Asia Research Network Journal of Education
Vol. 3, No. 1, pp. 1-6, Jan. – Apr. 2023

A Multisensory STEM Learning Activity on the Prevention and Control of Dengue Fever

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Received: 13 Oct 2021 Revised: 1 Apr 2023 Accepted: 19 Apr 2023

Abstract: The purpose of this paper is to clarify the learning activities provided by Sutaphan and Yuenyong's (2019) context-based STEM education learning approach. This method is divided into seven stages: (1) identification of social issues, (2) identification of potential solutions, (3) need for knowledge, (4) decision-making, (5) development of a prototype or product, (6) testing and evaluation of the solution, and (7) socialization and completion decision stage. The Dengue Alert: Prevention and Control through Innovative Devices Using a STEM Education Approach will allow students to combine their knowledge of Biology, Physics, and Economics to create an electronic mosquito repellent that will help to reduce dengue cases in the local community. The paper will go over how to give students the opportunity to apply STEM knowledge through the activities provided.

Keywords: STEM education, STEM Learning, multisensory, dengue fever

1. Introduction

Dengue fever is a mosquito-borne viral disease that has spread rapidly in all WHO regions in recent years. Female mosquitoes, primarily Aedes aegypti and, to a lesser extent, Aedes albopictus, transmit the dengue virus. This mosquito also spreads chikungunya, yellow fever, and the Zika virus. Dengue fever is found throughout the tropics, with local variations in risk caused by factors such as rainfall, temperature, and unplanned rapid urbanization (Andreata-Santos et.al., 2020).

Dengue fever is a mosquito-borne viral disease that causes an estimated 230 million infections worldwide each year, 25,000 of which are fatal. Global incidence has risen rapidly in recent decades, with approximately 3.6 billion people, or more than half of the world's population, now at risk, primarily in tropics and subtropics urban centers. Demographic and societal changes, particularly urbanization, globalization, and increased international travel, have all contributed significantly to the increase in the incidence and geographic spread of dengue infections (Wilder-Smith et al., 2012). The dramatic global spread and increased frequency and magnitude of epidemic DF/DHF in the last 40 years highlight the critical need for more effective disease surveillance, prevention, and control (Tissera et al., 2016).

Dengue fever was found in almost every barangay in Iligan City, Lanao Del Norte, Philippines. As a result, Iligan City declared a disaster zone on August 21, 2019. The local government declared it after the Department of Health declared an actual dengue outbreak due to the continuous rise of a case fatality rate of 1.15 percent, which is higher than the DOH-10 average of 0.4 percent (Ortega et al., 2020).

2. Developing STEM Education Learning Activities

A Multisensory STEM Learning Activity for Dengue Fever Prevention and Control will provide a platform for students to apply their knowledge of Biology, Physics, and Economics to create an Electronic Mosquito Repellent. The biology concept will include Aedes mosquitoes, a mosquito species that transmits dengue. Physics concepts include ultrasonic devices that repel mosquitos using high-frequency sounds and electrical circuits, while Economics concepts focus on the device's profitability and marketing via commercial advertisement. Further, this STEM learning activity will address an issue on dengue that need potential solution using improvised devices. The use of improvised materials has greatly aided the teacher in making science concepts more understandable to students. This relates to the use of alternative materials to create a device to aid learning whenever standard materials and teaching aids are unavailable (Erediano, et al., 2021).

Sutaphan and Yuenyong (2019) defined the context-based STEM education learning approach as (1) identifying social issues, (2) identifying potential solutions, (3) need for knowledge, (4) decision-making, (5) development of a prototype or product, (6) testing and evaluating the solution, and (7) socialization and completion decision stage. Literatures (Villaruz et.al., 2019; Adita and Yuenyong, 2021; Fachrunnisa et.al., 2021; Koes-H et.al., 2021; Setiawan et.al., Tinh et.al., 2021) suggested some practical ideas for developing STEM education learning activities in order to engage students to develop prototypes for the real-world problem solving. This paper, then, developed the lesson plan for the STEM Learning Activity on Dengue Alert that was highlighted in the table 1.

Table 1: STEM Lesson Plan on Multisensory STEM Learning Activity on the Prevention and Control of Dengue Fever (Sutaphan & Yuenyong, 2020)

STAGE	ACTIVITY
1. Identification of social issues	1. SOCIAL ISSUES: Dengue fever cases are on the rise in the majority of the city's barangays. The school, as an integral part of the community, has a social responsibility to aid in the prevention and control of dengue in the community. 2. School Concern: Bring the issue to the students' attention by asking them, "How can you help the community in the prevention and control of dengue?" Electronic Mosquito Repellent is the third product. Because the students specialize in Electrical Installation and Maintenance, they will create a mosquito repellent device out of readily available materials.

Table 1 (Cont')

STAGE	ACTIVITY
2. Identification of potential solution	1. Students and teachers collaborate on the cost analysis for their Electronic Mosquito Repellent Device design. 2. Students may discuss their potential design while taking into account various capital: physical, financial, social/technology, and human capital. Physical appearance – How does the mosquito repellent device appear? Is it simple to use? Financial – Are the materials to be used inexpensive and widely available? Social/Technology – What technology was used in the development of the electronic mosquito repellent device? Human – How safe is the device for the people who use it?
3. Need for knowledge	1. The students will participate in a WebQuest Activity. In this inquiry-based activity, students will focus on gathering the information needed to create their Electronic Mosquito Repellent. Students will be divided into three groups, each focusing on the information they will gather. 2. Students take on various roles such as biologist, physicist, and economist to gather relevant information in order to create a good product or output. This group will study the characteristics of Aedes mosquito species. At the end of the WebQuest Activity, they are expected to create an illustration of the Aedes mosquito's life cycle and explain each stage. Physicists- This group of students will gather information on the concept of ultrasonic devices that use high-frequency sounds to repel mosquitos. The group's output is a collection of various ultrasonic sensors, including their functions and applications. Economists – This group will focus on the cost analysis of the device they intend to build, taking into account the various materials used and their profitability when sold to members of the community. Mathematicians- This group will work on unit conversion and measurement units, particularly when working with ultrasonic devices. When working with ultrasonic devices, the group will create a list of sizes and their conversions.

Table 1 (Cont')

STAGE	ACTIVITY
4. Decision-making	1. Each group of students will present their ideas for their final product. 2. The other groups will ask questions, make suggestions, and make comments in order to improve and enhance the ideas presented by each group. 3. Before beginning to develop their device, each group will be asked to finalize their Electronic Mosquito Repellent design, taking into account the suggestions provided.
5. Development of prototype or product	Students design an electronic mosquito repellent prototype. During the activity, students will photograph and videotape each step of the experiment, as well as write down key observations. During the activity, the students will be guided by the following questions: 1. What factors did you consider when designing your electronic mosquito repellent? 2. What influenced your decision to use the materials you did? 3. What factors did you consider when selecting the materials and designing the electronic mosquito repellent? 4. What are the benefits of your device over competing designs? 5. Which step of your experiment do you find the most difficult to carry out? What steps did you take to overcome such adversity? 6. Can you tell me the story behind the name of your electronic mosquito repellent device? 7. Did you have fun with the activity? If so, why or why not? 8. What values have you gained as a result of the activity?
6. Test and Evaluation of the solution	The students will conduct an experiment to determine the number of mosquitoes caught in one day in order to test the device's effectiveness. Every two hours, the number of mosquitos caught will be counted and displayed on a graph. A Classroom-Based INNOVATOR'S DAY will be held to highlight the various groups of students' outputs. Each team will demonstrate their Electronic Mosquito Repellent. An expert in Electrical Installation and Maintenance, as well as Physics, will be invited to witness the Innovator's Day. A rubric will be used to evaluate the group's output. During the activity, there will be an open forum where students and experts can ask questions and make suggestions to improve the design of their devices. Finally, the teacher may inquire, "What other devices/products can you think of to address the current dengue issue in our community?"

Table 1 (Cont')

STAGE	ACTIVITY
7. Socialization and completion decision stage	Each group will present a product through a "Product Ad" (similar to a TV ad). In their commercial, they will demonstrate how their device works, the benefits of using it, and how cost-effective it is. This enables each group to promote the products of their imagination and creativity that can help solve or at least mitigate a problem in their community.

The table depicts the STEM lesson plan, which includes all of the learning activities at various stages, beginning with the identification of the social issue, in which students determine the problem in their community that needs to be addressed, in this case, the issue of dengue. This is followed by the identification of a potential solution, in which students collaborate to design an Electronic Mosquito Repellent. At this stage, the students collaborate to determine the most effective Electronic Mosquito Repellent for preventing and controlling dengue transmission. In the third stage, a WebQuest activity on the need for knowledge will be performed, in which STEM concepts will be used to provide possible solutions to the problem. During the decision-making stage, students will present their ideas for improvement in response to suggestions from other students. Once the images are completed, a prototype of their Electronic Mosquito Repellent design will be presented and tested to see if it provides a possible solution to Dengue cases, that is, if the device is effective in catching dengue-carrying mosquitoes.

3. Conclusion

This paper shared ideas for developing STEM learning activities on Multisensory STEM Learning Activity for Dengue Fever Prevention and Control. The STEM Learning activity allows students to participate in the community as part of their social responsibility by being aware of the current problem and how they can help to lessen or prevent it. Furthermore, this STEM-based teaching approach would broaden students' knowledge to include not only one area of study but also an interdisciplinary approach to solving a societal problem. This learning activity encourages student collaboration, where teamwork and cooperation play an important role in developing 21st-century skills among 21st-century learners.

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