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Beverage Powder: A STEM Education Project in PTEC Student Teachers

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Abstract

Worldwide economic growth has been consistent with technological advancements in the labor market. In this sense, STEM education is very significant in strengthening the ability of students to have the appropriate skills for the needs of the 21st century. Thus, this project intends to process agricultural raw materials such seasonal fruits into completed products that can be preserved for a long time in daily life and enhance the growth of local agricultural products. The STEM learning activity will be developed based on Sutaphan and Yuenyong (2019) which consisted of 7 stages including (1) Identification of social issues, (2) Identification of potential solutions, (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. As a result, many beverage powders are made using raw materials such as oranges, lemons and mangoes. This beverage powder can also be further processed using standard equipment such as mesh mixers, dryers and grinders to a fine powder, which can then be used as a raw material for making candy and ice cream. When kept and handled appropriately, this powder can last up to a year without the need for artificial preservatives. Regarding the experiment, analysis, evaluation and reflection, there was found that the delicious beverage powder can be composed of fruits, vegetables, flowers mixed with a little sugar, salt and lemon powder then dried under the sunlight or dryers. The study will issue on student teachers' experiences in integrated STEM knowledge throughout these activities. Furthermore, student teachers could apply this approach in their actual classes in the future.

Keywords: STEM Education, 7 Stages, Beverage powder, Fruit drying

1. Introduction

Cambodia is a country that relies heavily on agriculture and is rich in seasonal fruits such as Mangifera indica, Benincasa hispida, Citrus x Sinensis and Hibiscus sanguineus. Most young people, especially students, do not have the knowledge or ideas to process existing products in the community. Seeing this problem and the abundance of local fruit

products is low, so knowledge of processing and storing fruits for a long time is essential for students. This study links teaching and learning to train local students to understand and be creative, for example, mango contains fiber, protein, vitamin A, vitamin C, vitamin B6, which contains up to 14% nutrients brix (Guiamba, 2016). Lemons are rich in vitamins C and A, calcium, fiber (Mohanapriya et al., 2013). Acacia contains vitamins C, B2, A and potassium, magnesium (Ajayi et al., 2018). In addition to fresh fruit, they can also be processed for long-term storage, and some can be processed into powder, a drink that maintains quality and safety for consumers (Ashurst, 2016) . Producing fruit powder at home is a simple and enjoyable project. Fruits can be dehydrated in a number of ways, including by using a dehumidifier or sun drying (Riaz et al., 2022). Fruit processing-appropriate flour production technique is used to extract the fruit's juice while retaining its nutrients and flavor (Michailidis et al., 2014). In India, one of the most significant fruit crops is the mango (Singh et al., 2018). You can use the entire dried mango pulp to make custard powder, candies, and toffee. 95% of the nutrients from fresh fruits are retained in these powders (Rahman, 2022). Oven for drying Arrange the fruits or vegetables in a single layer on a tray in order to dry the oven. Put them in an oven for two days and minutes at 140 to 150 degrees Fahrenheit (60 to 66 degrees Celsius) (Michailidis et al., 2014). Sun-drying under the sun 30 0C (86 F) is the minimum temperature driers (Riaz et al., 2022). Examine the weather forecast and decide when, over several days, to sun-dry fruits. Moreover, fruit powder components may contain trace amounts of other substances like sugar, salt, and lemon (González-Molina et a., 2010). Fruit powder's low weight, volume, and durable packaging make it simple to handle and transport (Islam et al., 2016). Reduce the number of dried fruits you use by packing them in dry glass, a refrigerator, a box, or a moisture-proof bag. When you use a glass container, you can see the increased moisture within right away. For six months to a year, store in a cold, dry, dark place or in the refrigerator (De Oliveira et al., 2024).

The current STEM education in Cambodia is the way of promoting in school context (Sar, 2021). Hence, the STEM Learning Approach was considered for using for study in the topic of “Beverage Powder” conducted in science subject of biology teaching and learning. The project of Beverage Powder in STEM teaching and learning was conducted in class. The linkage of teaching and learning to the local students to understand and be creative, for example, mango products which contains of fiber, protein (Singh et al., 2018). The main aim of this STEM Learning Approach is to link investigation into learning content with project of making Beverage Powder in biology class and local product. There are various considerations of the study coming up with the product such as its costs, nutritional benefits, physical appearance as well as its packaging. Each of these are addressed by providing appropriate activities to scaffold the attainment of its objectives and goals in teaching and learning which link real world problem.

2. Developing STEM Education Learning Activities

The STEM Education Learning Activity bring students to practice integrated knowledge among science, mathematics, art, and economics in order to design their products which link to the study of scientific research, new discoveries, the invention of contemporary objects, science, engineering, technology, mathematics, computation, and innovation are all included in the field of STEM- S= Science, T=Technology, E=Engineering, M= Mathematics. The literatures (Fachrunnisa et.al., 2021; Koes-H et.al., 2021;Nugraheni and Yuenyong, 2022; Long et.al., 2024; Setiawan et.al., 2021; Srieng et.al., 2024; Theerasan and Yuenyong, 2019) suggested how to provide learning activities on STEM education regarding to Sutaphan and Yuenyong (2019) STEM education stage of teaching.

The process for producing beverage powder adheres to seven STEM phases (Sutaphan & Yuenyong's, 2019) in lesson plan. The Beverage Powder Model STEM education learning activity was developed based on 7 stages of Sutaphan and Yuenyong (2019) which education learning approach, included (1) Identification of social issues, (2) Identification of potential solutions, (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.

Table 1: Beverage Power Model STEM education learning activities

Stage	Activity
(1) Identification of social issues	Noticing that the local's fruits such as mango, orange, Wax ground, and Rosella flower, are in challenges in selling out to market, especially the price; and farmers and schoolchildren are lack of knowledge in producing high quality of fruit products, package, keeping fresh and so on.  This is the picture from farmer which is talking about the shortage of supporting from people and it is in the very low price of mango fruits.
(2) Identification of potential solutions	The quality and quantity of fruit available in the export market are seen as solutions to the issue. However, the fruit products cannot meet the demand standard due to knowledge of farmers and support from quality assurance expert in both planting and quality of fruit. This may lack of regarding the four disciplines that are utilized in the manufacturing process: science, technology, engineering, and mathematics. Learn about each fruit's benefits, scientific name, and nutritional makeup. ▪ Science: the pursuit and application of knowledge and understanding of the natural and social world following a systematic methodology based on evidence (Council 2015). ▪ Technology: meeting the market competition like design, keeping fresh, promoting, package. ▪ Engineering: Manufacturing by using machines and dryers can grind fruit. ▪ Math: computations and assessments determine how much of each ingredient is in the beverage powder.
(3) Need for knowledge	Gather knowledge and data about technology and discussion with senior student leaders, teachers and experts and research to get ideas and generate new concepts and further investigate to provide significant ideas and knowledge in designing project, quality assurance, processing, producing products and design package.

	
(4) Decision-making	Making decision based on interest in and offer guidance by teachers and coworkers; observing the issues encountered, at least in the case in the real context. Moreover, the farmers are lacking of skillful at staying hydrated or way of producing. Therefore, the decision was made: Process seasonal fruits into beverage powder and student teachers came up with different ideas of making by presenting ideas and having comments for producing new way manufacturing fruits in their local areas. 
(5) Development of prototype or product	Student teachers creates the powder at school during their laboratory activity schedule. Documentation (still pictures and videos) were required in every step of their experiment. Student teachers were guided with the following questions during their activity: • Production, preparation, procedure • Assign team members different duties • How can our fruit be dried? How can bacteria be reduced? • What are the ingredients involved in blending a beverage powder? What should be done to make the drink powder taste delicious? • What is the shelf life of beverage powder? • How can one draw in clients? 

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<td>(6) Test and evaluation of the solution</td>
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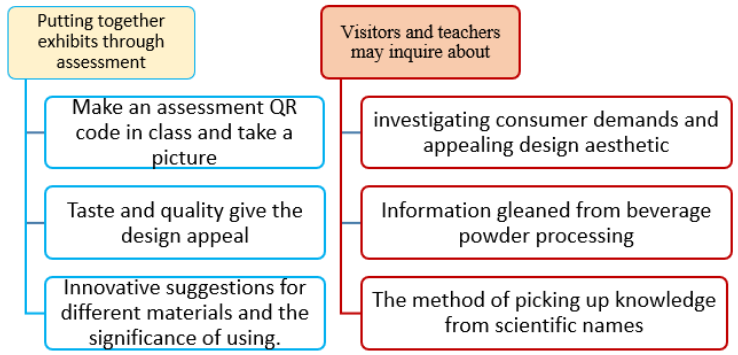





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<td>(7) Socialization and completion decision stage.</td>
<td>Each group have shown their product in science exhibition with their final product and publish it in social media. They can also display their output in the school and sell it. In this way, they will also learn the value of teamwork and entrepreneurship.

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Through study activities based on the project "Production of mango powder, orange juice and Rosella flower" to produce the product of mango powder, eggplant and Rosella powder can be used and this research activities, student teachers gained knowledge in processing local products depending on the fruit variety, highly hydrated fruit products range from 65% to around 97%, leaving a tiny amount of pure fruit powder (unsweetened). After The creation of this drink powder can assist growers in processing fruits that are more valuable for long-term storage then the market will allow, and we can transition from being a consumer to a producer. In order to teach local students to comprehend and innovate for example, by creating logos for cans and sizes, ice cream, candy, and baking powder on beverage bottles, as well as marketing to draw attention this research integrates teaching and learning. Apart from being fresh, fruits can also be processed to ensure quality, safety, and long-term storage for customers.

3.Conclusion

The creation of this drink powder can assist growers in processing fruits that are more valuable for long-term storage than the market will allow, and by importing from overseas, we can transition from being a consumer to a producer. Therefore, this article shared educational activities in STEM education by producing beverage powder to link creativities and new products in daily life. This paper also shared the ideas of developing STEM Learning Approach based on local context-based approach to solve the real-world problem. The 7 stages of Sutaphan and Yuenyong (2019) context-based STEM education learning approach could guide ideas of developing activities of teaching and learning will engage students to practice their knowledge and applying scientific and other knowledge for designing the solutions, and provided the context of instruction required real-world problem solving and task through teamwork. As student teachers' products of Beverage Powder, student teachers will have also chance to apply their scientific and other knowledge for problem solving in context of engineers, technology, or entrepreneurship and teaching methods.

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