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Evaluation Of Biology Teachers' Knowledge in Sidoarjo Regarding the Concept of Poliovirus and Wolbachia Infected Mosquitoes

Hebert Adrianto *
Medicine, Universitas Ciputra, Surabaya, 60219, Indonesia
hebert.rubay@ciputra.ac.id
**Corresponding author*

Ian Ardhiya Firmanto
Medicine, Universitas Ciputra, Surabaya, 60219, Indonesia
iardhiya@student.ciputra.ac.id

Mellyanawati
Medicine, Universitas Ciputra, Surabaya, 60219, Indonesia
mellyanawati@ciputra.ac.id

Bracovanca Diwayestara Bravimasta
Medicine, Universitas Ciputra, Surabaya, 60219, Indonesia
bdiwayestara@student.ciputra.ac.id

Olivia Tantana
Medicine, Universitas Ciputra, Surabaya, 60219, Indonesia
olivia.tantana@ciputra.ac.id

Ritunga
Medicine, Universitas Ciputra, Surabaya, 60219, Indonesia
imelda.ritunga@ciputra.ac.id

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***Abstract*—** Biology is a dynamic and constantly developing science. The Ministry of Health of the Republic of Indonesia reported nine cases of childhood polio in East Java in January 2024. In addition, the Ministry of Health launched a pilot project to implement *Wolbachia*-infected mosquitoes as an innovation to control dengue fever in five big cities in Indonesia. This health problem is studied in biology lessons on viruses in senior high school. This paper aims to analyze the knowledge of the concepts of polioviruses and *Wolbachia*-infected mosquitoes in the biology teacher community in Sidoarjo. The respondents were 43 biology teachers in Sidoarjo. Respondents' prior knowledge was measured by pretest. After the respondent takes the pretest, the respondent gets the concept of the virus. After the material, respondents do a post-test. 11 pretest questions and 11 post-test questions are packaged in Google form. The results showed that all participants participated in the activity from start to finish, taking the pretest, listening to the material, and doing the post-test. The pretest mean score was 40.18, and the post-test mean score was 91.36. The highest pretest score was 81.81. The highest pretest score was 100. A total of 15 teachers (34.88%) were unsure that *Wolbachia*-infected mosquito was the best solution to reduce disease. Twenty-one respondents (48.83%) agreed mainly with society's concern that the *Wolbachia*-infected mosquito is dangerous for humans. Respondents' knowledge increased after receiving the concept of the virus.

***Keywords*—**Poliovirus, *Wolbachia*-Infected Mosquito, Biology Teacher, Sidoarjo, Knowledge

I. Introduction

Biology is a science that specifically studies living things and the environment. Biology is always dynamic and always develops following developments in science and technology. Biology learning in schools also experiences paradigm changes to accommodate the demands of the times (Hakim, 2023). The teacher is one of the main actors involved in the learning process. Teachers have the task of transferring knowledge and shaping behavior (Agustina et al., 2022). Teachers are also figures in providing health education to students for healthy living (Lamanauskas & Augiene, 2020). Therefore, teachers need to follow the latest information in their field. Teachers who can keep up with current developments will be able to deliver material and answer students' questions regarding topics currently being discussed.

There are two important topics in the health sector in 2024. These two topics are also studied in biology subjects, namely viruses. Viruses and their role are essential materials taught in class. Viruses are difficult for students to understand because they have an abstract concept and cannot be observed directly by the human sense of sight. The Health Ministry announced an extraordinary polio incident in response to cases of polio in East and Central Java (M. Sari et al., 2024). In addition, the Ministry of Health launched a pilot project to Implement *Wolbachia*-infected mosquito as a Dengue Management Innovation in five large cities (Ina, 2023).

Poliomyelitis is an infectious disease caused by the poliovirus, which must spread globally because it causes paralysis, muscle atrophy, and even irreversible paralysis and death in children (Rasyidi et al., 2021). The Ministry of Health of the Republic of Indonesia reported 11 cases of child polio in East Java in January 2024, so

vaccination is being accelerated to prevent this disease from spreading widely (Devi, 2024). Immunization is a very effective and safe public health measure to prevent poliovirus infection. The worldwide burden of vaccine-preventable diseases is significant. Two vaccines are used globally to combat poliomyelitis. Jonas Salk produced and tested the first vaccine in 1952. The vaccine consists of an injectable dose of inactivated poliovirus. Sabin's vaccine is oral vaccination, which was tested in 1957 (Nanbur et al., 2019). Previous research found a significant relationship between maternal knowledge about poliomyelitis and acceptance of the polio vaccine, meaning that maternal acceptance of the polio vaccine was influenced by the mother's knowledge about the polio vaccine (Nanbur et al., 2019). Misperceptions about the polio vaccine can lead to rejection of the polio vaccine and routine immunization (Habib et al., 2023). It shows the importance of the knowledge that a person has, especially mothers and prospective mothers, when they have children

Aedes aegypti mosquitos significantly impact human health and the economy worldwide (Anders et al., 2020). Dengue Hemorrhagic Fever (DHF) is a vector disease by *Aedes aegypti* that is endemic in Indonesia throughout the year. (Darmawan et al., 2023). The cause of this disease is the dengue virus, which has four serotypes: DEN-1, DEN-2, DEN-3, and DEN-4. (Badoni et al., 2023). Various efforts have been made to reduce morbidity and mortality rates. Vaccines and drugs for dengue fever are still not available on the market. The national Breeding Site Eradication (Pemberantasan Sarang Nyamuk/ PSN) is the most popular government dengue vector management program in Indonesia. It focuses on "3M plus" actions of covering, draining, and burying discarded water containers. Improving water supplies, biological control of mosquitos using natural enemies like larvivorous fish, use of insecticides (spraying or fogging, and control of larval), and health education and community empowerment are additional programs. Even though efforts to prevent mosquitoes continue to be made, there is still a relatively high level of dengue fever cases. A novel approach to controlling DHF in Indonesia involves introducing Wolbachia-infected mosquitoes (Buchori et al., 2022). For field deployment, the strategy involves seeding wild *Ae. aegypti* populations with *Wolbachia* through fortnightly releases of relatively small numbers of *Wolbachia*-infected mosquitoes over a period of 2-3 months. Over the succeeding 3-6 months, and through the actions of cytoplasmic incompatibility, the prevalence of *Wolbachia* in the local mosquito population grows, until nearly all mosquitos in the area contain *Wolbachia* (Anders et al., 2020). The application of *Wolbachia* technology to the *Aedes aegypti* mosquito to control the vector has proven effective in preventing dengue in Yogyakarta (Saraswati et al., 2023; Tantowijoyo et al., 2020). However, there are still concerns from the public and stakeholders regarding the application of this technology, especially since the Ministry of Health launched the *Wolbachia*-infected mosquito Implementation Pilot Project as a Dengue Management Innovation in five big cities.

Agents that cause infectious diseases often develop, and agents even develop, drug-resistant capabilities. Some diseases appear and have never been known before, there are also diseases that have existed before and then appear again and cause problems somewhere. The development of disease and health certainly causes the development of information, so teachers are required to constantly follow developments in science, in biology, especially in disease. For eight years, we collaborated with the biology teacher community in Sidoarjo (MGMP Biology Sidoarjo) to reinforce medical biology concepts. The results of the discussion meeting with administrators found that the teacher community needed to strengthen the idea of the poliovirus and the *Wolbachia*-infected mosquito, a hot discussion topic in Indonesia.

This paper aims to analyze the knowledge of the concepts of polioviruses and *Wolbachia*-infected mosquito in the Sidoarjo biology teacher community.

II. METHODS

The activity stages generally consist of three stages, namely the preparation stage, implementation stage, and data analysis stage. The preparation stage includes coordinating with management to determine the time and location of the activity. The coordination results decided that the activity would be held on Wednesday, February 7, 2024, at SMA N 1 Taman at 10.00-13.00 WIB. The activity was attended by 43 biology teachers who joined the biology teacher community in Sidoarjo. The implementation phase began with an opening by the principal of SMAN 1 Taman, an opening by the head of the biology teacher community in Sidoarjo, photo documentation, pretest implementation, material delivery, discussion and question and answer, and posttest implementation. The data analysis stage includes pulling the Google Form Excel file, grouping the data, and calculating the data.

The method used to train participants in strengthening concepts. Activities are carried out offline at SMAN 1 Taman. The biology concepts are divided into poliovirus and the *Wolbachia*-infected mosquito.

The properties prepared during training and data collection were biology books used by schools, teaching materials in PPT, laptops, projectors, pointers, cameras, 11 pretest questions, and 11 posttest questions packaged in Google form.

All participants took a pretest before giving the material and a posttest after the material in the Google Form application within 11 minutes. There are 11 questions that participants must answer. One question is done in 1 minute. Data on questions answered most correctly and incorrectly, the highest score, the lowest score, and the average MGMP Biology score were processed and analyzed descriptively.

III. Results and Discussion

Activities have been carried out very well and smoothly. All participants participated in the activity from start to finish, taking the pretest, listening to the material, and doing the post-test. The number of participants who attended was 43 people, spread across state and private schools. Participants received material and clarification regarding erroneous opinions circulating in society, such as whether humans need vaccination because vaccination causes side effects and the *Wolbachia*-infected mosquito, which can cause harm and disease to humans.

The principal of SMAN 1 Taman and the head of the Sidoarjo biology teacher community opened the activity before it started. The documentation of these activities will be presented in Figure1 dan Figure 2.

Figure 1. Opening by the school principal

Figure 2. Photo with participants

Two topics were presented at the meeting: poliovirus and the *Wolbachia*-infected mosquito. Poliovirus material is provided because case reports will occur in 2024. The theoretical concepts discussed are history, etiology, virus ultrastructure, mode of transmission, pathogenesis, clinical manifestations, risk groups, prevention, immunization, mandatory vaccination types, preferred immunization, and appropriate immunization schedule. They are determined by IDAI in 2023. The second material is the *Wolbachia*-infected mosquito. The theoretical concepts discussed are *Wolbachia* bacteria, *Aedes aegypti* mosquitoes, *Wolbachia*-infected mosquito, technological developments, application in society based on research results in the field, and the safety side of *Wolbachia*-infected mosquito. The documentation of these activities will be presented in Figure3.

Figure 3. Delivery of concept of the virus in forum

Respondents' prior knowledge was measured by pretest. After the respondent takes the pretest, the respondent gets the material. After the material, respondents do a posttest. The results showed that the average pretest score was 40.18, and the average posttest score was 91.36. The highest pretest score was 81.81. The highest pretest score was 100. Respondents' knowledge increased after receiving the material. Distribution of test scores of respondents is shown in Figure 4.

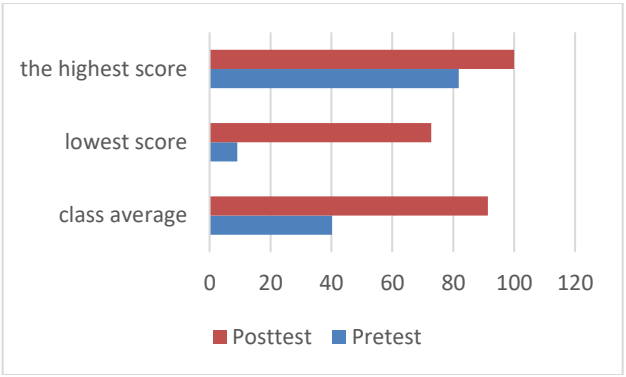

Figure 4. Distribution of test scores

Table 1 shows the distribution of respondents' knowledge based on false answers and correct answers for each pre-test question. Polioviruses and *Wolbachia*-infected mosquito are not viruses that are studied for a long time every year, so it is challenging for teachers to keep up with developments in this field.

Table 1. Distribution of the number of correct and incorrect answers on the pretest

Question number	Pre-test	
	Correct (%)	Incorrect (%)

Question number	Pre-test	
	Correct (%)	Incorrect (%)
1	9 (20.9)	34 (79.1)
2	24 (55.8)	19 (44.2)
3	11 (25.6)	32 (74.4)
4	7 (16.3)	36 (83.7)
5	11 (25.6)	32 (74.4)
6	10 (23.3)	33 (76.7)
7	43 (100)	0 (0)
8	7 (16.3)	36 (83.7)
9	22 (51.2)	21 (48.8)
10	25 (58.1)	18 (41.9)
11	21 (48.8)	22 (51.2)

Table 2 shows the distribution of respondents' knowledge based on wrong answers and correct answers for each post-test question after respondents received material from the lecturer.

Table 2. Distribution of the number of correct and incorrect answers on the posttest

Question number	Post-test	
	Correct (%)	incorrect (%)
1	33 (76.7)	10 (23.3)
2	43 (100)	0 (0)
3	42 (97.7)	1 (2.3)
4	31 (72.1)	12 (27.9)
5	41 (95.3)	2 (4.7)
6	32 (74.4)	11 (25.6)
7	43 (100)	0 (0)
8	43 (100)	0 (0)
9	43 (100)	0 (0)
10	41 (95.3)	2 (4.7)
11	40 (93)	3 (7)

The first question asked: The polio cases widely reported in Indonesia are caused by type/strain two viruses. What is another name for the type 2 poliovirus? More than 50% of participants (79.1%) answered the pretest question incorrectly. For the posttest, the number of participants who responded incorrectly decreased to 23.3%. The Oral Polio Vaccine, containing Type 1, Type 2 and Type 3 strains (Brunhilde, Lansing and Leon) (Chauhan et al., 2023).

Errors in answering are still found because teachers need time to learn quickly and remember the material given. The pretest, material delivery, and posttest are done in one day. Previous findings reported that participants who were weak at memorizing needed sufficient time to understand the material provided by the doctor resource person at that time; they heard several new terms. The teacher's memory was limited, so it was not optimal when answering questions, and participants worked quickly. Haste and lack of concentration cause test scores to be low (Tantana et al., 2024).

The second question asks, "How does the poliovirus first enter the human body?" Before participants were given the material, 24 participants (55.8%) were able to answer correctly. After participants were given the material, all participants could answer this question correctly. The poliovirus can be transmitted between humans through the mouth via the oral-fecal route. This pathway makes the poliovirus fall into the enterovirus group (Chen et al., 2021).

The third question, "When was Indonesia last declared polio-free by the World Health Organization (WHO)?" was also answered most often incorrectly (74.4). For the post-test, only one participant answered incorrectly (2.3%). Indonesia has been proclaimed polio-free since March 27th, 2014, and is anticipating the poliovirus type 2 mutation (Heriyanto et al., 2018). This question gives the impression of being a theory, but it conveys the meaning of caution that being free does not mean being free forever. A vaccination program that is not strong will result in the emergence of disease.

The fourth question asks, "What is the shape of the capsid of the poliovirus?" A total of 36 participants answered this question incorrectly (83.7%). This question relates to the structure of viruses. Viruses have various structures. The poliovirus capsid has a symmetrical icosahedral structure. The poliovirus capsid comprises 60 copy units, each containing three coat proteins, namely VP0, VP1, and VP3. After receiving the material, 31 participants (72.1) were able to answer correctly (Li et al., 2023).

The fifth question asked, "At what age do people first get polio immunization?" A total of 11 people (25.6%) answered correctly, and the remaining 32 (74.4%) answered incorrectly. Humans receive polio immunization from the age of 0 months. This age is recommended by IDAI 2023. namely zero oral polio (OPV) is given when going home from the hospital/clinic (Sitaresmi et al., 2023)

The sixth question asks, "Which is NOT the first symptom of polio?". Only ten people (23.3%) answered correctly, while most responded incorrectly (76.7%). Early symptoms of polio include sore throat, fever, weakness, and headache (Pereira et al., 2023). Sudden limb weakness will indeed occur in sufferers but does not occur at the start of the infection.

All participants were able to answer number 7 correctly. The form of question number 7 was "What are the defects caused by the poliovirus?". The correct answer is withered and paralyzed legs, known as acute flaccid paralysis (AFP). AFP is a sudden flaccid paralysis that affects children under the age of 15. AFP is acute since the paralysis occurs quickly, from 1-14 days of the onset of symptoms such as tingling, pain, and numbness to maximum paralysis (Armyta, 2019). To accomplish polio eradication, the WHO recommends monitoring cases of AFP and polio, as well as poliovirus circulation (Simeonova et al., 2024).

The eighth question asks, "what specimens are taken to detect polio-positive/negative patients?". Thirty-six people (83.7) answered this question incorrectly. The correct answer is feces. As a highly infectious disease, the poliovirus is spread through contact with contaminated feces entering the oral route (Tesfaye et al., 2020). One of the four Global Polio Eradication initiatives is AFP surveillance, which includes laboratory evaluation of stool specimens (Tegegne et al., 2022)

The ninth question asked, "What mosquito species is currently trending for *Wolbachia*-infected mosquito?". Wolbachia-infected *Aedes aegypti* has been praised as a promising new technique for solving dengue fever disease (Buchori et al., 2022). Wolbachia-infected *Aedes aegypti* mosquitos decreases population size due to early embryonic arrest (known as cytoplasmic incompatibility [CI]) and suppresses dengue viral transmission through the pathogen blocking action provided by *Wolbachia* (Mains et al., 2019). After receiving the material, all participants were able to answer the posttest questions correctly (100%).

The tenth question asks, "Where do *Wolbachia*-infected mosquito' nest and lay eggs?". Most subjects were able to answer this pretest question correctly (58.1%), and the rest responded incorrectly (41.9%). After receiving the material, only two people answered incorrectly (4.7%). The correct answer is the Bathtub in the house. Previous studies reported that the type of container in the house was positive for *Aedes aegypti* larvae are bathtubs (20%), buckets (20%), water reservoirs (15%), toilet bowls (10%), drums (10%) and used tires (5%) (Riyanti & Munar, 2021). *Aedes aegypti* was mostly present indoor houses (Lopez-Solis et al., 2023). *Anopheles* has water habitats in direct contact with flowing land, such as public bathing places, wells, and tin mining pits (S. Sari et al., 2022). *Mansonia* mosquitoes are found in open forests and swampy forest areas with stagnant water or in open swamps where many aquatic plants grow. Larvae attach themselves to aquatic plants, from whose auriferous aerenchyma they get the oxygen necessary for breathing, especially the root tissue of floating plants (Eichhornia, Pistia, Salvinia, Typha, and grasses) (Soares Gil et al., 2021). *Culex* mosquitos breed in organically polluted habitats such as sewer systems, wet pit latrines, cesspits, drains, canals, and ponds (Liu et al., 2019).

The eleventh question asks, "What diseases will be controlled with *Wolbachia*-infected mosquito technology?". As many as 51.2% answered incorrectly the name of the disease they wanted to control with the *Wolbachia*-infected mosquito. For the post-test, the number of participants who answered incorrectly was reduced to 7%. The *Wolbachia*-infected mosquito tested was the *Aedes aegypti* species. These mosquitoes play an important role as primary vectors for dengue hemorrhagic fever (Kularatne & Dalugama, 2022).

We also sought opinions from teachers on the topic of the *Wolbachia*-infected mosquito. Two questions are asked: Currently, the Ministry of Health is implementing the *Wolbachia*-infected mosquito release project in five regions, namely Semarang, West Jakarta, Bandung, Kupang, and Bontang. Do you believe that *Wolbachia*-infected mosquito is the best solution to reduce disease? Explain your argument. Second question: There are societal issues and concerns about the *Wolbachia*-infected mosquito being dangerous for humans. Do you agree? Explain your argument.

A total of 15 teachers (34.88%) were unsure that *Wolbachia*-infected mosquito was the best solution to reduce disease. Distribution of Respondents' confidence in Wolbachia-infected mosquitoes as the best solution is shown in Figure 5.

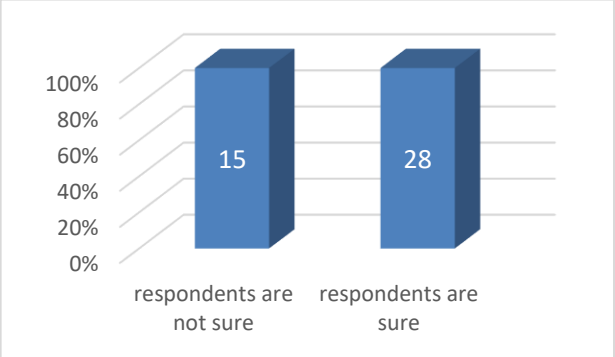

Figure 5. Distribution of respondents' confidence in *Wolbachia*-infected mosquitoes as the best solution

Some of the arguments given by respondents who do not believe that *Wolbachia*-infected mosquito is the best solution are as follows.

> *I don't believe it yet because there must be proof (respondent 1)*
>
> *It does not guarantee a reduction in disease because it could bring about other diseases (respondent 2)*
>
> *Not sure because it is estimated that there will be other diseases caused by different mosquito species (respondent 3)*
>
> *Because we cannot differentiate Wolbachia-infected mosquito from other mosquitoes, all mosquitoes can be killed by being sprayed with mosquito repellent (respondent 4)*
>
> *Wolbachia is not necessarily effective in controlling dengue fever because the increasing population of mosquitoes released into nature will add new problems in controlling the population (respondent 5).*
>
> *No, because it cannot be predicted that when in the wild, the mosquito will remain normal or experience mutations that will cause effects in the future (respondent 6).*

Respondents believe that the *Wolbachia*-infected mosquito is a solution to reducing dengue fever because it has passed laboratory and field research tests. Some arguments from respondents who say that the *Wolbachia*-infected mosquito is the best solution are as follows.

> *I believe it because experts have researched and tested this disease (respondent 1).*
>
> *I believe this because Wolbachia is a bacterium that can inactivate the dengue*

virus in the body of the Aedes aegypti mosquito (respondent 2).

I believe. Before it is decided, there must have been earlier research (respondent 3).

*Yes, it may be possible because Wolbachia-*infected mosquito *can reduce the replication of the dengue virus, thereby reducing dengue fever (respondent 4).*

I believe this because previous research has been conducted (respondent 5).

Twenty-one respondents (48.83%) largely agreed with society's concern that the *Wolbachia*-infected mosquito is dangerous for humans. Distribution of teachers' concerns about *Wolbachia*-infected mosquitoes for humans is shown in Figure 6.

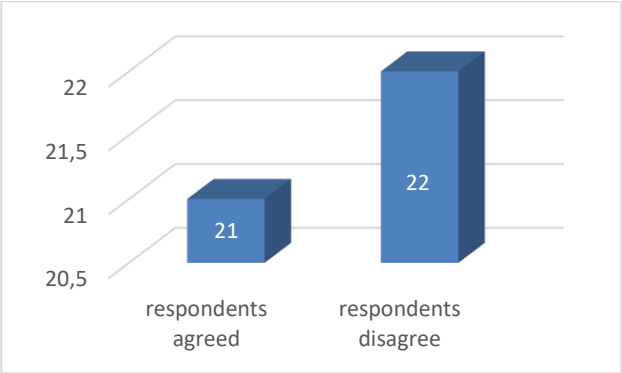

Figure 6. Distribution of teachers' concerns about *Wolbachia*-infected mosquitoes for humans

Respondents argued about the fear of *Wolbachia*-infected mosquito if they were developed in the field. Most of the incidents of mutations in mosquitoes and the new impacts that emerged were the thoughts and fears of respondents regarding the *Wolbachia*-infected mosquito.

It can become a threat or pest if the population is excessive (respondent 1).

The occurrence of mosquito mutations can lead to negative impacts and can harm humans (respondent 2).

There are other effects caused by mosquitoes (respondent 3).

These findings at least provide material for consideration by the Government to organize the information so that it is more detailed and adequate and does not cause controversy, unrest, rejection, and pressure from certain parties. Academics and educators must also follow developments in this information with a research approach.

After the activity was completed, respondents who had the highest pretest and posttest average scores received appreciation for being more enthusiastic about learning. Figure 7 shows that the end of the activity was closed with documentation with the participants.

Figure 7. Photo with participants who got the highest score.

IV. Conclusion

Respondents' knowledge increased after receiving the material. They also gained an understanding of the information so that they did not misperceive it. Respondents could apply the poliovirus and *Wolbachia*-infected mosquito material when delivering virus material in class.

Suggestions for future study are research on the effectiveness of other interventions, such as repeated workshops, online training, or providing learning media (learning modules, educational videos) to increase teacher knowledge.

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