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Effectiveness of Research Based Booklet Media of Conventional Biotechnology Application as A Supplement of Biotechnology Teaching Materials in Senior High School

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Abstract

The implementation of learning using booklet media of conventional biotechnology application on biotechnology materials is expected to be able to help the students achieve of all basic competencies of learning and can improve student learning outcomes which are still low. The booklet was developed based on the results of the research, and then validated by experts to test the feasibility of the booklet. This research aims to analyse the effectiveness of the conventional biotechnology application booklet media. This research uses a pre-experimental design with one-group pretest-posttest design. The trial was conducted on the students of class XII MIPA 1 and XII MIPA 2 in NU 1 Kradenan High School in the 2019/2020 school year taken by purposive sampling technique. The results showed that the application of conventional biotechnology booklets was effectively used as a supplement for teaching biotechnology materials in high school. The average of N-gain 0.71 indicates that there was an increase in learning outcomes from pre-test to post-test with high criteria. The average classical completeness reached 92%, the average percentage of student attitudes reached 80% and the average student skills reached 81% with effective criteria. Based on the research results, the use of booklets is recommended in learning biotechnology to improve student learning outcomes in the cognitive, affective and psychomotor domains.

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INTRODUCTION

Based on the observations at four high schools in Blora Regency in 2018, 75% of schools have not applied practicum in the biotechnology learning process. Learning is done by lecturing and discussing. This learning process activity is not fully appropriate with the basic competencies that want to be achieved, namely students have not done an experiment / practicum and present an experimental report based on the scientific method yet. This is because practicum requires a long time, while the learning time is limited. In addition, the learning interaction in the classroom has not reached good quality. This can be seen from the few students who ask or answer the questions from teacher. Students also still get difficulties in understanding biological concepts.

The importance of understanding concepts in the teaching and learning process greatly influences attitudes, decisions, and ways of solving problems. According to Sudarsa et al. (2013), with a good mastery of concepts, good learning outcomes will also be generated. Therefore, in the learning process the teacher should be able to activate students' thinking ability by making the lesson challenging, the creativity to discover, and make the lesson memorable.

Learning is a complex process that consists of several interrelated aspects, so that we need appropriate methods and media to support the learning process in order to realize effective learning for students. Novitasari et al. (2015) and Aulia et al. (2019) state that, the use of appropriate learning models and media effectively increases students' cognitive, affective, and psychomotor learning motivation and outcomes.

Practicum is a learning activity that aims to give students the opportunity to test and apply a theory by using laboratory facilities and also outside the laboratory (Rustaman, 2005). Practicum based learning can motivate the students to involve in the learning process which is occur. Learning method which emphasizes on the students' activities will get the optimal results. Practicum is learning that can help students to find facts from theories they learned so that students have both cognitive and psychomotor abilities (Murti et al., 2014). Practicum in learning Biology is an effective method for achieving learning objectives so that it can improve students' learning outcomes.

Practicum based learning can be assisted with the use of appropriate media, so students can do practicums independently. Learning media is a solution to solve the problems of the learning process. Learning media can optimize the learning process, increase student motivation and also help students to understand concepts (Ariyanto et al., 2018). The application of media in learning is important and it can improve the standard of education (Jonathan et al., 2017).

One of the effective learning media in biotechnology materials is by providing the biotechnology product sample which is concrete, easily found and applied. This concrete example is presented in the form of a booklet. The booklet is informative, its design can attract the attention of students, so that it can facilitate the teacher to explain the application of biotechnology in daily life.

Learning media in the form of booklets of the application of conventional biotechnology are compiled based on the study of the researchers. The booklet is used as a supplement of teaching biotechnology materials to help students in the implementation of independent practicum. The use of booklet of conventional biotechnology application as a learning media for the biotechnology materials is expected to be able to achieve all learning competencies and can improve students' learning outcomes that are still low.

METHODS

Booklet of the conventional biotechnology application was developed based on the study of several conventional biotechnology products manufacturing that were treated. After that, validation of the booklet media is done by the material validator and the media validator. Validation was also carried out by biology

teachers and 10 students of class XII. After product validation, improvements are made based on the suggestions given by the validator in order to obtain a better product. A valid and appropriate product is applied to students to find out its effectiveness.

The booklet product implementation was carried out in two classes of class XII students of SMA NU 1 Kradenan, Blora Regency, in the odd semester of the academic year 2019/2020. This research is a Pre Experimental Design study with the type of One Group Pre-test and Post-test Design. The subjects of this study were students of class XII MIPA 1 and XII MIPA 2 as the experimental class. Subjects of the research is determined by using purposive sampling techniques. The independent variable in this study is the application of independent practicum-based learning by using booklet of conventional biotechnology application on biotechnology materials, while the dependent variable is the students' learning outcomes on biotechnology material as seen from cognitive, affective and psychomotor aspects. Data sources include student cognitive learning outcomes (pretest-posttest), affective learning outcomes (observation), and psychomotor learning outcomes (observation). Data were analyzed using the N-gain test to determine the increase of students' cognitive learning outcomes (pretest-posttest) in the experimental class.

RESULTS AND DISCUSSION

The effectiveness of the use of conventional biotechnology application booklets can be seen from student learning outcomes. Learning outcomes consist of three aspects namely cognitive, affective and psychomotor. Cognitive learning outcomes can be seen from the results of the posttest, affective learning outcomes can be seen from the attitude of students during the learning process, and psychomotor learning outcomes can be seen from the innovative ability towards products made and practicum reports. Cognitive learning outcomes are presented in Figure 1.

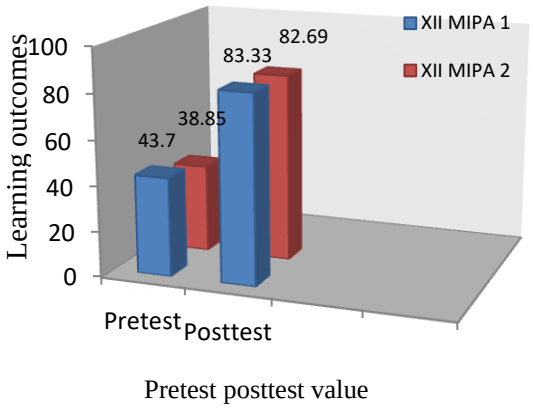

Figure 1. Cognitive Learning Outcomes

Based on the cognitive learning outcomes, the students' classical completeness in both classes > 90,00%, with an average value of students' learning outcomes in class XII-MIPA 1 of 83,33 and in class XII-MIPA 2 of 82,69. N-gain scores which are obtained in both classes are included in the high category, which is 0,71 for class XII MIPA 1 and for class XII MIPA 2 N-gain scores obtained is 0,72. Based on the average value of N-gain obtained, the two classes shows a high increase, which means that the application of conventional biotechnology booklet is effectively used in the learning process. This is in line with the results of the study of Afifah et al. (2018) and Wulandari et al. (2017) that the use of media in the learning process effectively improves the results of students' pretest-posttest.

Booklets are effectively used in the learning process because booklet media are arranged based on the students' needs to achieve basic competencies in learning biotechnology. In addition, the booklet is compiled based on the results of the study on biotechnology products in the students' environment. This is in accordance with the study of Boeker et al. (2013) and Suniah et al. (2018) that, learning media by correlating the potential for environmental-based research is attractive and effective to improve student cognitive learning outcomes. Norsalisa et al. (2013) states that, the use of instructional media which is contextual in nature is effectively used

in learning, because the use of media can increase individual and classical completeness.

The conventional biotechnology application booklets can improve the quality of learning because it can help teachers to deliver the material easily. The use of booklets in the learning process can also provide direct experience for students. They not only listen to the teacher's explanation, but also involved in the process of making biotechnology products. This activity makes students find the concept of material, so they can understand based on what they practice. Besides that, learning by using media can save the time because the practicum can be done independently with booklet as a guidence. This is in line with the study of Oyedele et al. (2013) which shows that the application of learning models which are equipped with learning media is very important in the formation of students' concepts. The learning process by utilizing learning media can save the time, so it is more effective.

In addition to improve students' cognitive outcomes, the applying conventional biotechnology booklet can also increase student activity. Affective learning outcomes are presented in Figure 2.

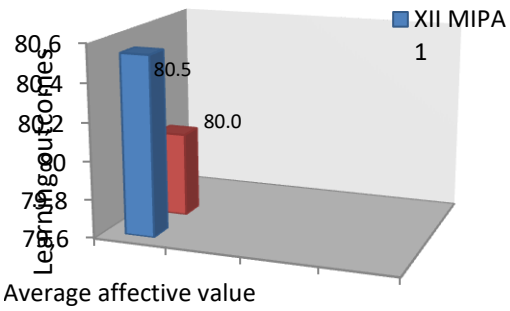

Figure 2. Affective Learning Outcomes

Student learning outcomes from the affective domain can be seen from their attitude during learning process. Students' activities observed in the learning process are paying attention, respecting, collaborating in group activities, curiosity, giving opinion and having responsibility. Based on observations that were done, it is obtained an average affective value of 80,56 for XII MIPA 1 and 80,04 for XII MIPA 2. The results of the attitude assessment data analysis indicates that the affective analysis score criteria belongs to the effective category. This shows that the booklet is effective to improve students' affective learning outcomes. This is consistent with the opinion of Salim et al. (2017), learning by involving the surrounding environment can increase the affective value of students. The booklet invites students to apply the concept of biotechnology conventionally, it will motivate students to interact directly with the object study so that learning becomes more interesting and fun.

The use of applications of conventional biotechnology media booklets makes students enthusiastic in learning. This can be seen from the students' curiosity which is quite high by asking questions related to biotechnology material. In addition, the attitude of paying attention to teacher's explanation and appreciation when there are friends who ask questions or opinions, collaborate with the group when practicing making biotechnology products, argues to convey creative ideas, and a responsible attitude by completing all the student worksheets given.

The use of conventional biotechnology application booklets media makes students enthusiastic in learning. This can be seen from the students' curiosity which is quite high by asking questions related to biotechnology material. In addition, it is also shown by paying attention to the teacher's explanation, appreciating to the friends who either asking questions or giving opinions, collaborating with the group to create biotechnology products, arguing to convey the creative ideas, and having responsibility by completing all the student worksheets given.

Psychomotor learning outcomes obtained from student activities in innovating biotechnology products and making the lab reports. The results of student grades in the psychomotor domain are presented in Figure 3.

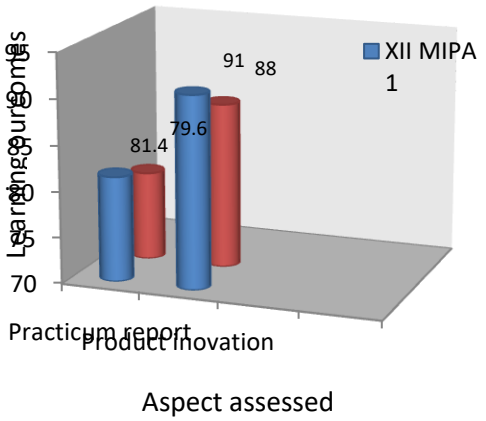

Figure 3. Psychomotor Learning Outcomes

The average value of psychomotor in class XII MIPA 1 is 86,24 while in class XII MIPA 2 is 83,825. The results of the skills assessment data analysis indicate that the criteria for psychomotor analysis scores belong to the effective category. The booklet given is able to guide students to become skilled. The media booklet contains biotechnology products with innovation. It makes students interested in making various innovations on making conventional biotechnology products. Students can be creative by doing direct practice. According to Ogren et al. (2017), learning resources that are accompanied by colored images can trigger students' innovative ideas. The results of product innovation assessment obtained an average of 91 for class XII MIPA 1 and 88 for class XII MIPA 2. While for the report assessment, class XII MIPA 1 obtained an average of 81,48 and class XII MIPA 2 obtained 79,65. According to Mulyanto et al. (2017), students must gain experience by doing activities and are actively involved in learning so that they can construct knowledge in their minds and improve learning outcomes. This can be a memorable thing for students in the long term (Arini et al., 2017).

The booklet that was compiled was able to meet the basic learning competencies which are students understood the principles of biotechnology and were able to make reports on the results of conventional biotechnology experiments. Through the compiled booklets, knowledge is not simply transferred from teacher to student. Students can find their own both experiences and concepts in accordance with biotechnology materials, especially conventional biotechnology. The booklet does not only cover the material but also contains the processes of making conventional biotechnology products that are equipped with images, so that the learning process becomes more interesting and can help students in achieving their cognitive, affective and psychomotor domains.

CONCLUSION

Based on the results of the research and discussion that has been stated, it can be concluded that the booklet of conventional biotechnology application is effectively used as a supplement of teaching materials for biotechnology materials in high schools to help the students achieve their basic learning competencies. The booklet that was developed can help the students to do practicum independently and considered effective as a supplement of teaching materials based on its effect on cognitive, affective and psychomotor values which belong to high criteria.

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