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Laboratory Course During Pandemic Covid-19: Do Lab at Home to Promote Creative Thinking Skill

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Abstract

During online learning, students are generally asked to study practicum procedures that have been provided by the lecturer, then they are given raw data from practicum results in the previous semester for analysis and preparation of practicum reports. Another method used is to provide demonstration videos or use digital applications such as virtual labs. In general, students can attend lectures smoothly and well, but many also say that this method is boring because there is almost no difference with theoretical classes. The object of the research is second semester chemistry students, which consists of 1 class of chemistry program and 1 class of chemistry education program. The research begins with a pretest, then students carry out the planned learning, then ends with a posttest and filling out a questionnaire. The project in the do lab at home practicum is specified to titrate a solution of vinegar with a solution of baking soda or vice versa. Each student prepares a buffer solution with various pH according to the instructions of sub-project 1, makes an acid-base indicator solution from natural materials according to the instructions of sub-project 3, and determines the RGB ratio of a buffer solution that has been given a natural acid-base indicator using the instructions of the sub-project. In quantity, all students upload practicum videos, with a duration ranging from 8-15 minutes. Based on the results of the practicum videos uploaded by students, the first creativity that can be seen immediately is the composition of video editing, such as sound quality, image quality, and the addition of information in the video. In this study, in general, it can be said that students are in the development stage for the fluency-brainstorming indicator. Just like fluency indicators, flexibility indicators are also generally still in the developing stage, they still need help in taking new perspectives. Making videos, although not the main product, can train students' skills, including creative thinking. In detail, risk taking indicators are further divided into 2, namely risk taking-1 and risk taking-2. Most of the students are at the developing level for the risk taking-1 indicator.

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INTRODUCTION

Since the beginning of 2020, almost all higher education institutions have been forced to implement distance learning due to the Covid-19 pandemic. At Semarang State University, this has been in effect since March 2020, or the third week of odd semester lectures in 2020/2021. In that semester, both lecturers and students were still adapting to sudden changes so that lectures were not optimal. Then in the next semester (even semester 2020/2021), lecturers and students are better prepared to carry out online learning.

Chemistry 1 Practicum course is one of the subjects that must be followed by second semester students in the 2020/2021 even semester. This course is designed for 16 meetings with 13 materials. Chemistry 1 practicum is a general (basic) chemistry practicum so that most of the materials provided are still verification. Even so, almost every material has a special project for students to work on. During online learning, students are generally asked to study practicum procedures that have been provided by the lecturer, then they are given raw data from practicum results in the previous semester for analysis and preparation of practicum reports.(Agung Tri Prasetya et al., 2021; Simon et al., 2021; Soong et al., 2021). Another method used is to provide demonstration videos or use digital applications such as virtual labs (Caruana et al., 2020). Demonstration videos can be taken from the internet or made by a team of lecturers, while the digital application used is an application that can be downloaded for free. In addition, you can also use virtual reality or augmented reality (Clark et al., 2016; Dabrowski & Manson McManamy, 2021; Deckert et al., 1998; Early & Lasker, 2018). The laboratory has not been able to provide this technology due to limited resources.

In general, students can attend lectures smoothly and well, but many also say that this method is boring because there is almost no difference with theoretical classes. In addition, there are some things that cannot be achieved with this method, especially regarding laboratory skills. Laboratory skills for chemistry students are inseparable. Chemistry 1 practicum is still verification because its main objective is to equalize perception and knowledge, especially related to laboratories. Experience working in a wet laboratory is fundamental, considering that the materials in the chemical laboratory are Hazardous and Toxic Materials.

Based on this description, in this study, a practicum method was carried out by utilizing existing tools around the house, hereinafter referred to as the do lab at home method. This do lab at home method is inspired by Andrews. Research (Andrews et al., 2020a) with slight modifications to suit the material in the 1st Chemistry Practicum course.

METHOD

This research is a mix method research with exploratory sequential design method (Creswell & Creswell, 2018). The research is limited to acid-base material (alkalimetric acid titration), conducted in the even semester of 2020/2021. The object of the research is second semester chemistry students, which consists of 1 class of chemistry program (class A) and 1 class of chemistry education program (class B). The research begins with a pretest, then students carry out the planned learning, then ends with a posttest and filling out a questionnaire. Data collection took 4 weeks, apart from data preparation and analysis.

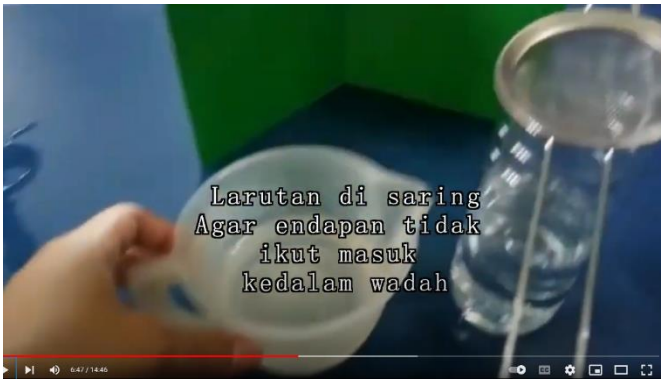
RESULTS AND DISCUSSION

The project in the do lab at home practicum is specified to titrate a solution of vinegar with a solution of baking soda or vice versa. Each student prepares a buffer solution with various pH according to the instructions of sub-project 1, makes an acid-base indicator solution from natural materials according to the instructions of sub-project 3, and determines the RGB ratio of a buffer solution that has been given a natural acid-base indicator

using the instructions of the sub-project. 2. From this activity, calibration curve data will be obtained, namely the RGB ratio of natural acid-base indicators at various pHs. This will be applied to the titration process, by comparing the color of the solution in the titration results and the color of the calibration curve. Project based learning were chosen because it is the most suitable for online laboratory course and it could accommodate students thinking skills (4C skills) (A. T. Prasetya et al., 2020, 2019; A T Prasetya et al., 2020; Sudarmin et al., 2019, 2019).

In quantity, all students upload practicum videos, with a duration ranging from 8-15 minutes. After observing, for class A, there was no coordination between students regarding data sharing, they simply practiced making a buffer solution from a mixture of vinegar and baking soda and tested the acid-base indicator. For example, for group 1, there are those who use purple cabbage as an indicator of the same base, there are also those who use hibiscus flowers. Within one group the use of indicators alone is different.

In general, making a baking soda solution using a tablespoon for class A, then dissolved in ice water. This is done to approach the assumption of a baking soda solubility of 6.9 g/100 g water at 0(Andrews et al., 2020a). However, there are also those who actually practice making a baking soda solution until it is saturated in ice water, then filtered to get a properly saturated baking soda solution (Figure 1). While the vinegar solution is obtained by dissolving vinegar from the packaging directly, assuming the levels on the label match the actual levels. There are several recommended brands of vinegar based on the results of previous practicums related to the identification of vinegar on the market.



Source: research documentation

Figure 1. Making a solution of baking soda

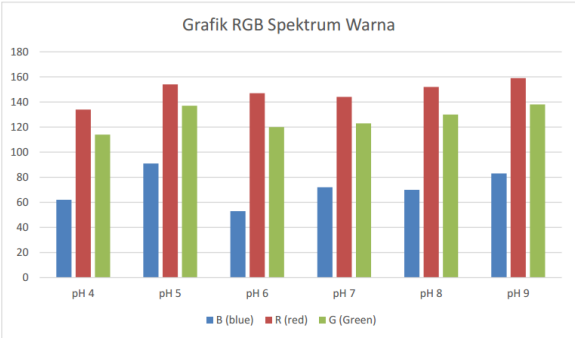
The acid-base indicators of the natural ingredients used are quite diverse, such as purple cabbage extract, turmeric, hibiscus flower, and dragon fruit. The use of these natural ingredients has been widely researched and is commonly used as an indicator of natural acid-base(Andrews et al., 2020b; Caraballo et al., 2021; Fortman & Stubbs, 1992; Linder et al., 2019; Symcox, 2013). The determination of the R:G:B ratio was also in accordance with the procedure developed in Phase 1. For group 1 class A, some decided to use the ColorMeter Free application (Figure 2). RGB measurements are strongly influenced by image quality and the position of placing the measurement point, so measurements with different devices, places, and times are likely to produce different data even though the object taken is the same. The application of analysis using RGB data has also been carried out quite a lot, especially since the COVID-19 pandemic (Andrews et al., 2020b; Cannon & Ong, 2013; Caraballo et al., 2021; Agung Tri Prasetya et al., 2021)

Source: research documentation

Figure 2. RGB measurement process

Based on the results of the practicum, class A did not meet expectations, because the project was only carried out to determine the route of the acid-base indicator from natural materials. Each group member tried the analysis at a different pH, then the data were combined to create a calibration curve. This was due to the limitations of project implementation and unclear instructions. At least every student has practiced it directly and deserves to be appreciated considering the existing limitations. In addition, this activity also received quite a positive response even though it was carried out at home and using simple equipment.

The results of the project implementation in class B were better than those in class A, because they also carried out the acid-base titration process even though they used an injection or a dropper instead of a burette. One of the results of making a calibration curve, shown in Figure 3, is a graph between RGB values at various pH's. After that, a titration demonstration was carried out to compare the results of calculations and experiments. One of the indicators used is turmeric extract. A total of 20 mL of the vinegar solution is titrated with the baking soda solution. Based on the calculations, the equivalence point should have been with the addition of 12 mL of baking soda solution (approximately pH 9), but it took 14 mL to reach pH 9 based on the calibration curve. The difference in results is due to several factors, for example the use of measuring instruments that are less precise, and the calibration curve is inaccurate. Measurement of the color spectrum with the RGB analysis method is strongly influenced by the image/photo taken. Differences in light intensity and image position will result in different RGB ratios. Therefore, this method is referred to as the semi-quantitative analysis method.



Source: research documentation

Figure 3. Example of RGB analysis results from turmeric indicators at various pH values (student work)

In general, the projects given to students in this study did require students' creativity, because they had to do analytical chemistry practicum even though it was done at home. The analysis of creative thinking skills as a

learning process in this research is carried out qualitatively based on the rubric created. Slightly different from creative thinking indicators in general, there are 7 indicators of creative thinking skills that are used to analyze the learning process. The rubrics are obtained from the *Irubric* project (Table 1). Each indicator is divided into 4 levels, namely a) beginning/beginner, b) developing/development, c) proficient/expert, and d) exemplary/exemplary (Ellianawati et al., 2020; AT Prasetya et al., 2020; AT Prasetya et al., 2020; Solving, 2018).

Based on the results of the practicum videos uploaded by students, the first creativity that can be seen immediately is the composition of video editing, such as sound quality, image quality, and the addition of information in the video. Although this is included in the assessment, it is only an additional assessment because creativity is very dependent on individual tastes and the availability of facilities and infrastructure. Therefore, creativity assessment is carried out more systematically using creative thinking indicators.

1. Fluency-brainstorming and Fluency-Possible Solution

The fluency-brainstorming indicator shows how many ideas come up (in quantity) from students. Ideas in this context are still general in nature, both in terms of project content and technical implementation. In this study, in general, all students contributed at least 1 time giving an idea to the project they were working on. This is fulfilled because indeed in the given project, each student is required to provide ideas or suggestions for problem solving. When face-to-face synchronously (video conference), only a few students can give some ideas directly with the guidance of the lecturer. Based on these results, it can be said that students are in the development stage for the fluency-brainstorming indicator. This is probably because students are not used to expressing ideas or opinions in front of lecturers comfortably, especially the implementation of online learning causes class conditioning to be less than optimal. Some students turn off the camera during the discussion citing the weak internet signal. Regardless of whether it is true or not, the lecturer cannot 100% ensure that the student pays attention or not during the discussion.

In general, the indicator displays several possible solutions to the problems at hand or fluency-possible solutions, which are at the developing level. That is, most students try to think of more than one possible solution or approach to the problem at hand. Two to three students have been able to evaluate it and determine the best solution (at the proficient level).

2. Flexibility

The flexibility referred to in the creative thinking indicator is the ability to take different points of view on a problem. Just like fluency indicators, flexibility indicators are also generally still in the developing stage, they still need help in taking new perspectives. For example, in the sub-project for making buffer solutions, students were immediately confused about how to weigh baking soda solids even though there was no analytical balance at home. Through discussion and information seeking, they can come up with various alternative solutions to these problems.

3. Originality

The indicator of authenticity is seen from the level of novelty and uniqueness of ideas, responses, and forms of solutions that students put forward. In general, the ideas they convey are predictable and still conventional. Although there are some who propose unique ideas such as using concepts in physics to make mathematical balances in grams. Although in the end the idea was not implemented due to various factors, especially time constraints.

4. *Elaboration*

In general, elaboration indicators can be said to be at the proficient/expert level, meaning that students can develop and add details to the projects they are doing. This is especially evident in project implementation. In addition, the elaboration indicator can also be seen in the results of the videos made. Making videos, although not the main product, can train students' skills, including creative thinking.

5. *Risk Taking/* Risk Taking

In detail, risk taking indicators are further divided into 2, namely risk taking-1 and risk taking-2. The second difference is that risk-taking-1 observes the ability to face fear of embarrassment or rejection, while risk-taking-2 observes how strictly you follow a predetermined procedure. Most of the students are at the developing level for the risk taking-1 indicator. They avoid things they know will be potentially wrong or difficult to do, fearing rejection by their lecturers or friends. The risk taking-2 indicator is generally at the exemplary level, meaning that they carry out the project based on the agreed procedure.

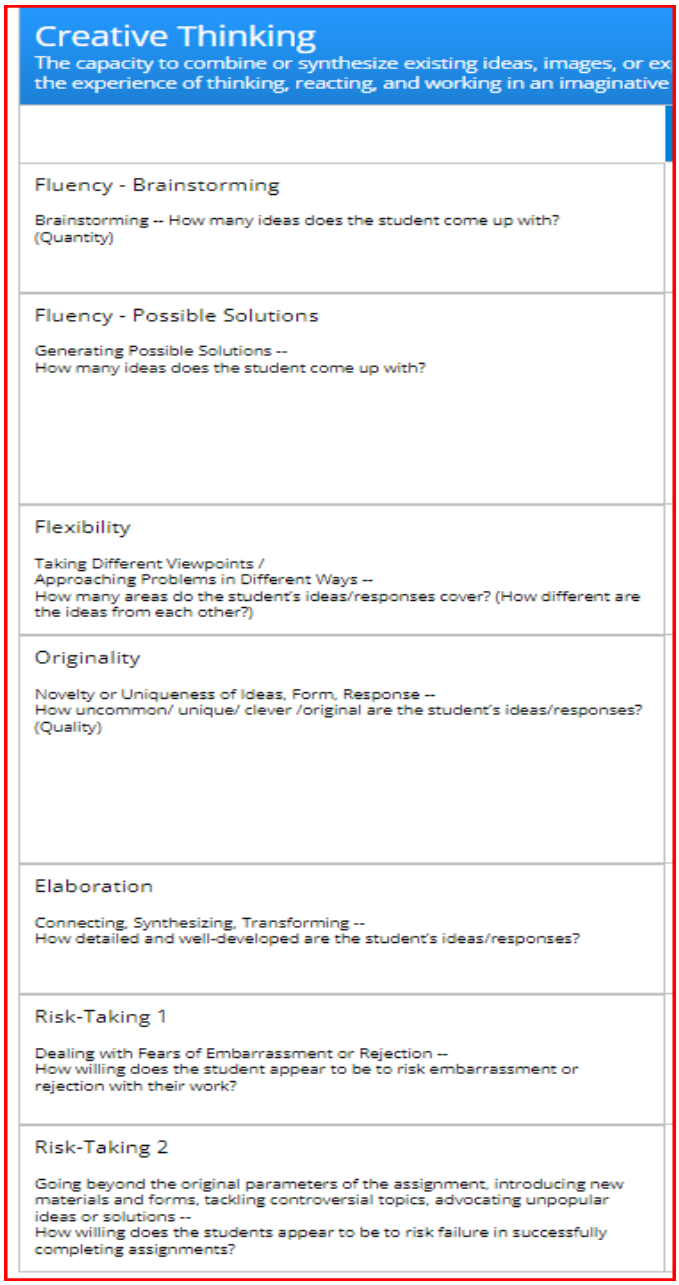


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Figure 4. Creative thinking skills assessment rubric

The project was design using tools and materials at student's living environment, beside it could help improve creative thinking skill, it is also could help them to apply green chemistry principle. They apply use save material (food grade and nature material), and minimalize waste by using accurate calculation before practice. Green chemistry has been a concern of scientists for a long time. Many studies have developed methods and materials to comply with the principles of green chemistry, for example the development of new materials that can decompose quickly, and the discovery of renewable energy sources. Green chemistry is also applied by science teachers so that students know and apply the principles of green chemistry. Green chemistry also help student to improve their thinking system, included creative thinking skill (E. Haryani et al., 2021; S. Haryani et al., 2019; Sudarmin et al., 2019, 2019).

CONCLUSION

Based on the results of the study, it can be concluded that the application of a do lab at home practicum can accommodate creative thinking skills. In general, the students' creative thinking skills in this study were at the developer level. Further research is needed, especially quantitative research so that the resulting data is more systematic and objective. In addition, it is also necessary to develop home lab activities for other materials in order to increase the variety of learning.

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