BIOMIND Portal for Developing 21st Century Skills and Overcoming Students’ Misconception in Biology Subject

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ABSTRACT

This research was conducted to investigate the effectiveness of BIOMIND portal in enhancing students’ 21st century skills and overcoming their misconceptions in Biology subject. 118 Indonesian high school students were involved in this quasi-experimental study. The experimental group underwent learning experiences using BIOMIND portal whereas the control group experienced conventional learning approaches. The effectiveness of the BIOMIND portal was measured based on the students’ 21st century skills development and their level of misconceptions. There were significant differences in the 21st century skills development found between the experimental group and the control group. In addition, this research has found that the BIOMIND portal could overcome misconceptions among students due to the trainings given during interventions. This study concluded that teaching and learning using BIOMIND portal has brought positive impacts especially in developing the 21st century skills and overcoming students’ misconceptions in Biology subject.

KEYWORDS

21st Century Skills, BIOMIND Portal, Misconception, Problem-Based Learning (PBL)

INTRODUCTION

The 21st century poses many global challenges whereby in this decade, technology, research, knowledge and the society changes and evolves almost in every second (Tan, 2003; NCREL & Metiri Group, 2003). Today’s schoolchildren will be the leaders of tomorrow, and the education system was responsible to equip them with the competencies required to thrive in the digital era. There was an increasing demand for students to have good verbal competence to communicate and explain ideas and to have the competencies to manage technology (Duran et al., 2011). However, school leaders today faced a serious dilemma; whereby the community expect their graduates to be ready to thrive in the digital age, nevertheless the 21st century skills required for such successes were not well defined. The 21st century skills were not included in many state learning standards or measured on most state and local assessments (NCREL & Metiri Group, 2003). Without adequate competencies of the 21st century skills, students were being prepared only to succeed in yesterday’s world, but not tomorrow’s (NCREL & Metiri Group, 2003).

In this sense, the education system must provide the students with the education that they need to survive in a knowledge-based, global society. The science curriculum being implemented in Indonesia has always focused on competence mastery, not solely on subject content mastery (Vebrianto &...
Kamisah, 2014). The teachers played important roles in determining the appropriate learning materials to fulfil the students’ learning needs; yet in many cases, teachers still find difficulties in arranging adequate and appropriate learning materials to cater to the students’ learning requirement. As a result, the effectiveness of the teaching and learning process is hampered (Kunandar, 2010).

Biology subject is a part of science curriculum where it consists of many concepts that the students must comprehend. Consequently, conceptual understanding is very important as it acts as a basis for the students to think and to promote higher order thinking process such as formulating principles and generalizing (Chin & Chia, 2004). Besides mastering concepts, students must also be able to apply and correlate one concept with another by using the concepts in problem-solving processes and formulate new ideas. As a highly conceptual subject, Biology was always perceived to be one of the most difficult subjects by students; where this perception was shown in their Biology learning evaluation test results (Vebrianto & Kamisah, 2014). The students’ results in monthly tests, term exams, and the national exam were not satisfying enough; this showed relatively poor conceptual understanding of Biology. According to Yustina et al. (2011), the students’ low score in Biology can be accounted by their difficulty in learning Biology especially in understanding and mastering biological concepts.

Not limited to that, the science subject scores of grade 8 Indonesian students were low, according to the 2011 Trends in International Mathematics and Science Study (TIMSS). There was a decrease by 21 points in 2011 results compared to the results in 2007. Indonesia was at the 40th position out of 63 countries and 14 states participated. Indonesia’s position was slightly above Morocco and Ghana (Martin et al., 2012). In addition, the 2011 Progress in International Reading Literacy Study (PIRLS) revealed that the reading literacy of grade 4 Indonesian students was at the 41st position out of 45 countries participated, with an average score of 405, which was below the average score of 500 for international students with a standard deviation of 100 scores. Even though Indonesia has scored higher than Qatar (score=353), Kuwait (score=330), Morocco (score=323) and South Africa (score=302), still the scores in reading literacy were not satisfying enough (Mullis et al., 2012; Balitbang, 2013). Reading literacy includes the skills to find information, to understand and interpret readings, as well as to reflect and evaluate the readings (Bahrul & Suhendra, 2010).

The unsatisfactory reading literacy results of Indonesian students compared to other countries might be due to the scenario that while constructivism has started to be applied in the classroom teaching and learning in other countries, the Indonesian classroom still highly practices behaviourism, which was highly teacher-oriented (Yustina et al., 2011). Indonesian students still perceived knowledge as a set of facts that must be memorized (Vebrianto & Kamisah, 2014). Students would just listen to the teachers’ explanation, scribble notes and complete the exercises given. Hence, there were no concept construction processes in teaching and learning among students, whereby they tend to memorize the materials or concepts without deep understanding, only to do the exercises given. As a result, the students would fail to master the concepts and misconception would frequently happen (Vebrianto & Kamisah, 2014).

Misconception was defined as “ideas that are different from the ones generally accepted by scientists”. According to Aydin and Balim (2009) and Odom and Barrow (1995), misconception could be avoided by means of meaningful learning. A significant amount of research has indicated that most people has develop ideas about scientific phenomena before beginning of formal science education; these ideas, even if they were scientifically incorrect, tend to remain persistent, despite efforts to teach scientifically accepted theories and concepts (Stein et al, 2007).

Students’ ability to understand a concept depends on the complexity of the concept and the cognitive development of the students (Mohd Ali et al, 2007). Therefore, every student must possess various knowledge levels about various biological concepts. The information about students’ knowledge level was very important in order to induce the students to achieve comprehensive learning, where the students would be able to apply the knowledge learnt in daily life (Vebrianto & Kamisah, 2011). To help the students in achieving conceptual comprehension and in reaching various
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