Development of STEM education learning unit in context of Vietnam Tan Cuong Tea village

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Abstract. The paper will clarify STEM learning activities using team teaching approach by the Physics, Chemistry, and Biology through Sutaphan nad Yuenyong [11] context based STEM education learning approach. The activity will be started by identification of social issues that science teacher raises the social issue about the tea production process in Tan Cuong, Thai Nguyen, Vietnam. The context may engage students to learn concept on heat transfer, chemical composition, ecosystem, and so on in order to practice among concepts in science, technology, engineering and mathematics. The decision making stage, lets the students decide on how they are going to make the required prototype for Physics, Chemistry and Biology aspect as possible solutions to the problem. The development of prototype or product stage, students are given enough time to create the Tea dryer machine, fertilizers or system of growing the tea plant, short film for advertising the Tan Cuong tea village STEM education tourist place. Test and evaluation of the solution stage, students will apply their knowledge related to their prototype or product for test and evaluation of the solution. The socialization and completion decision stage, the students’ will have an exhibit of their output. The paper will discuss how to provide students chance to applying STEM knowledge through these activities.

Keywords: STEM education, tea, heat, chemical composition, ecosystem, Vietnam

1. Introduction

STEM education with the tasks of providing crucial knowledge and skills for students in 21st Century will become a widespread education model in the future [1]. In the United States, STEM education was promoted by successive US Presidents as playing a key role in US competitiveness and future economic prosperity. A similar situation developed in the European context where STEM was promoted at each level of the education system and particularly in the higher education context through the determination of research priorities and funding [17].

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From the 2014-2015 school year, STEM education has been included in the documents guiding the implementation of secondary education tasks by the Vietnam Ministry of Education and Training (VMoET) [13]. As a result, so many of STEM-focused schools have emerged, as well as many of programs focused on providing STEM-enhanced learning experiences for children both inside and outside of school. STEM reform in Vietnam originated as a top-down approach and start from the national policy [12][14][15]. Therefore, STEM education is increasingly concerned by the school and society.

Context-based learning (CBL) is one of the ‘big ideas’ in (science) education (Kortland, 2005). STEM context or context based STEM are mentioned in many research. A boarded view of perceptions, beliefs and actions on STEM, Yuenyong [7] suggested consensus five characteristics distinguish integrated STEM instruction from other teacher pedagogy: (a) the content and practices of one or more anchor science and mathematics disciplines define some of the primary learning goals; (b) the integrator is the engineering practices and engineering design of technologies as the context; (c) the engineering design or engineering practices related to relevant technologies requires the use of scientific and mathematical concepts through design justification; (d) the development of 21st century skills is emphasized; and (e) the context of instruction requires solving a real-world problem or task through teamwork. This conceptualization of STEM is grounded in learning research [7].

The main goal of this context based STEM Education Learning activity is to apply physics, chemistry and biology to design, create, or make something related to grow tea plant and produce the tea. Students may engage to apply the knowledge of chemistry, informatics to analyze the process of how to grow tea, investigate the chemical composition, and assess the quality of tea products. Students also apply knowledge of social sciences to write / talk about tea cultivation. Students may engage to apply knowledge of Physics for designing the process of drying the tea leaves or Tea dryer machine. And, they may apply knowledge of biology to clarify the environment for growing the tea. Each of these will be addressed by providing appropriate activities to scaffold the attainment of its objectives and goals.

2. Literature review

Science, technology, engineering, and mathematics education has commonly been referred to as STEM education in the United States since the early 1990s [23]. In some spaces, STEM is simply a replacement term for science or mathematics [23], but in others, STEM refers to a more integrated approach to teaching and learning that necessitates explicit connections between disciplinary content and practices [19].

More recently, though, calls have been made to include STEM instructional practice in K-12 education to improve students’ STEM achievement and increase their interest in STEM careers [21].

Although the number of STEM education initiatives is increasing, current approaches for the implementation of STEM remain varied. There is some ways of implementation of STEM education in school. For example, In the USA, STEM programs and STEM schools have added additional science, mathematics, technology, or engineering stand-alone coursework for students to enroll in or STEM schools and/or STEM programs add on new STEM-focused coursework with an interdisciplinary format [16].

STEM education is an interesting field where developed many model and concepts. All the keywords “STEM”, “STEAM” [17] [22] [20] are mentioned by so many studies and easy to find in many scientific databases. Gasiewski et.al. [18] investigated the relationship between students’ engagement and introductory STEM courses and found that students were more emotionally and behaviourally engaged in STEM classrooms where professors applied a student-centered approach and where collaboration with others frequently took place. iSTEM is a good practice to engage students in the STEM learning environment, as it facilitates teachers’ implementation of a general student-centred approach [25]. In contrast to traditional ‘segregated’ STEM, integrated STEM requires the application of knowledge and practices from various STEM disciplines to solve complex and transdisciplinary problems [20].
Context-based approaches ‘bring the learning of science closer to the life and interests of students’ and ‘show how the use of contexts would improve their interest in science and therefore enhance their understanding [29]. If the pre-knowledge of learners should be taken into consideration, the learning environment, especially the learning tasks, should build links between students’ prior experiences and the content to be taught. This should be easier if the content is explicitly connected to experiences outside the classroom – and thereby situated or contextualized [24]. Ideally, contexts designed to students to experience competence and social embeddedness, not just within but also outside the classroom, by becoming able to apply school knowledge to the real world.

In this study, the “STEM context” can be understood as a designed context in which students are placed in an experience environment and use STEM-related knowledge to perform a task. Through the STEM context, students construct their knowledge, formulate and train skills not only related to STEM topics but also to other soft skills.

3. Developing STEM Education Learning Activities

The developed Lesson Plan is a collaboration among Physics, Chemistry & Biology teachers to address the issue on the tea production in Tan Cuong village, Thai Nguyen, Vietnam. All of the concepts were based from the Grade 12 Curriculum Guide of the three specified subjects. The concept on heat transfer, chemical composition, ecosystem, and so on. And, students learn the subject on the relation between concepts in science, technology, engineering and mathematics. The lesson plan 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 [11], 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.

Regarding on the 7 stages of context based STEM education teaching approach, the activities could be started from social issues and/or human needs such as heat transfer, chemical composition, ecosystem, energy, market, commerce, and designing some technological products. The 7 stages 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. And, students will have also chance to apply their scientific and other knowledge for problem solving in context of engineers, technology, or entrepreneurship [11].

3.1 Purposes of the Lesson Plan

1. Learning Objectives
   a. Knowledge: Students will be able to:
      - Describe the origin of tea tree, its structure and characteristics.
      - Describe the tea production in Thai Nguyen: the history of tea jobs and its development, the process of tea production, different types of produced tea and tea consumption.
      - Identify the tea culture: The beauty of tea drinking in the culture of Thai Nguyen people in particular and of Vietnamese in general.
      - Recognize the importance of tea industry for national economic developments and identify the position of Vietnamese tea compared to those of other countries in the region and in the world.
      - Apply the knowledge of chemistry, informatics to analyze the process of how to grow tea, investigate the chemical composition, and assess the quality of tea products. Students also apply knowledge of social sciences to write / talk about tea cultivation.
      - Apply knowledge of Physics for designing the process of drying the tea leafs or Tea dryer machine
      - Apply knowledge of biology to clarify the environment for growing the tea
      - Apply mathematical knowledge to design paper tea boxes, determine the most economical ways to cut tea boxes.
Fig. 1. Thai Nguyen Tea paper box (4cm×8cm×12cm)

b. Skills: Students will be able to:
- Restate the characteristics of tea plants, and distinguish different types of tea plants.
- Describe and perform some basic stages of tea growing, tea harvesting, processing, packaging the tea products.
- Design the process of drying the tea leaves or Tea dryer machine
- Design and create a type of products relevant to tea (tea bags, green tea cake, tea scented sachets...).
- Describe the process of making tea, make tea, perform the actions of inviting everyone in the family with the elderly, or the same age for some tea,...
- Develop the ability to review relevant documents, evaluate and analyze.
- Develop skills to use technical devices such as cameras and some learning tools such as mind maps, problem tree-diagrams, other diagrams.
- Develop skills to present the team-work products.

c. Attitude
- Being aware of the role of tea plantation in the locality and preserve the cultural heritage of tea.
- Strengthen the love of the homeland, the responsibility and the duty to protect the national cultural heritage.
- Is responsible for promoting Vietnamese tea brand with international friends.

3.2 Activities
- Activity 1: Investigating the origin of tea tree and its usage.
- Activity 2: Visiting the tea production and processing process in Tan Cuong Thai Nguyen.
- Activity 3: Experiencing tea drinking culture, participating in activities to spread tea culture of Thai Nguyen people.
- Activity 4: Participating in innovative activities to develop tea processing techniques, preserving and promoting tea culture.
- Activity 5: Exhibition activities to introduce innovative tea products. Summarizing and evaluating student activities.

Types of activities: Field trips and research.
Data collecting method: Survey (applying scientific methods).
Participants: Students of 12th grade.
Preparations:
- Location: Tan Cuong Commune, Thai Nguyen City
- Duration: 1 day
- Transportation:
  + Car
  + Materials and facilities for observation and information collection: cameras, camcorders, questionnaires, information collection sheets.
  + Materials and facilities for presenting results: Computer, projector, paper, pen, ...
- References: documents about tea cultivation and tea culture.
- Teacher preparation: Develop a plan to visit and research tea growing and tea culture of Thai Nguyen people, assigning specific tasks for each student and relevant participants.

Figure 2: Students’ studying field trip at Tan Cuong

Table 1: Task assignment

| People in charge | Activities                                                                 | Tasks                                      | Duration |
|------------------|---------------------------------------------------------------------------|--------------------------------------------|----------|
| Teacher          | Contact the tea villages and households in Tan Cuong Commune, Thai Nguyen City. Schedule time for students to visit the field trip site. | Observation, investigation                 | 180 phút |
| Group 1          | Study the history of tea cultivation in Tan Cuong, the geographical location, and average area of a tea hill. | Observation, investigation                 | 180 phút |
| Group 2          | Research on the origin of tea types, tea tree classification, tea tree characteristics, planting, tending and harvesting methods. | Observation, investigation                 | 180 phút |
| Group 3          | Investigate the production of tea-related products.                       | Observation, investigation                 | 180 phút |
| Group 4          | Research the economic and spiritual roles of tea tree in the life of people in the tea villages. | Observation, investigation                 | 180 phút |
| Group 5          | Develop a plan to expand tea domestic and international consumption markets. | Observation, investigation                 | 180 phút |
| Group 6          | Filming, reporting, taking photos.                                        | Observation, investigation                 | 180 phút |

3.3 Implementation

a. Introduction: Introduction and orientation (30 minutes)

Teachers introduces the situation:
- Tea has long become a traditional drink of our nation. Tea is an ethereal pleasures characterized traditional culture and philosophy of Vietnamese people.
- This drink is not only available in Vietnam. In the world, tea is a relatively popular drink. People drink tea in many types and ways. However, the tea drinking is considered as an elegant hobby only in a few countries like China, Japan ... and in Vietnam.
- In each region of the country, there are different kinds of special drinks which are characterised by the culture of the regions. But today, in the trend of increasing cultural integration, people are
gradually giving up industrial drinks. Tea is becoming more popular than before and is claimed to stop
the bring peaceful to people in a quiet, no hustle space. People drink tea anytime and anywhere, from
sidewalk bars to a delicious and famous tea shop for popular and premium tea.

- In recent years, our country's tourism industry has experienced strong development. More and
more tourists are coming, and almost every of them wants to learn about Vietnamese culture. In
addition to the many types of human and natural tourism resources that are being effectively exploited,
tea is also a rich resource for tourism development. Tea drinking or the art of enjoying tea becomes a
cultural beauty of Vietnamese people.

- Learning about tea and tea culture will help students gain more knowledge about the "drinking
(âm)" culture in particular and the cultural identity of the nation in general. Moreover, students can
introduce to domestic and foreign tourists about a long-standing tea drinking culture in the country. In
order to achieve those learning objectives, we have designed and organized creative experience
activities with the topic: "Tea and tea culture".

b. Main activities:
   Activity 1: Investigating the origin of tea tree and its usage
   - Objectives: Students develop documents and other materials for the field trip.
   - Implementing:
     + Teachers organize activities to help students identify research tools by brainstorming method.
     + Teachers finalize the tools (documents and materials) that need to be designed and used for
     research.
     + Teachers instruct students to design and use some research tools.
   - Activity conclusion 1:
     + Students gain some basic knowledge about tea plants and tea planting. The reasons for
     conducting research on this issue.
     + Students plan, design information sheets and questionnaires as instructed by the teacher.
   Activity 2: Visiting the tea production and processing process in Tan Cuong Thai Nguyen
   - Objectives: Students will gain understandings about tea cultivation, production processes, how
     hard is the work of tea workers, the job values, and raise awareness of cultural conservation and
development. During the field trip, students will experience a number of stages in the practical process
     of planting, tending, harvesting and processing tea.
   - Implementing:
     + Assigning research tasks to students into groups:
       • Group 1: study the history of tea cultivation in Tan Cuong, the geographical location, and average
       area of a tea hill.
       • Group 2: research on the origin of tea types, tea tree classification, tea tree characteristics,
       planting, tending and harvesting methods.
       • Group 3: investigate the production of tea-related products.
       • Group 4: research the economic and spiritual roles of tea tree in the life of people in the tea
       villages.
       • Group 5: develop a plan to expand tea domestic and international consumption markets.
       • Group 6: filming, reporting, taking photos.
     + Organizing the field trip
     • Students visit tea producing households as planned.
     • Students conduct assigned research tasks.
     • Teachers guide students to the field trip to collect information.
     • Find out information about the tea households.
     • Listening and recording the information of the host family – the owner, the workers about tea
     plants and tea planting in Tan Cuong.
   - Conclusion:
     + Conclusion about the tea production process.
     + Conclusion of the field trip.
This activity helps students understand how hard is the work of the tea workers and be aware of preserving and developing this traditional job.

Activity 3: Experiencing tea drinking culture, participating in activities to spread tea culture of Thai Nguyen people
- Objectives: Students experience Tan Cuong tea festival and understand the good values in Vietnamese tea culture.
- Implementing: Playing games (3 parts).
  + Part 1: Picking tea leaves
    • Students from all teams will take turn to pick tea leaves for 5 minutes. Each student in turn will pick tea leaves with their lips. After 5 minutes, the competitions of each team will be evaluated and scored by the workers at the tea hill.
  - Part 2: Drying tea leaves
    • Students design the process of drying the tea leaves they have just picked. They may design tea dryer machine
      • The workers will assess the tea leave quality and give scores.
  - Part 3: Drinking tea
    • Teachers and students will visit a family in a tea village in Tan Cuong. They will learn about the tea drinking culture of Thai Nguyen in particular and of Vietnamese people in general. Students and local peoples will talk about how to make tea, how to invite tea, and the principles of tea making.
      • Students will later divide into groups to experience making tea, invite tea around, and enjoy the tea.
      • People from the village evaluate, comment and score.
- Conclusion of Activity 3: This activity helps students understand the beauty of Vietnamese tea drinking culture.

Activity 4: Participating in innovative activities to develop tea processing techniques, preserving and promoting tea culture
- Objectives: Students create tea-related products after the field trip.
- Implementing:
  + Teachers can provide some support relating to generate research content, determine objectives and time duration for creating tea-related products to preserve the traditional trade of the tea villages.
  + Preparation time for each team is 1 week. After 1 week the teams will compete together in class.
  Students in class will be divided into 2 teams, each team will do 2 parts.
    • Part 1: Innovative products
      In this competition, students from each team will introduce to the class about a product created and made by the group (green tea cake, scented tea bag, logo design, tea packaging, ...).
    • Part 2: Advertising
      Students from groups presented a plan to promote the tea brands in Vietnam. Students can use many formats of presentation such as: acting, fashion show...).
- Activity 4's conclusion:
  + Help students have many opportunities to create products that help preserve and promote the image of tea trees, the beauty of tea culture of Vietnam.
  + Raise awareness for students about promoting the image of tea tree and Vietnamese tea culture with friends in the region and around the world.

Activity 5: Exhibition activities to introduce innovative tea products. Summarizing and evaluating student activities
- Objectives: Students summarize their knowledge of tea production. Location of tea tree and Vietnamese tea culture in the region and in the world.
- Implementing: Presentation and discussion
  + The group representative presents the results, other members listen and ask discussion questions.
  + Teacher guides students to discuss with questions:
    • What is the impact of the work in the tea villages on people's lives?
• The role of tea tree in the health and spiritual life of the people.
• The issue of raising awareness and a sense of cooperation to protect Vietnamese tea cultural heritage, and to spread the culture with international friends.
- Activity conclusion 5: Teachers assess student learning outcomes with specific products.

**Activity 6.**
- Component activity 6.1. (Common to the whole class). Acquainted with spreading problem (type 1 and type 2) [26].
- Component activity 6.1. Exploring the box manufacturing process containing products and goods

Students: Search for documents (images on the internet), find boxes of some small products as examples, review, research, etc. to answer the following questions:
- Question 1. Identify the procedure to make paper box for product packaging.
- Question 2. What are some criteria of designing and printing paper boxes?
- Question 3. Take an example of some paper boxes, how to cut them, and also about the design criteria, print the paper boxes that they have presented above.

The results are as follows: The groups of students learn, generally give some basic, correct and satisfactory answers with the following content.

Answer questions 1. Box making process is: Request - Design - Print.
Answer questions 2. Beautiful, unique style, suitable for products, own brands, containing information about the product and about the manufacturer, often have the company's slogan, thrifty.
Answer questions 3. Some of the pictures students get are as follows:

| a) | b) |
|----|----|
| ![Fig. 3](image1.jpg) | ![Fig. 3](image2.jpg) |

Fig. 3. Some of spread pictures (drew by students group)

From the above results, it can be seen that students have many imaginative ways and therefore are different results. After students open some types of paper boxes, students did a better job of adjusting their own shapes (most of them were folded parts, not just box-shaped ones like the ones in the theory section).

In fact, students are not familiar with this type of activity, they mainly learn through the internet but do not actively approach the production facilities (because the production facilities that students experience are not packaged by paper box which packed by vacuum bag). Students have not considered saving the paperboard so that it is economical as well as cutting to make sure that the boxes can be folded securely (fig. 4, a). After the teacher suggests, instructing students to learn some ways to cut paper boxes (on the internet), students can spread the picture as well as in fig. 4. b).

### 3.4 Evaluation of activities, organization of experience drawing

a. Comments of students and teachers about the attitude of work results of the groups. Review knowledge after groups have presented. Teacher summarizes the target learning content.

b. Homework: Students answer questions and write a field trip report.
4. Conclusion

It is possible to develop the problem-solving capacity of students through STEM activities. Not only does it complete the aim of teaching, but it also makes the opportunities for students to self-study, self-research, develop problem-solving capacity. Problem-solving capacity of students in experimental class after impacts are always better than before impacts which are shown clearly by the observing form of teachers.

The exploitation and application of the strengths of STEM education are extremely beneficial and necessary for general education in Vietnam. STEM education creates people who can meet the needs of the 21st century, responding to the nation's economic and social development and can positively impact the changing economy's knowledge in the context of globalization.

Teaching in STEM education orientation provides the needs of innovating teaching methods in high schools. STEM education guidelines should be developed in schools, and testing, evaluation, and testing activities should be consistent with STEM's basic ideas.

However, this research needs to be performed on a wider audience, for a longer time to make conclusions will be more feasible. This study still points to the various limitations of the practical application of mathematics as mentioned in [27].

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