Developing the lesson plan of STEM education: designing Moringa leaf tea

Supriyono Koes-H¹, Aurelia Astria L. Jewaru¹, Fitroh Fuadah¹, Nur Utami Amalia¹, Sukanya Sutaphan², Chokchai Yuenyong², and Jirakan Yuenyong²*

¹Department of Physics, State University of Malang, Malang, East Java, Indonesia
²Faculty of Education, Khon Kaen University, Thailand
First author’s e-mail address: supriyono.koeshandayanto.fmipa@um.ac.id
*Corresponding author’s e-mail address: hjirak@kku.ac.th

Abstract. The paper will clarify STEM education learning activity of the designing Moringa leaf tea. The STEM education learning activity will be developed based on Sutaphan and Yuenyong [17] the context-based STEM education learning approach. The activity will start from identification of social issue of designing the tea from the Moringa leaf that Indonesian people usually eat Moringa leaves as a vegetable. The issue of making a tea from moringa leaf could motivate students to design not only moringa tea but also various favor of teas, label or packaging. Then, the lesson plan will provide activities regarding on the 7 stages of Sutaphan and Yuenyong [17] the context-based STEM education in order to scaffold students to practice knowledge for designing some technology prototypes or products through engineer design process. For making something related to moringa tea, the lesson plan will provide students chance to practice integration of knowledge. These knowledges include chemistry (e.g. temperature, oxidation, basic measurement skills), Physics (e.g. heat transfer, energy), mathematics (e.g. the ratio of the ingredients, measurement skills, conversion of units), arts (e.g. creative packaging and presentation of their Moringa Leaf Tea and the flavor variant), and so on. This paper may have implications for designing STEM education learning activities.

Keywords: STEM education, tea, thermodynamics, nutrition

1. Introduction
The substance of education is allowed to change in the curriculum to encourage students’ capabilities to prepare well-educated resources in the 21st century, especially the rapidly emerging areas of STEM (Science, Technology, Engineering, and Mathematics) [1], [2], [3]. There is become increasingly significant, particularly scientific and technological fields need to develop students to follow by globalization and technological economy. Thus, the education approach emphasized improvements in the quality of curricula and instruction that was integrated STEM focused on students’ application knowledge and skills. Moreover, the learning process leads students to reach adaptation in their life. Several advantages of STEM education are improved students become well on real-life problems, creators, innovators, and mastery of information. In addition, another stay focused on an educational strategy based on professional practices that contribute to student relations among mathematics, statistics, and science [4], [5], [6], [7], [8], [9], [10], [11], [12].

Students are human resources that should be developed by appropriate education systems. Especially, basic knowledge around the world. Nevertheless, they did not show good results in PISA and TIMSS, they have low-key knowledge and skill that essential for full participation in modern...
scientists. [13]. Students were not ready enough to compete in international competitions and join in modern science. The TIMSS score decreased in 2011. To increase human resources quality in the future, educators, teachers or others who involved with a duty to educate students can be started to be qualified human resources. Consequently, these are seen as necessary elements in preparing the next generation of technological and scientifically literate citizens and those employed in integrated fields such as medicine, computer science, agriculture, and others [14].

Research in secondary schools in Indonesia has started in the last few years which is science learning based on inquiry contexts with the STEM approach. The finding revealed that students attained to design their products of ice cream as well as supplement the integration of STEM engages in project-based learning such as chemistry, mathematics, art, and economics [11]. The results displayed that learning activity can give opportunities to practice more than one element and provide hands-on experience in the manufacturing process. Moreover, STEM was considered by some parties including companies, educators, and parents that missed some key components of child growth. It can be seen that students needed is not only knowledge and skills but they also have multitasking on creativity. By experts, such creativity is trained by integrating STEM with the "Art" aspect.

This study aim to investigated STEM-based science teaching by applying of project designing about social issue of Moringa Leaf Tea that is the popular vegetable in Indonesia regarding the five capitals: physical, financial, social/technology, human, and natural capitals.

2. Developing STEM education learning activities: designing Moringa leaf tea
The developed lesson plan of the designing Moringa leaf tea STEM education learning activities will be developed based on Sutaphan and Yuenyong [15] the context-based STEM education learning approach. The context of Indonesian people usually eat Moringa leaves as a vegetable will be provided in order to enhance students to identify the problem for making something relate to produce a tea from moringa leaf.

Sutaphan and Yuenyong [15] the context-based STEM education learning approach consists of 7 stages. These included (1) Identification of social issues, (2) Identification of potential solution, (3) Need for knowledge, (4) Decision-making, (5) Development of prototype or product, (6) Test and evaluation of the solution, and (7) Socialization and completion decision stage. The 7 stages of context based STEM education teaching approach, the activities may motivate students to practice knowledge for designing something related to produce moringa tea (e.g. process of making moringa leaf tea, favor of teas, label or packaging. Through designing those things, the integration of knowledge could be provided; for examples, include chemistry (e.g. temperature, oxidation, basic measurement skills), Physics (e.g. heat transfer, energy), mathematics (e.g. the ratio of the ingredients, measurement skills, conversion of units), arts (e.g. creative packaging and presentation of their Moringa Leaf Tea and the flavor variant), and so on. The highlight of learning activities could be viewed as showed in the table 1.

| STAGE | ACTIVITY |
|-------|----------|
| 1. Identification of social issues | 1. Social Issue: Indonesian people love to eat Moringa Leaf because it tastes good and has many benefits for the body. Indonesian people usually eat Moringa leaves as a vegetable, to be more practical and easy to find the Moringa Leaf so that the Moringa Leaf can be used as tea drinks. |
### Table 1 (Continued)

| STAGE                        | ACTIVITY                                                                                                                                   |
|------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------|
| 1. Identification of social issues | 2. Teachers raise the issue: “How can you make a tea from moringa leaf?”  
3. Product: Moringa Leaf tea with a healthy twist, inexpensive, and delicious. Students may design a label or packaging and flavor variant. |
| 2. Identification of potential solution | 1. Students and teachers share the cost analysis in the design of their ice cream products.  
2. Students discuss the right price for their Moringa Leaf Tea.  
3. Students discuss their possible design on the Moringa Leaf Tea regarding the five capitals: physical, financial, social/technology, human, and natural capitals.  
   - Physical – The aesthetic value of their Moringa Leaf Tea, impressive packaging  
   - Financial – Using good but affordable local ingredients and not expensive.  
   - Social/Technology – Material selection using appropriate materials, natural, healthy, find ways to solve the problem of Moringa Leaf Tea.  
   - Human – The safety of food, affordable prices, good for health.  
   - Natural – The use of organic ingredients |
| 3. Need for knowledge        | 1. Project-Based Learning (PBL). Each group will have four members.  
2. Students need to gather related information in order to create the right product.  
3. Students interview people who plant the Moringa Leaves, so they know the leaves are suitable for use.  
4. Students may research more information on the internet. Based on the information gathered, the students now have many considerations to build their idea of making a Moringa Leaf tea leaves are practical.  
   - CHEMISTRY – Temperature, Oxidation, basic measurement skills, conversion of units  
   - PHYSICS – heat transfer  
   - MATHEMATICS – the ratio of the ingredients, measurement skills, conversion of units.  
   - ARTS – creative packaging and presentation of their Moringa Leaf Tea and the flavor variant.  
   - ECONOMICS – profitability and low cost. The students develop Scientific and Technological Literacy, which is the aim of K to 12 Education. |
Table 1 (Continued)

| STAGE | ACTIVITY |
|-------|----------|
| **4. Decision-making** | 1. Students as a group will present their idea in front of the whole class.  
2. Non-presenters will give comments, ask questions to refine the idea further.  
3. Each group will be asked to refine and finalize their experiment design before starting to develop their product. |
| **5. Development of prototype or product** | 1. Students create the ice cream at school during their laboratory activity schedule.  
2. Documentation (still pictures and videos) is required in every step of their experiment.  
3. Students will be guided with the following questions during their activity:  
  - What is the difference consuming moringa leaves as a vegetable and as a tea?  
  - In what step in your procedure where you can see the Temperature, Oxidation?  
  - What is the story behind your packaging/branding?  
  - Did you enjoy the activity? Why or why not?  
  - What values have you learned from the activity? |
| **6. Test and Evaluation of the solution** | 1. Held an exhibition about Moringa leaf tea, after which an assessment by the visitors. The assessment is:  
  - Label  
  - Packaging  
  - Demonstration  
  - flavor variant  
  - ingredients  
2. Teachers and Visitors may ask about:  
  - size of ingredients  
  - the process of making labels and packaging  
  - the process of making Moringa leaf tea  
  - how is the drying process  
  - What is learned from the process of making tea |
| **7. Socialization and completion decision** | Each group will make a vlog on their final product and publish it on their social media. They can also display their output in the school and sell it (directly or online). |

3. Conclusion
The paper clarified how to provide STEM education through Sutaphan and Yuenyong [15] context based STEM education learning approach. It is possible to provide the context of Indonesian people usually eat Moringa leaves as a vegetable in order to enhance integrated practicing knowledge for making something, for examples, process of making moringa leaf tea, favor of teas, label or packaging. That knowledge could be provided based on school curriculum.
The possible solution as the designing process of making moringa leaf tea, favor of teas, label or packaging will be introduced to the students to enhance them to develop the prototypes. To support student practicing knowledge, the classroom will move to the need for knowledge stage where students will gather related information in order to create the right product through the project based learning (PBL). Students may find the appropriate temperatures for drying maringa leaf, and applying concept of oxidation and heat transfer for theoretical framework of producing. The mathematical skills (e.g. measurement skills, conversion of units) need to be practiced on the way of developing prototypes. Students may need the arts as providing creative packaging and presentation of their Moringa leaf tea and the flavor variant. And, economics point of view (e.g. profitability and low cost) will challenge students to develop a solution as real world solving problem.

After students learn some more related knowledge, they could develop their prototypes or products which concurrent through knowledge based that could be provided on the decision making and development of prototype or product stage. The questions as scaffolding of students’ making the prototypes; for examples, students will be guided by the following questions: what the difference consuming moringa leaves as a vegetable and as a tea is, what step in your procedure where you can see the temperature and oxidation, what the story behind your packaging/branding is, and what values have you learned from the activity.

The test and evaluation of the solution stage, students’ prototypes will be validated through exhibition about Moringa leaf tea. The prototypes will be assessed by the visitors. The issues of assessment will be considered on label, packaging, demonstration, flavor variant, and ingredients. Teachers and visitors may ask some questions that related to the following issues, for examples; size of ingredients, the process of making Moringa leaf tea, the process of making labels and packaging, and the drying process. In the socialization and completion decision stage, students have to make a vlog on their final product and publish it on social media (e.g., Instagram and Youtube). Then, students will get the comments from their social media (Instagram and Youtube) in order to revising their prototypes and products. And, students will have also chance to apply their scientific and other knowledge for problem solving in context of engineers, technology, or entrepreneurship [15].

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