# Development of environmental friendly chemistry practicum module for vocational high school

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# Development of Environmental Friendly Chemistry Practicum Module for Vocational High School

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**Abstract.** The presence of a chemistry practicum module is important for the implementation of practicum in the vocational school. The practicum module is needed so practicum can run smoothly, learning objectives can be achieved, and reduce the risk of work accidents. On the other hand, the use of chemicals in the school is still quite large and the utilization of organic waste as practicum material is still limited. There is a need for an environmental friendly and integrated chemistry practicum procedure. Therefore, it is necessary to have an environmentally friendly chemistry practicum innovation for the subject of Organic Material Analysis in vocational high school. This research aims to develop an environmental friendly chemistry practicum module that utilizes fruit waste as practicum material for the production of ethanol, acetic acid and ethyl acetate. The integrated chemistry procedure is introduced in this practicum which uses products from the first practicum (ethanol) as a reactant for the production of the second practicum (acetic acid) and the third practicum (ethyl acetate). This is a research and development with ADDIE development model. The validity of the environmental friendly chemistry practicum module was assessed by validators; the effectiveness of the module was evaluated based on the score of students' practicum reports; and the practicality of the module was evaluated from students' responses using questionnaire. The environmental friendly chemistry practicum module is very valid criteria with an average percentage of 94.672%; very effective criteria based on the score of students' reports with an average score of 87.515; and very practical with an average percentage of 90.555%. It can be concluded that the environmental friendly chemistry practicum module is valid, effective and practical. The environmental friendly chemistry practicum module can help the students for conducting experiments and promote students' attitude concern towards the environment.

## INTRODUCTION

Laboratory work is one method that can strengthen students' understanding of chemistry learning. Students perform directly research, observe the phenomenon, reveal facts, and compare theories related to objects during practicum [1, 2]. The topic of ethanol synthesis, acetic acid production and ethyl acetate production in the laboratory are topics for Organic Material Analysis subject which is taught for class XI in vocational high school. The presence of a practicum module is important for the implementation of practicum in the vocational high school. The presence of a practicum module can overcome students' learning problems. Based on [3] practicum module is needed so practicum activities can run smoothly, learning[4] objectives can be achieved, and reduce the risk of work accidents. Based on [5] the practicum module is needed as a guide so that students can carry out practical activities following scientific procedures.

Chemistry practicum generates chemical waste due to excess solvent and reagents [6]. This finding is in line with finding from an interview with a chemistry teacher at a state vocational high school, SMK Negeri 2 Depok, Sleman Yogyakarta. The use of chemicals in the school is still quite large. The production of chemical waste in chemistry practicum is contrary to the goal of education for sustainable development (ESD). Chemistry learning should promote sustainable education and students' environmental awareness by conducting environmental friendly chemistry [7]. On the other hand, the use of materials derived from natural materials can partially reduce the use of chemicals and minimize waste. Therefore, it is necessary to have an environmental friendly chemistry practicum innovation for the subject of Organic Material Analysis in vocational high school. An environmental friendly practicum is a practicum

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