Ice Cream STEM Education Learning Activity: Inquiry from the Context

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Abstract. The paper will clarify the ice cream making STEM education learning activities which provide through Sutaphan nad Yuenyong [11] context based STEM education learning approach. This approach consists of 7 stages including (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. Icecream STEM Education Learning Activity will bring students to practice integrated knowledge among chemistry, mathematics, art, and economics in order to design their products of icecream. This may has implication for organizing STEM education in school setting.

1. Introduction

In the 21st century, scientific and technological innovations have become increasingly important as we face the benefits and challenges of both globalization and a knowledge-based economy. To succeed in this new information-based and highly technological society, students need to develop their capabilities in STEM to levels much beyond what was considered acceptable in the past.” [1]

The Philippines had just implemented the K to 12 Basic Education Program. It aims to create a functional basic education system that will produce productive and responsible citizens equipped with the essential competencies and skills for both life-long learning and employment. Today, the education system tries to impose on students the attitude of lifelong learning. Life-long learning (LLL) as viewed involves all strategies that are put in place to create opportunities for people to learn throughout life by providing both the individual needs and that of the relevant community [2]. Lifelong learning can be associated to the following notions: (1) individuals take ownership of the need for and the content of learning, (2) learning focuses on how students think rather than on what to think about, (3) teachers become role models and mentors for lifelong learning rather than distributors of information, (4) evaluation encourages students for self-development and becomes a facilitator in the process rather than classifying them according to a norm, and (5) learning is considered as an enjoyable and essential part of the individual [3]. Methods such as problem-based learning, conscious learning, mutual teaching and cognitive apprenticeship, and such naturally motivating activities and similar teaching strategies as cooperation, reflection and student autonomy are employed by individuals in order to remain updated in today’s world [4]. It is also important to note that problem solving, critical thinking, and reasoning skills are essential to lifelong learning for these skills allow learners to acquire the knowledge, skills and attitudes necessary not only for academic success but also
for their overall well-being [5]. In order to help students become lifelong learners, the schools should be organized in such a way that the students will have the opportunities to develop these skills.

Science education in the Philippines cannot be considered as a strength. Based on results from 2014, the passing rate for the national achievement test (NAT) for grade six pupils is only 69.21%. The passing rate for high school seems far worse, with a passing rate of only 46.38% from 2010 statistics. Aside from the aforementioned national examination, the Philippines has exhibited a consistently abysmal performance in international surveys such as Trends in International Mathematics and Science Study (TIMSS). In 2003, for high school, the country ranked only 34th out of 38 countries in HS II Math, and 43rd out of the 46 participating countries in HS II Science. For elementary, fourth grade participants ranked 23rd out of the 25 countries in both math and science. Our country stopped participating in the survey in 2008, perhaps after getting such lackluster scores [6].

The current situation of STEM education in the Philippines proves that we have a long road ahead of us. Nevertheless, this should not stop us from pausing and admitting that yes, there is a problem that we should work upon. We can still encourage more people to become STEM educators. We can still improve our NAT scores, and confidently participate in international surveys once more. Improving science education will not only allow our country to have citizens who are thinkers first and foremost, but also increase the number of STEM graduates to address the glaring industrial and agricultural needs that will boost the economic growth of our country [7].

The main goal of this context based STEM Education Learning activity is to investigate the colligative properties of solution specifically the freezing point depression by producing a locally-made nutritious ice cream. There are various considerations of coming up with the product such as its costs, nutritional benefits, physical appearance as well as its packaging. Each of these will be addressed by providing appropriate activities to scaffold the attainment of its objectives and goals.

2. Developing STEM Education Learning Activities

Icecream STEM Education Learning Activity will bring students to practice integrated knowledge among chemistry, mathematics, art, and economics in order to design their products of icecream. Chemistry concept may include colloidal emulsion, freezing point depression, enthalpy change, and basic measurement skills. Mathematics may include ratio of the ingredients, measurement skills, and conversion of units. Arts include creative packaging and presentation of their ice cream. And, economics include profitability and low cost.

The lesson plan of icecream STEM Education learning activity was developed on concept of Context-based STEM education learning approach which the STEM education learning activities should provide not only the ways of investigation and solving problem but also a real world problem solving. Regarding on Sutaphan and Yuenyong [8], the context-based STEM education learning approach 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 lesson plan could be highlighted as the table 1.
Table 1: Lesson plan on ice cream making on context based STEM education learning approach (Sutaphan and Yuenyong [8]).

| STAGE                              | ACTIVITY                                                                                                                                                                                                 |
|------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1. Identification of social issues| 1. Social Issue: Filipinos love to eat ice cream especially during hot season. Discuss with the students about their favorite ice cream, why they like it and their opinion about health issue of the ice cream.  
   2. Teachers raise the issue “How can you make a local ice cream that has nutritional value?”  
   3. PRODUCT: ICE CREAM with a healthy twist  
   Students may design a label or branding/packaging in their ice cream. |
| 2. Identification of potential solution| 1. Students and teachers share the cost analysis in the design of their ice cream product.  
   2. Students may discuss their possible design on the ice cream regarding on the five capitals: physical, financial, social/technology, human and natural capitals.  
   Physical – The aesthetic value of their ice cream, interesting packaging  
   Financial – Using good but affordable local ingredients  
   Social/Technology – Material selection using appropriate materials, find ways to solve the problem  
   Human – The safety of food and its nutritional value  
   Natural – The use of organic ingredients |
| 3. Need for knowledge              | 1. Project Based Learning (PBL). Each group will have 4 to 5 members.  
   2. Students need to gather related information in order to create a good product.  
   3. Students may tap or ask help from local ice cream manufacturers on how to make an ice cream. They could also interview food technologists on what ingredients to be used in order to produce a healthy ice cream.  
   4. Students may research more information in the internet.  
   Based on the information gathered, the students now have many considerations to build their idea of making a healthy ice cream.  
   CHEMISTRY – colloidal emulsion, freezing point depression, enthalpy change, basic measurement skills, conversion of units  
   MATHEMATICS – ratio of the ingredients, measurement skills, conversion of units  
   ARTS – creative packaging and presentation of their ice cream  
   ECONOMICS – profitability and low cost  
   Basically, the students develop Scientific and Technological Literacy which is the aim of K to 12 Education. |
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|---|---|
| **Table 1 (Cont’)** |   |
| **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 further refine the idea.  
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** | Students create the ice cream at school during their laboratory activity schedule. Documentation (still pictures and videos) are required in every step of their experiment.  
Students will be guided with the following questions during their activity:  
1. What are the ingredients you are using in your ice cream?  
2. Cite the specific ratio and amounts of ingredients?  
3. What are the health benefits involve in your ice cream?  
4. In what step in your procedure where you can see the colloidal emulsion? Freezing point depression? Enthalpy change?  
5. What is the story behind your packaging/branding?  
6. Did you enjoy the activity? Why or why not?  
7. What values you have learned from the activity? |
| **6. Test and Evaluation of the solution** | An ICE CREAM CHALLENGE will commence and there will be honourable panel of judges to be invited. Their ice cream will be evaluated through the aesthetic value/packaging/branding, texture, taste, cost and nutritional value.  
An open forum will commence so that the students will use these information to better improve their product.  
Teacher may ask this question: “Aside from ice cream making activity, cite other examples where the concepts of colloidal emulsion, freezing point depression and enthalpy change can be applied?” |
| **7. Socialization and completion decision stage** | Each group will make a vlog on 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 entrepreneurship. |
3. Conclusion
This paper shared the ideas of developing STEM learning activities through ice cream STEM education based on context based approach. The 7 stages of Sutaphan and Yuenyong [8] context based STEM education teaching approach could guide ideas of developing learning activities from social issues to develop some products. The ice cream STEM Education Learning Activity will allow students using applying scientific and other knowledge for designing the solutions, and provided the context of instruction requires solving a real-world problem or task through teamwork. As students’ products of ice cream, students will have also chance to apply their scientific and other knowledge for problem solving in context of engineers, technology, or entrepreneurship [8].

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