu City from diploma specification aspects (Figure 1), showed that none of the teachers are bachelor graduates in Natural Science Education. Instead, there were 4 teachers who hold degree in Biology Education, 7 in Physics Education, 3 in Chemistry Education, and 1 from each Industrial Engineering, Building Engineering, and master in Education Policies and Development.

Science learning requires teachers who have sufficient knowledge to impart knowledge in Natural Science subject as a whole. Therefore, in Natural Science subject instruction, teachers who hold bachelor degree in Natural Science Education are needed, as stated by Rahayu et al (2012) that the implementation of the integrated Natural Science subject instruction demands adequate teachers' professionalism and they should have enough ability to impart knowledge in Natural Science as a whole.

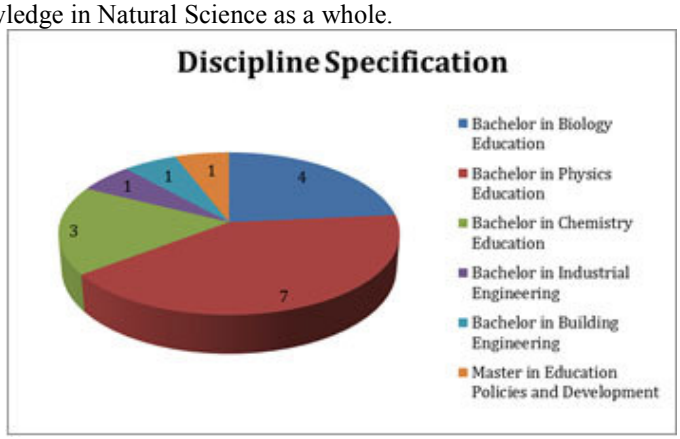

Figure 1. The Specification of Natural Science Subject Teachers in Batu City

Natural Science subject teaching methods (Figure 2) were implemented in various ways: a single teaching (13 teachers), a team teaching with two teachers (two teachers), and a team teaching with 3 teachers (1 teacher). The learning resources used by the teachers were the students' books, any kind of tools that were brought to class (do not have a laboratory), using objects that exist in the environment, looking for another book (internet), discussions with other teachers, teachers' own learning media, learning tools/medias which are modified by the students, and books from the library and government.

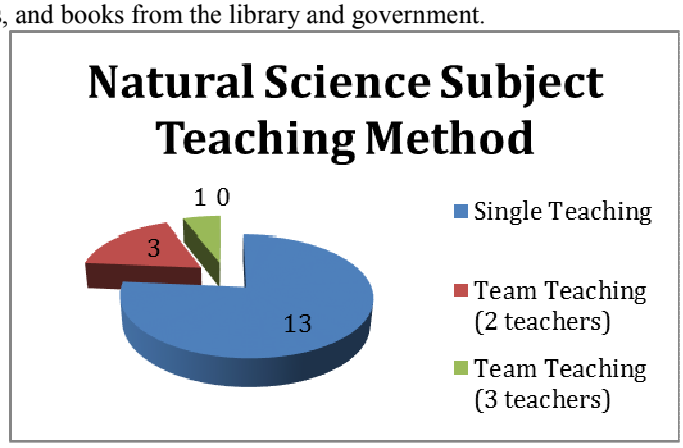

Figure 2. Natural Science Subject Teaching Methods

Natural Science subject instructional model which was taught consisted of two models, first, the model of science learning in the subject using 2013 Curriculum with the time allocation of 5 meeting hours: 2 meeting hours for Biology subject and 3 hours for Physics subject. Some of the schools also implemented 2013 Curriculum with integrated Natural Science instruction wrapped up in one basic competence. The scoring system used separated assessment model through tasks, daily tests, and one report book which consisted of midterm and final test scores. Natural Science subject instructional techniques were implemented as described below: When there were some learning materials related to Physics and Biology, those two subjects will be taught simultaneously. Meanwhile, Chemistry materials were discussed either on Physics or Biology class. When the materials were related to calculation, the assessment was in the form of question exercises and examples, so the students were easier to learn and give example on the real objects. The difficulties faced by the teachers were mostly about understanding and teaching materials irrelevant to their study discipline.

The second instructional model was Natural Science taught in two subjects. It implemented School-based Curriculum. 5 meeting hours were divided into 2 hours for Biology subject and 3 hours for Physics subject. Physics materials were taught by a Physics teacher; Biology materials are taught by a Biology teacher; while Chemistry materials are taught by a Biology teacher. For teachers/schools that have already implemented 2013 Curriculum, the materials have been integrated and guided in the teacher handbook. The assessment system still separated the scores for Physics, Chemistry, and Biology; all of which are assessed through daily tasks and tests. The mid-semester exam and final exam scores in report book showed the average score combining the scores of Biology, Physics, and Chemistry. However, in the progress report, the description of outcomes of each material is given. Natural Science instructional techniques were elaborated as follows: When there were some learning materials related to Physics and Biology, those two subjects will be taught simultaneously. However, for Chemistry, the instruction was given after Physics and Biology materials were fully completed, and only during any available meeting hours at the end of the semester. It is suggested that the teachers of Natural Science subject are given instructional method trainings in teaching Natural Science subject, mainly about practicum (light material), (transport in humans and energy transportation), and blood circulation. The solutions that teachers could take to face any difficulties are sharing with other teachers at the schools and at the Association of Subject Teachers (MGMP), as well as inviting parents who work as doctors and nurses. The role of the schools in addressing to the issues related to conduct performance improvement through training programs.

Both Natural Science subject instructional models mentioned above could be used in Junior High schools in Batu City provided that the Natural Science subject emphasizes the nature of science that consists of three aspects: scientific product, process, and attitude. In accordance with the opinion of Ali et al (2013), it stated that learning Natural Science subject in schools must contain the nature of science that is consisted of three aspects: scientific product, process, and attitude, as well ensure that teachers are able to be facilitators in teaching learning activities and able to create appropriate instruction suitable for students' abilities and needs, mandated by the curriculum.

Rahayu (2012) also added that the scientific method can be applied in teaching Natural Science subject in schools so as to familiarize students to perform scientific work. It is urgent to expose students to a problem in order to find a solution and to motivate students to perform scientific work by applying scientific methods. In

addition, in terms of teachers' competence, the instruction of integrated Natural Science subject needs professional teachers with relevant education background, bachelor degrees in Natural Science Education, because they are teachers who understand the integration of Chemistry, Biology, and Physics of earth space materials.

According Sujaya et al (2013), one of the external factors affecting the learning achievement is the school factor, which includes teaching methods. In order to get optimal learning achievement, teachers should be able to determine and select the appropriate teaching methods and manage them well. Accordingly, teachers should be able to choose instructional models to suit the characteristics of the learned materials, so that the learning objectives or competencies that have been defined can be achieved. Ali et al (2013) also asserted that the quality of human resources is linked to the quality education of Natural Science. Based on these statements, the learning process in the classroom constitutes a determining factor of the students' success in learning; as a consequence, the learning activities in the classroom need to be managed properly.

The teaching methods of Natural Science subject vary considerably (Figure 3) and nearly all methods are commonly used. However, only the study tour method that is rarely, even never be used. In 2013 Curriculum, some suggested instructional models are Inquiry Based Learning, Discovery Based Learning, Project Based Learning, and Problem Based Learning. Teachers are not optimally applying the learning model in Curriculum 2013. This is caused by the factor of readiness of students and teachers, facilities, and policies. 2013 Curriculum emphasizes on the assessment of the three components in the process. The three components include skills, knowledge, and attitude. The three components are obtained in the learning process. Additionally, 2013 Curriculum emphasizes authentic assessment.

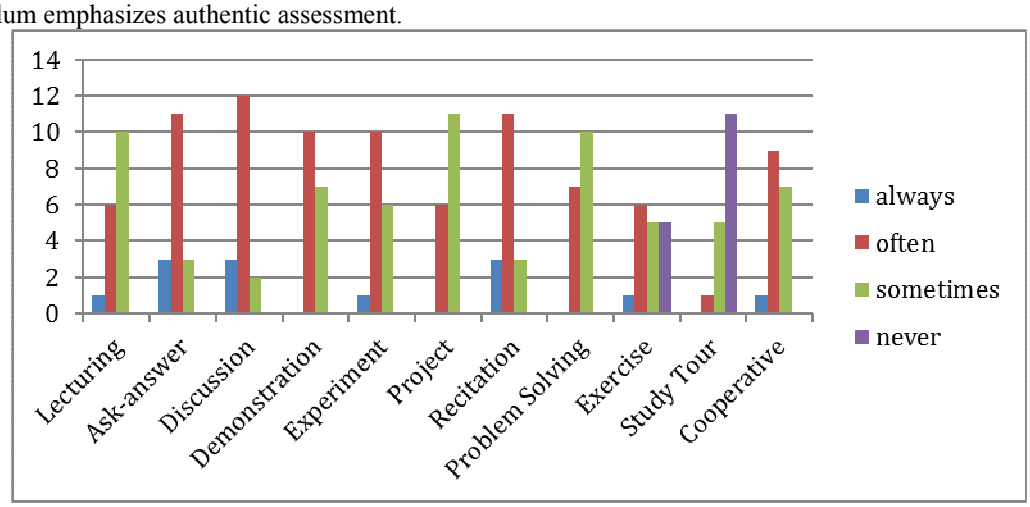

Figure 3. The Used Teaching Methods of Natural Science Subject

The use of varied Natural Science subject teaching methods is good, because according to the research of Sujaya et al (2013), teachers need to be aware that not all of the subject materials are suitable to be taught using the same instructional model related to the improvement of students' learning achievement. It is important to be aware that some learning models can be used by teachers in the instructional process to achieve learning objectives that have been previously defined.

Rahayu et al (2012) adds that an integrated learning can be initiated with a particular subject or theme that is then linked to each other through a subject of good planning, thus creating a more meaningful learning. Integrated Natural Science subject instructional model is a whole packaged model incorporating Biology, Physics, and Chemistry. In an integrated learning of Natural Science subject, a theme is discussed from the viewpoints of Biology, Physics, and Chemistry, so that students can study Natural Science holistically.

The types of assessment used by the teachers of Natural Science subject also varied (Figure 4). They often used essays, discussion, summarizing, and homework. The types of assessment that were sometimes used were a project and portfolio. However, the teachers never used analysis of the article, learning journal, and self-assessment.

According Sujaya et al (2013), authentic assessment instructional model gives students more opportunity to discover and understand the concepts by themselves. Moreover, they will try to solve complex problems using meaningful learning experiences. These authentic assessments enable the process of learning in which students can explore their understanding and academic ability in a variety of contexts, inside or outside the classroom, in order to resolve the problems faced independently or in groups.

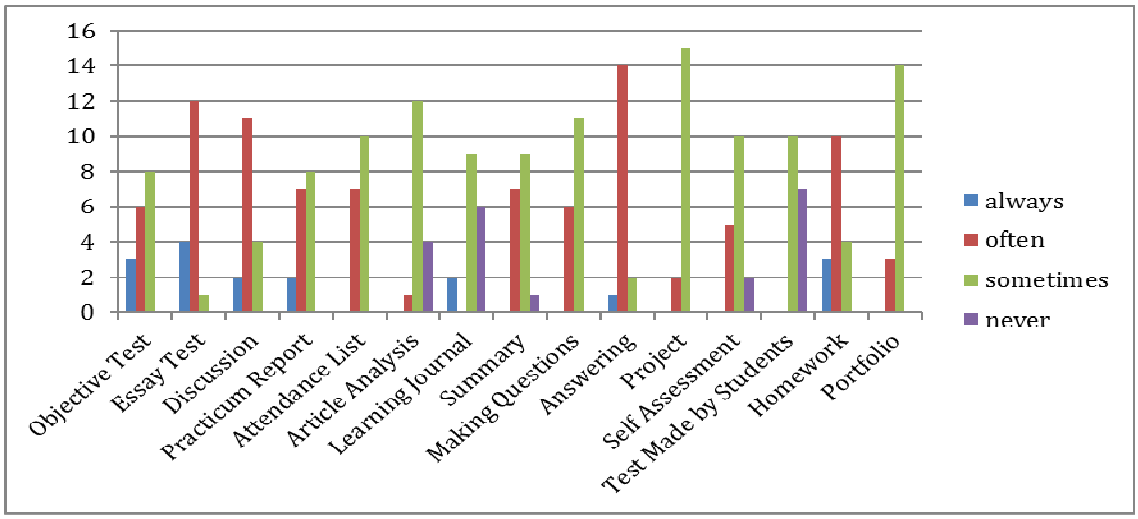

Figure 4. Kinds of Assessment Which Used by the Natural Science Subject Teachers

School instructional activities have shifted from teacher-centered to student-centered. This change brings about consequences. One of them is that assessment system changes to be authentic assessment, because the multi-domain assessment provides various assessment techniques. With varying assessments, not only are the domains of cognitive abilities assessed, but affective and psychomotor domains as well (Figure 5). Sutrisno (2012) asserted that the paradigm shift from teacher-centered to student-centered education leads to consequences of involving students in the assessment. It is necessary to administer self-assessment as it actively involves students. According to Orsmond (2004), one of the functions of peer assessment and self-assessment in a formative test is to get feedback. According to Weaver in Bedford (2007), feedback is an important component in the process of learning and the students' development.

According Sujaya et al (2013), learners' knowledge understanding is better with the application of authentic assessment, because they are given the experience to discover and perform in accordance with their competencies. Based on these statements, performance as a form of authentic assessment has required learners to do in accordance with the competence to be achieved, so that learners experienced by themselves, not just listening to stories. Learners gain a real understanding on what they know and what they can do. It does not provide any threat so that the fear in learning can be overcome and ultimately can increase their motivation to learn. According to the Minister of Education and Culture (2013), authentic assessment which tends to focus on complex or contextual tasks allows students to demonstrate their competence in a more authentic setting, so that this assessment actively involves students. Hendarni and Harry (2006) also state that proper learning puts its emphasis on helping students to be able to learn how to learn and not as how much information to get at the end of the learning period. Authentic assessment emphasizes the learning process; and thus the data must be collected from the real activities undertaken by students during the learning process.

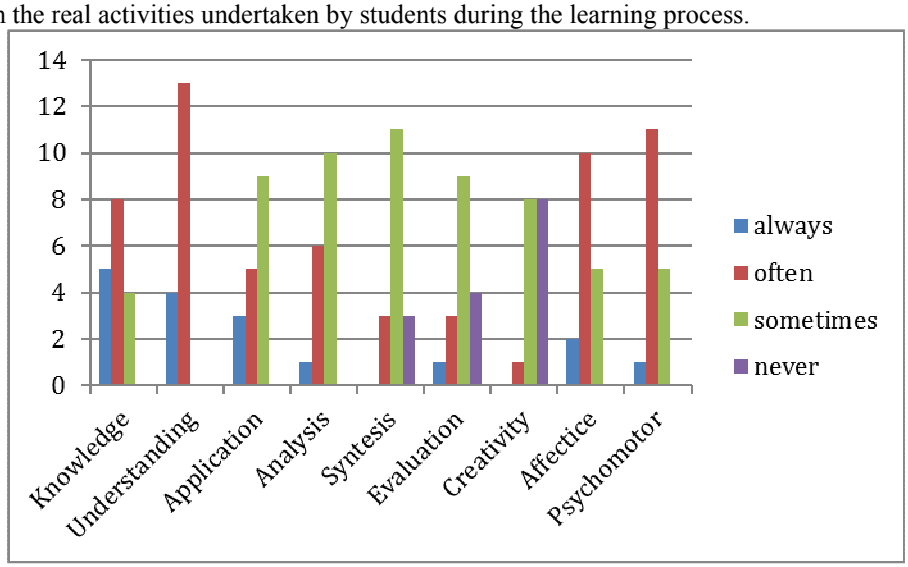

Figure 5. Kinds of Assessment

The teachers mostly assessed the aspects of C1, C2, and C3; while aspects of C4, C5, and C6 (Evaluation and Creativity), affective and psychomotor assessments were rarely administered. Likewise,

creativity measuring was still rarely used. In fact, 2013 curriculum requires students' critical thinking, along with creative and innovative capabilities. Teaching Natural Science subject only for low level aspects of assessment and rarely taking students' creativity into consideration will lead to less achievement of students in learning Natural Science subject entirely. In line with Ali et al (2013), teaching Natural Science subject is to deal with how to seek understanding about the nature systematically. In other words, Natural Science subject does not only cover collections of knowledge mastery of facts, concepts or principles, but also a process of discovery. Marzano (1993) stated that the "paper and pencil tests" could not provide comprehensive information about by students' performance and understanding. While, authentic assessment gives students opportunities to develop the ability to think, especially high level thinking, as conveyed by Marzano (1993). He found that critical thinking instruction can be done through teachers' questions, writing, collaboration, discussion, and practice. This can be obtained by students only when the teacher gives ample opportunities through student-centered learning. Student-centered learning is not only about lecturing and working in the classroom; it is demanding more on varieties of learning. Mueller (2008) suggests that authentic assessment is an assessment of learning that refers to the situation or the context of the "real world" that requires a variety of approaches to solve problems as well as provides the possibility that the problem could have more than one solution.

Based on the assertion of Sujaya et al (2013), the success factors of a learning process are teachers' learning models and motivation to achieve. Thus, teachers must select and customize learning which is suitable to the psychological factors of students, especially students' motivation that leads to achievement. Natural Science subject is expected to be a tool for students to learn about themselves and environment, as well as prospects for further development in applying what they get from school into their daily lives.

4. Conclusion

According to the research results, data analysis, and discussion, it can be concluded that:

1. Natural Science subject teachers do not have relevant discipline or education background.
2. Team teaching has been implemented in Natural Science subject, but it has not incorporated the proper syntax of team teaching.
3. Natural Science subject has implemented both School-based Curriculum (KTSP 2006) and 2013 Curriculum (K13).
4. The authentic assessment system has not been fully applied.

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