



Learning Observation: The Demands of 21st Century Biology Learning in Senior High School

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Abstract. The sophistication of technology and access to information in the twenty-first century pushed education providers to transform preparing students to face a more challenging future. Effective and relevant teaching and learning strategies are needed in biology learning to meet the needs of future generations. Therefore, this study aims to observe the biology learning process in one of senior high school. A qualitative research approach with an observation method was used in this study. This research was conducted in class X SMA N 1 Tanjung, Brebes, Central Java. Data collection techniques used in this study are observation check list, questionnaires, and interviews. Observation of the biology learning process carried out focused on the lesson plan document, learning process, and interviews as well as student and teacher questionnaires on the biology learning process. The data collection process was carried out 3 times. The results obtained from this study indicate that teachers already know the demands of the curriculum and the needs of the 21st century. This can be seen from the of lesson plans made by the teacher. However, other findings from this study are, the skills of teachers in implementing the lesson plan with discovery learning methods are still not optimal. Learning activities undertaken have not yet led to the provision of student skills needed in 21st century. This research is expected to be used as a reference for improving the process of learning biology.

Keywords: Biology learning process, 21st century teaching and learning, Observation.

Introduction

Technological advances in the industrial revolution era 4.0 made disruption in all lines of life including education. Education has an important role to prepare the next generation to be able to have the competitiveness needed in the future (Holland & Piper, 2016). Therefore, a new transformation in the world of education is needed to facilitate students to be able to master technology, be able to think critically, be able to communicate well and be able to work together in teams (Cakir, 2017; Schwarzman & Buckley, 2019). This concept is commonly referred to as 21st century teaching and learning (Lee & Martin, 2017; Shidiq & Yamtinah, 2019).

At the beginning of the 21st century, science education has many problems that must be faced. Some of the problems faced are the availability of suitable textbooks and adequate classroom resources; preparation and training of professional science teachers; the latest teaching of science; and drastically increasing use of the Internet as a source of information (Hadinugrahaningsih et al., 2017; Urbani et al., 2017). In addition, science

education now involves a variety of stakeholders (for example, scientists, teachers, policy makers, and cognitive scientists), all of which provide a unique perspective on scientific knowledge that influences the way science education is delivered in schools (Kanapathy et al., 2018).

21st century education emphasizes student-centered learning. Students are encouraged to be able to build their own knowledge from existing learning resources through a series of learning activities carried out (Chen & She, 2014). Science learning is directed so that students can make discoveries through hands on and minds on activities (Osman et al., 2013). Biology learning, which is part of science, should follow the principles of 21st Century learning. Effective and relevant teaching and learning strategies are needed in biology learning to meet the needs of the current generation. Students in the 21st century era prefer digital resources to access information, communicate, and solve problems. However, in contrast to the desired expectations, most biology teachers still apply traditional and outdated methods in teaching biology (National Research Council, 2009; Turiman et al., 2012). Teachers convey biological facts directly to students and encourage memories of factual knowledge that cannot train students to solve complex biological problems (Osman et al., 2013).

Through the 2013 curriculum in Indonesia, biology learning should be delivered with a scientific approach that spurs students to be able to play an active role in finding and building their own knowledge. There have been many attempts by researchers to make biology learning effective and meaningful. As the development of student worksheets that fit the needs of the 21st century (Aulia et al., 2018; Windiastuti et al., 2018), the use of multimedia in learning biology (Moedjiono et al., 2018), the use of Science, Technology, Engineering, and Mathematics approaches to learning biology (Saptarani et al., 2019), use of a cooperative approach (Haviz, 2015), use of the Science Technology and Society approach (Aikenhead, 2018) and the use of other approaches to improve students' various skills in biology (Juhanda et al., 2019; Lung, 2012; Widodo, 2017).

Various sources of references on approaches, media and assessments of effective and meaningful biology learning are widely available (Halim et al., 2018; van Rooy, 2012). This should be used and implemented by biology teachers in learning biology in their class. With the many sources of information and media available on learning biology in the 21st century, teachers should be able to implement biology learning following the demands of 21st-century education (Urbani et al., 2017). However, there are still many biology lessons that are traditionally carried out by lecturing. Therefore, it becomes an urgency for this research, to make observations in the biology learning process. These observations were made to see whether biology learning carried out was following the demands of 21st-century education or not. Besides, this observation is also needed to reveal the obstacles that teachers experience in implementing biology learning following the demands of 21st-century education. Therefore, this study aims to observe the biology learning process in one of senior high school. With the observation conducted, it is expected to improve the quality of the biology learning process. In addition, through this research it is hoped that it can contribute as a reference for teachers and education practitioners to improve the quality of learning that is carried out in accordance with the demands of the Indonesian curriculum and learning needs of the 21st Century.

Methods

A qualitative research approach with an observation method was used in this study. This research was conducted in class X SMA N 1 Tanjung, Brebes, Central Java. This school was chosen by purposive sampling technique. The subjects of this study were two biology teachers. Data collection techniques used in this study are observation, questionnaires,

and interviews. These three techniques are used to obtain valid data through the process of data triangulation.

Observation of the process of biology learning that is carried out is focused on observing the lesson plan implementation prepared by the teacher. Observation of the implementation of biology learning in the classroom, and interviews as well as questionnaires that aim to solicit opinions of students and teachers on the process of implementing biology learning in the classroom. The data collection process was carried out 3 times. Triangulation qualitative data analysis techniques were used in this study by comparing observation, interviews and questionnaires data.

The instruments used in this study include observation checklists on the analysis of lesson plan documents. This instrument was adapted from Permendikbud No. 22 of 2016 concerning Basic and Secondary Education Process Standards. Besides, an observation rubric is used in the biology learning process that has been validated by experts. This rubric has scoring rules using a Likert scale of 1 to 4. In this rubric, the focus of the assessment is on preliminary, core and closing activities. Preliminary activities focus on providing perceptions and contextually motivating students according to the benefits and applications of teaching materials in everyday life by providing examples and comparisons of local, national and international levels, and adapted to the characteristics and levels of students. The core activities are based on observing, questioning, collecting data, associating, and communicating activities. The last activity, namely closing activities, focuses on assessing and/or reflecting on activities that have been carried out consistently and programmed. Also, a questionnaire instrument was also used in this study. This questionnaire contains 39 statements to reveal students' responses to biology learning.

Results and Discussion

Improvement of Student Learning Achievement

There have been many studies using various techniques to measure changes in teacher practices because of professional development. This measurement is carried out directly or indirectly. Most of these studies use questionnaires that are reported to have benefits to facilitate administration and the possibility of large sample sizes (Scantlebury et al., 2001). However, other research clearly shows that how a teacher understands and implements teaching practices in the classroom affects the effectiveness of the learning being carried out (Suyanto, 2017). This is one of the limitations of using survey data only. Therefore, this researcher not only looked at survey data but also saw the suitability of the learning plan prepared by the biology teacher, and the implementation of the biology learning process in the classroom. There are three core parts of this research, namely: analyzing biology learning plans by teachers through lesson plans that are made; Observation of the learning process of biology in the classroom; and student questionnaire responses as well as interviews with students about the biology learning process carried out.

Lesson Plan Analysis

Learning planning includes syllabus and lesson plans. In this study, the syllabus was not analyzed because for the 2013 curriculum the syllabus was prepared by the national government. Based on the results of the interview, Biology teacher at SMA Negeri 1 Tanjung compiled a lesson plan together with the Biology subject teacher association (MGMP). The lesson plans analyzed are adjusted to the learning that will be observed in 3 meetings in class X. The first lesson plan about Ecosystem material is about the components of the ecosystem, the second lesson plan about the energy pyramid, then the third lesson plan about the biogeochemical cycle.

This lesson plan is analyzed referring to the syllabus of Biology and Permendikbud No. 22 Year 2016. The results of the analysis of lesson plan 1 to 3 shows almost the same results, that the lesson plan prepared by Biology teachers at SMA Negeri 1 Tanjung has a good criterion. The results obtained from the data analysis show that from the preparation of the lesson plan the teacher has included each component of the lesson plan completely as the lesson plan component contained in the syllabus of biology subjects and Permendikbud number 22 of 2016 in the 2013 curriculum. However, in the preparation there are some components of the lesson plan that are not appropriate, such as the development of Basic Competence (KD) in learning indicators, components of the steps of learning activities consisting of preliminary activities, core activities, closing activities and learning assessment that are not in accordance with the 2013 curriculum and 21st century skills. Analysis of several components in more detail is shown in Table 1. The percentage of suitability of the lesson Plan with the Permendikbud and 21st century needs is shown in Figure 1.

Table 1. Comparison of components in lesson plan used

Component	Lesson Plan		
	1 st	2 nd	3 rd
Basic competencies	In the RPP the first meeting to the last meeting on ecological material using KD. 3.10 and KD. 4.10,		
Learning objectives	students can analyze information / data from various sources about the ecosystem and all interactions that take place in it and present work that shows interactions between ecosystem components (food webs, the biogeochemical cycle), so that students can build awareness of the greatness of God, grow disciplinary behavior, honest, active, responsive, polite, responsible, and cooperation.		
Topic of the lesson	ecosystem component	energy pyramid	biogeochemical cycle
Method	Lecture	Discovery Learning	Discovery Learning
Media	LKS book	LKS book	LKS book

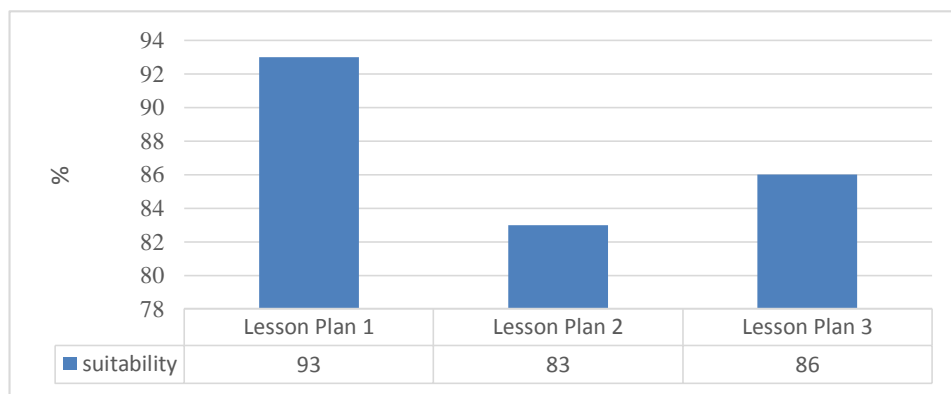


Figure 1. The percentage of suitability of the lesson Plan with the Permendikbud

Based on table 1, all three Lesson plans have the same basic competencies and learning objectives. The same basic competencies for the same subject matter are common and in accordance with the provisions of the curriculum. However, the same learning objectives for each different meeting topic make the learning objectives ineffective. Lecture learning methods used by teachers in the first lesson plan are not in accordance with the principles

of the 2013 curriculum and 21st century learning which emphasizes student-centered learning activities. The demands of 21st-century learning are students as the centre of learning (Griffin et al., 2012; Michalopoulou et al., 2019; Nagarajan & Overton, 2019). The teacher acts as a facilitator who can develop students' skills in ways of thinking, ways of working, tools for working, and ways for living in the world (Matsko et al., 2020; Ndlovu & Mostert, 2018; Shidiq & Yamtinah, 2019). So that the lecture method used and teacher-centred is no longer suitable for use in learning biology in the 21st century (Wafula & Ongunya Odhiambo, 2016)

The second and third lesson plans are in accordance with 2013 curriculum requirements and 21st century demands which uses a student-centered method. There are many choices of learning methods that can be chosen by biology teachers. Like the inquiry method that has proven successful in increasing student participation (Eastwood et al., 2013; Leibfarth et al., 2018; Longo, 2016), and the inquiry practicum model in biology practicum which has been proven to have improved student learning achievement (Howard & Miskowski, 2005; Setty & Kosinski-collins, 2015). Another alternative method that can be used is problem-based learning (Aydin-Gunbatar et al., 2018; Quattrucci, 2018), dan project-based learning (Baptist & Subali, 2019) and Guided-inquiri. In addition, the demands of learning etiquette 21 encourage the use of student-centered learning methods so that students can increase their level of thinking, creative, critical, communication and collaboration skills (Jumrodah et al., 2019; Maryuningsih et al., 2019; Saputri et al., 2018; Shidiq et al., 2014, 2015).

The media used in learning activities by biology teachers in SMA Negeri 1 Tanjung is more in the use of student worksheets or teacher handbooks, from interviews obtained. This happens because of the limitations of the completeness of the existing media in schools, so more by using modules or student worksheets owned by students. According to the biology teacher at the learning meeting in the previous semester, one of them was on the virus material used as a teaching aid for the virus props created by the students, so that in some learning, they could use media other than those at school. 21st century learning with technological advancements requires teachers to be able to conduct learning and assessment using technology (Ada, 2018; Baser et al., 2016; Griffin et al., 2015; Khlaisang & Koraneekij, 2019). Some research in the field of biology learning has applied the sophistication of existing technology, such as the use of android-based augmented reality (Chen & Liu, 2020; Moedjiono et al., 2018; Qamari & Ridwan, 2017), use of adobe flash media (Astuti & Nurcahyo, 2019), using blended learning media and real media for hand-on learning such as the use of butterfly houses (Halimah et al., 2019). The use of contextual, real and interesting media by making the environment a place of learning can add to the interests and achievements of students (Shidiq, 2016).

Learning Implementation

The next research result is analyzing the learning process of Biology in class X. In analyzing the biology learning process the researchers followed the implementation of the learning process in class X MIPA 5 for three meetings tailored to the lesson plans that the teacher had prepared. Implementation of the observed study was a learning activity carried out on one of the Biology class X teachers guided by Permendikbud No.22 of 2016 concerning process standards. Important notes during the learning process are shown in Table 2.

Table 2. Comparison of Learning Implementation

Aspect	1 st meeting	2 nd meeting	3 rd meeting
Direct teaching	Implemented on the aspect of knowledge through material learned from textbooks and the delivery of teachers. While the aspect of skills is less emphasized in learning activities, although		

	there is interaction between students and teachers in the question and answer activity.		
Indirect teaching	Conducted by applying spiritual aspects through prayer in learning, aspects of social attitudes are applied to learning activities through interactions between students and teachers, although not all students are active in implementing social aspects that are carried out in learning activities		
Student activity	Learning with the lecture method makes students less likely to be active in the learning process	With the discovery learning method used by the teacher, students become more active than previous meetings, but student participation has not been maximally involved	With the discovery learning method used by the teacher, students become more active than previous meetings, but student participation has not been maximally involved

The learning activities at the first meeting were carried out on ecological material with the topic Organizational level of living things, components, and types of ecosystems. The implementation of learning at the meeting is carried out in class with a reference to the textbooks owned by students and teacher's textbooks. Implementation of learning with the lecture method at the first meeting makes students passive. This is not in line with the expectations of the 2013 curriculum and 21st century learning. Student's status can be improved through various hand-on activities, or laboratory practicums. Other studies have shown that increasing student learning activities in the classroom can improve student achievement and student attitudes toward biology (Gardner & Belland, 2012; Kim & Bolger, 2017; Parishan et al., 2011; Romine et al., 2017; So et al., 2019) besides that active learning will reduce the gap in student learning achievement (Haak et al., 2011; Schiffer et al., 2020; Weitzel & Blank, 2020).

At the second and third meetings, learning is done by the discovery learning method. So that the syntax in the implementation of learning adapted to the model used, including the provision of stimulus, identification of problems, collecting data, processing data, proving, concluding (Nerita et al., 2019; Schwarzman & Buckley, 2019). This method is one of the recommended ones in the 2013 curriculum. The implementation of the second and third meetings which were conducted using the discovery method, although it had increased student activity, there were still students who were not active in the learning process. This is possible due to the lack of attention given by the teacher to these students. Teachers who act as facilitators and supervisors in the learning process should be able to activate and involve all students in the learning process. As in several other studies that have successfully used the discovery method, such as discovery method in biology at university (Wilke & Straits, 2001), and the use of guided discovery in high school (Nerita et al., 2017, 2019).

Learning conducted at the second and third meetings was by the planned syntax. However, aspects of student skills are less developed. Biology learning in the 21st century emphasizes the acquisition of student skills to face global competition (Rizal et al., 2020). Therefore, students' skills should be given more attention to be trained in learning biology. There have been many studies that can be used as examples to train students' skills in learning biology and other learning, such as creative thinking skills (Herpiana et al., 2019; Ulger, 2019; Yang et al., 2016), critical thinking skills (Maryuningsih et al., 2019; Saputri et al., 2018), communication skills (Foote, 2013; Getenet et al., 2016; Jia et al., 2016;

Tiffany et al., 2017), collaboration skills (Koenig, 2011; Le et al., 2018), and problem solving skills (Chai et al., 2015; Quattrucci, 2018; Urbani et al., 2017).

Student responses to learning biology

Student responses in a learning process can influence the success of the learning process (Hurlbut, 2018). Measurement of student responses to the Biology learning process applied by Biology teachers at SMA Negeri 1 Tanjung is used to strengthen the results of observations and interviews. In the implementation of learning in the preliminary activities according to students has been done well by the teacher, activities in this introduction include greeting, checking the presence of students, and conveying important points of the material to be learned. In the implementation core activities, students assume that the teacher has given students the opportunity to answer the questions asked. The teacher always observes and monitors student learning activities.

The teacher conveys the benefits of the learning activities carried out relating to the material being studied the main points of this core activity questionnaire, students assume the teacher can convey and answer student questions clearly and easily understood. This is believed by as many as 84.84% of students. These preliminary, core and concluding activities are in accordance with the 2013 curriculum. However, according to students the activities to involve students in learning still need to be improved. Active learning can increase student participation and achievement (Ayyildiz & Tarhan, 2018; Walker & Warfa, 2017). Biology learning following the demands of 21st-century education is student-centred, so student activity is important (Duran & Dökme, 2016).

Based on the data obtained it can be assumed that students respond positively to the implementation process and assessment conducted by the teacher, even though the teacher must further improve the implementation and assessment of learning. The results of the interview and supported by students' responses to the teacher shows that in the implementation and evaluation of biology teacher learning at SMA Negeri 1 Tanjung is quite good.

Conclusion

Observation and Analysis of the implementation of biology learning conducted shows that teachers already know the demands of curriculum and 21st century needs. This can be seen from the implementation of lesson plans made by the teacher. Two of the three lesson plans have used discovery learning methods that place students at the centre of learning. However, other findings from this study are, the skills of teachers in implementing the lesson plan with discovery learning methods are still not optimal. Learning activities undertaken have not yet led to the provision of student skills needed in the 21st century. This observational study only uses one school and one class at 3 meetings, therefore generalizations in this study still cannot be made. However, this research is expected to be a reference, evaluation and reflection material for teachers and researchers in the field of biology learning to carry out learning following the demands of the 21st century.

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