



## Development STEM-Based Biotechnology Learning Tools to Practice Critical Thinking

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### ABSTRACT

This study aims to describe the validity of learning tools in terms of several aspects such as content, language, and presentation. The method used in this research is to use a modified 4D (Define, Design, and Development), model and implemented in the Postgraduate Program for Science Education, State University of Surabaya. The data collection technique was carried out by the validation method. The assessment instrument uses a validation sheet. The tools developed are in the form of lesson plans, Student worksheet, and critical thinking ability tests. The validity of this STEM-based biotechnology learning tool is based on content feasibility, language feasibility, and presentation feasibility. Validity of STEM-based biotechnology learning tools were assessed by three validators consisting of two biology lecturers and one biology teacher. Data analysis was carried out quantitatively. The results of the validation of STEM-based biotechnology learning devices by three validators obtained an average score of 3.83 lesson plans, 3.67 Student worksheet, and 3.67 critical thinking ability test with a very valid category. Based on data analysis, it can be concluded that the learning tools developed are valid and suitable for use in learning

### INTRODUCTION

In 21st century education, the national education system faces very complex challenges in preparing for the challenges of the quality of human resources (HR) that are able to compete in the global era. This can be achieved by preparing various activity-based learning models that are in accordance with the competencies and learning materials. The skills needed by students are critical thinking, communicative, collaborative, and critical thinking skills. Education is an effort to develop an individual's ability to live optimally as a member of society or as an individual. A quality education system in terms of process is if the learning process takes place effectively and students experience a meaningful learning process. Education essentially cannot be separated from human life because with education humans can be efficient and independent. Learning in schools itself has a goal related to improving the quality of human resources. The 20<sup>th</sup> of 2013 Article three states that national education functions to develop the ability to build dignified national character and civilization in the context of educating the nation's life which aims to develop the potential of students so that humans who believe and fear God Almighty. one, noble, healthy, knowledgeable, capable, able to solve problems, critical, independent, and become a democratic and responsible citizen (Sunhaji, 2014).

Science is a subject related to finding out about nature systematically, so that science is not only mastering a collection of knowledge in the form of facts, concepts, or principles but also a process of discovery (Depdiknas, 2016). In general, science is not



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