

Educational Program on the Introduction and Use of a Microbiology Kit for Students at State Vocational High School 6, Ambon City

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ABSTRACT

Microbiology is a field of science that studies microorganisms. Microorganisms in nature play many roles in life, both beneficial and harmful. A comprehensive understanding of the basic concepts of microbiology is essential for academics, practitioners, clinicians, and the general public, including students. This educational activity aims to provide students at State Vocational High School 6 in Ambon City with an understanding of microbiological concepts, both theoretical and practical. Limited laboratory facilities and practical equipment often pose a challenge for schools, especially vocational high schools. An understanding of microbiological concepts, both in theory and practice, is expected to equip students to apply their knowledge of microorganisms and improve their skills in conducting simple observations or identifying microbes using a microbiology kit. The method used in implementing the Community Service Program (CSP) at State Vocational High School 6, Ambon City, involved outreach activities packaged as hands-on educational sessions on the Introduction to Microbiology Kits. This community service program yielded theoretical understanding and practical skills in performing microbiological work among students, as evidenced by evaluation responses after following and conducting the microbiological work program. This educational activity supports the government and Universitas Pattimura through the involvement and role of lecturers and students in the community, as well as enhances the application of scientific knowledge and skills in microbiological work to meet the needs and challenges of producing competent, reliable, and integrity-driven human resources to further support the development of Maluku.

Keyword: Microbes, Microbiology Kit, State Vocational High School 6 Ambon

ABSTRAK

Mikrobiologi merupakan bidang ilmu yang khusus mempelajari mengenai mikroorganisme. Mikroorganisme di alam memiliki banyak peran bagi kehidupan, baik yang menguntungkan maupun merugikan. Pemahaman yang komprehensif tentang konsep dasar mikrobiologi merupakan hal penting yang perlu dipahami oleh kalangan akademisi, praktisi, dan klinisi, bahkan masyarakat, dalam hal ini juga siswa-siswi. Kegiatan edukasi ini bertujuan untuk memberikan pemahaman siswa terhadap konsep mikrobiologi, baik secara teori maupun praktik pada SMK Negeri 6 Ambon. Keterbatasan fasilitas laboratorium dan peralatan praktikum sering menjadi tantangan bagi sekolah, terutama sekolah menengah kejuruan. Pemahaman tentang konsep mikrobiologi, baik secara teori maupun praktik, diharapkan dapat membekali siswa untuk dapat mengerti konsep mikroorganisme secara aplikatif dan meningkatkan keterampilannya dalam melakukan pengamatan atau identifikasi mikroba secara sederhana dengan menggunakan *microbiology kit*. Metode dalam pelaksanaan PkM di SMK Negeri 6 Ambon yaitu berupa sosialisasi yang dikemas dalam bentuk kegiatan edukasi *hands-on* tentang pengenalan *Microbiology Kit*. Kegiatan PkM ini memberikan hasil berupa pemahaman teoritis dan keterampilan praktis dalam melakukan pekerjaan mikrobiologi bagi siswa-siswi yang dibuktikan dengan hasil evaluasi setelah kegiatan ini dijalankan. Luaran yang diperoleh berupa pengetahuan dan keterampilan laboratorium dalam melakukan pekerjaan mikrobiologi. Kegiatan edukasi ini mendukung pemerintah dan Universitas Pattimura melalui keterlibatan dan peran dosen dan mahasiswa kepada masyarakat



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serta meningkatkan pemanfaatan ilmu pengetahuan dan keterampilan dalam pekerjaan mikrobiologi untuk dapat memenuhi kebutuhan dan tantangan SDM unggul yang cakap, andal, dan berintegritas untuk mendukung pembangunan Maluku lebih baik lagi ke depannya.

Keyword: Mikroba, *Microbiology Kit*, SMK Negeri 6 Ambon

1. Introduction

Microorganisms are tiny living organisms that are generally invisible to the naked eye and can only be observed using a microscope. Microorganisms play many important roles in human life across various sectors, ranging from food, agriculture, livestock and fisheries, health, and the environment. Microorganisms can provide beneficial effects but may also cause harmful impacts on humans. The science that comprehensively studies and examines microorganisms—including their characteristics, interactions, and roles—is known as microbiology. Knowledge of the microbial world and its beneficial roles remains a focus of attention for microbiologists worldwide [1]

Microbiological work must be conducted under sterile and aseptic conditions. A thorough understanding of microorganisms can be gained by studying reference materials and through hands-on practice in the laboratory. Instruction and hands-on experience in the laboratory can help students comprehensively understand microbiology, starting with the equipment (microbiology kits) and instruments used in microbiological work, and how to perform microbiological tasks correctly and safely in the laboratory. Microbiological work in the laboratory must be conducted with a focus on safety. Therefore, familiarity with and understanding of microbiology kits and microbiological work must be accompanied by knowledge and skills regarding safe laboratory practices. Risk assessment during laboratory work is also an important consideration [2].

State Vocational High School 6, Ambon City, is one of the leading vocational high schools located on Jl. Wolter Monginsidi – Lateri, Lateri Village/Subdistrict, Baguala District, Ambon City, Maluku Province. This vocational high school offers five programs of study: accounting, pharmacy, medical laboratory technology, multimedia, and health care administration. State Vocational High School 6, Ambon City, and its five departments represent the potential and strength of Maluku Province as a partner in preparing high-quality human resources who are ready to tackle challenges and provide solutions to existing problems. An understanding of microbiology concepts, microbiology kits, and their applications, along with the ability of State Vocational High School 6, Ambon City students to perform simple microbiology laboratory practices, can serve as invaluable preparation for their future careers.

Laboratory facilities at State Vocational High School 6, Ambon City, remain limited. The lack of laboratory facilities and equipment can result in students at this school lacking laboratory skills. This is certainly a critical issue that needs to be addressed and resolved, given that one of the distinguishing features between vocational high schools and general high schools lies in the skills students acquire. Vocational high schools typically have a heavier practical workload compared to general high schools. The presence of a laboratory with adequate facilities can help stimulate students to develop practical skills that cannot be acquired through lectures and reading alone [3].

Given these conditions, the staff of the Biotechnology study program conducted a Community Service Program to provide an understanding of microbiology concepts and their applications, as well as microbiology kits, improve laboratory work skills in accordance with existing SOPs, and train the analytical and critical thinking skills of students at State Vocational High School 6, Ambon City.

The role of medical laboratory professionals is essential today, requiring a range of critical qualifications, such as the ability to operate complex instruments, perform quality control, conduct highly complex tests, interpret test results and research data, address technical issues, and provide appropriate testing guidelines based on the type of sample and desired test [4]. This certainly poses a significant challenge in preparing competent and outstanding medical laboratory professionals for the future. Existing learning without hands-on practice is insufficient to equip students because they do not have enough experience to deal with and work with microbiology equipment, and work cause lack of knowledge and laboratory skills. Microbiology kits are helpful and advantageous because they consist of basic microbiology laboratory equipment that is used daily

in a laboratory. These microbiology kits are portable, affordable, and safe. It facilitates students to learn independently and is suitable for schools with limited laboratory facilities. Knowledge and experience with microbiology lab kits are crucial for students before learning more related applications/work, such as studying antimicrobial resistance (AMR) [5]. Based on the above explanations, this program aimed to improve students' knowledge and practical skills in microbiology through microbiology kit-based laboratory training.

2. Methods

This CSP was conducted on October 27–28, 2025, involving two university students, thirty-eight senior high school students, and two teachers from State Vocational High School 6, Ambon City, as partners. This activity lasts for 2 hours. A total of 20 out of 38 students, selected as representatives, will be given questionnaires to complete. There are two questionnaires: one to be completed before the activity and one after. The two questionnaires contain different sets of questions. The data obtained from the two questionnaires were then processed in a simple graphical format and analyzed descriptively. The method used in implementing the CSP at State Vocational High School 6, Ambon City, consisted of outreach activities packaged as hands-on educational sessions on the Introduction to Microbiology Kit. The training comprised three stages: preparation, implementation, and evaluation. The flow and details of the program are shown in the figure below:



Figure 1. Community Service Program Workflow

The activity began with preliminary discussions with the school and coordination with the School Principal to identify the needs of students at State Vocational High School 6, Ambon City. This phase involved the principal, teachers, and student representatives. The orientation was conducted to convey the purpose and objectives of the program and to align the perspectives between the educational activity team and the partner school. Following the orientation, training was provided for students and teachers on the following topics: microbiology and microorganisms, the role of microorganisms, microbiology kits & their components, and application of microbiology laboratory practices using microbiology kits.

In addition to the orientation, students will also immediately practice microbiology work using microbiology kits to gain a real-world understanding through the hands-on activities provided during this program. Participants will be guided through hands-on microbiology activities using a microbiology kit. This application serves as a form of technology transfer for performing microbiology tasks using the microbiology kit. A team of faculty members and students will provide mentoring and give students direct hands-on opportunities to try performing microbiology tasks using the microbiology kit. Feedback and evaluation of the activity process will be obtained through a questionnaire.

To ensure sustainability, this program will be structured as part of the handover of hands-on training modules to the school and a program of periodic hands-on mentoring on the use of the microbiology kit in microbiology work. The active participation of State Vocational High School 6, Ambon City, as a partner school is evident from the activity plan through to the implementation of the activities, as demonstrated by the partner's involvement in facilitating administrative tasks and meeting needs before and during the activities, providing facilities and space for conducting the CSP, and providing participants for the activities, including both students and teachers.

Evaluation was conducted in two forms: formative evaluation, conducted during the activity to assess alignment with the activity's objectives, and summative evaluation: conducted at the conclusion of the activity by distributing a questionnaire to measure the achievement of activity objectives, including students' theoretical

and practical understanding. Program sustainability is designed through providing training modules and collaborating with teachers at the school to ensure the program can continue.

3. Results and Discussion

The program at State Vocational High School 6, Ambon City, was conducted as an outreach program featuring an educational session on the Introduction to the Microbiology Kit and hands-on practice using it to analyze microbiology samples. The activity began with an opening session, followed by an educational session on the microbiology kit, a hands-on session using the microbiology kit, a question-and-answer session regarding the microbiology kit, and a closing session. The activity concluded successfully with strong participation from students and teachers (Figures 2–5).



Figure 2. Opening Session of the Educational Activity



Figure 3. Educational Session on the Microbiology Kit



Figure 4. Hands-on Session Using the Microbiology Kit



Figure 5. Q&A Session on the Microbiology Kit

The educational activity consisted of three parts: it began with an introduction to the educational activity team and an explanation of the objectives, followed by an introduction to the concepts of microbiology and microbes, an explanation of the role of microbes in life, an explanation of the microbiology kit (components and functions of each component), and hands-on use of the microbiology kit in processing microbiology samples. The microbiology kit components include petri dishes, test tubes, round and straight inoculation loops, a Bunsen burner, a spreader, a micropipette, a microtip, 70% alcohol, an Erlenmeyer flask, a test tube rack, a lighter, cling wrap, and aluminum foil. The components of this kit are nearly identical to those of the Crafty Micro Box, which includes inoculation loops, petri dishes, bulb pipettes, parafilm, L-shaped plastic spreader rods, conical tubes, gloves, filter paper, cotton swabs, a Bunsen burner, a ruler, a permanent marker, aluminum foil, and others [6]. An excerpt from the educational material presented during this program is shown in Figure 6.



Figure 6. Excerpt from the Educational Materials Presented

Before introducing the microbiology kit and how to use it for sample analysis, students were first guided to gain a thorough understanding of microbes, microbiology, and the beneficial and harmful roles of microbes in life. The interaction of the microbiota consortium with the host can induce health by regulating homeostasis [7] and its positive contribution to the human body. Examples of the beneficial roles of microbes include the probiotic, antimicrobial, and antioxidant properties of *Lactobacillus casei* [8], while examples of the harmful roles of microorganisms include the identification of certain microorganisms causing spoilage in fresh fruits and vegetables in households in France [9]. Microbes can also produce toxin which danger, especially to humans. Food contamination by endo and exotoxins should get special attention because it can cause adverse effects [10]. Aside from beneficial roles in food industry applications, microbes can also produce a variety of biopesticides, so they can be used to control pests [11], produce an enzyme, namely laccase, that is utilized to produce bioethanol from lignocellulosic biomass by valorization [12], produce biosurfactant for bioremediation of crude oil contaminated soil [13], and many other applications.

The training “Introduction to the Microbiology Kit” at State Vocational High School 6, Ambon City can provide benefits to students and teachers in the form of understanding or insights regarding microbiology concepts, microbes, the roles of microbes in life (both beneficial and harmful roles), the microbiology kit (components and functions of each component), as well as the application of the microbiology kit in microbiological work through hands-on sessions. In addition to enriching students’ understanding, insights, and microbiology skills, this CSP also hones students’ analytical and critical thinking abilities, thereby training and preparing them before they enter higher education or the workforce. Knowledge and skills in microbiology are required in various fields, including the health sector, for the training of healthcare workers [14]. Some key competencies that microbiologists and healthcare workers must possess include the ability to work safely in a laboratory, process and analyze data, draw conclusions from research results and data, and possess computational skills [15]

This Community Service Program received a positive response from students and teachers. Throughout the activity, students listened attentively to the material presented and actively asked and answered questions during the Q&A session. Overall, the program proceeded smoothly and successfully, concluding with a group photo session with the students and teacher representatives (Figures 7 and 8).



Figure 7. Group Photo of Teacher Representatives and the Team



Figure 8. Group Photo of Students and the Team

The CSP began and ended with the administration of the evaluation form. These evaluation forms were administered to assess the students' understanding and technical skills before and after the educational activity took place. The evaluation responses before and after this program are shown in Figures 9 and 10. Based on the data in Figure 9, it is evident that the majority of students were unfamiliar with microbiology and the equipment used in the Microbiology Laboratory. Twelve out of 20 students had never used equipment in the Microbiology Laboratory, such as microscopes, petri dishes, and inoculation loops. Interestingly, 15 out of 20 students understood the importance of hygiene and aseptic procedures when working with microbes, and 2 students even had a very strong grasp of these concepts. This indicates that the students have a theoretical understanding of microbiology. However, they have a limited understanding and lack the technical experience and skills required to work in a Microbiology Laboratory.

Based on the evaluation responses after the training (Figure 10), the following data were obtained: The majority of students agreed that the material presented was easy to understand, with 6 of them stating they strongly agreed. A total of 15 students also stated that using the microbiology kit helped them understand the basic microbiology concepts presented. This result is supported by other research that stated that over 90% students agreed that hands-on activity and the use of scientific research in microbiology teaching confer benefits to students in learning microbiology [16].

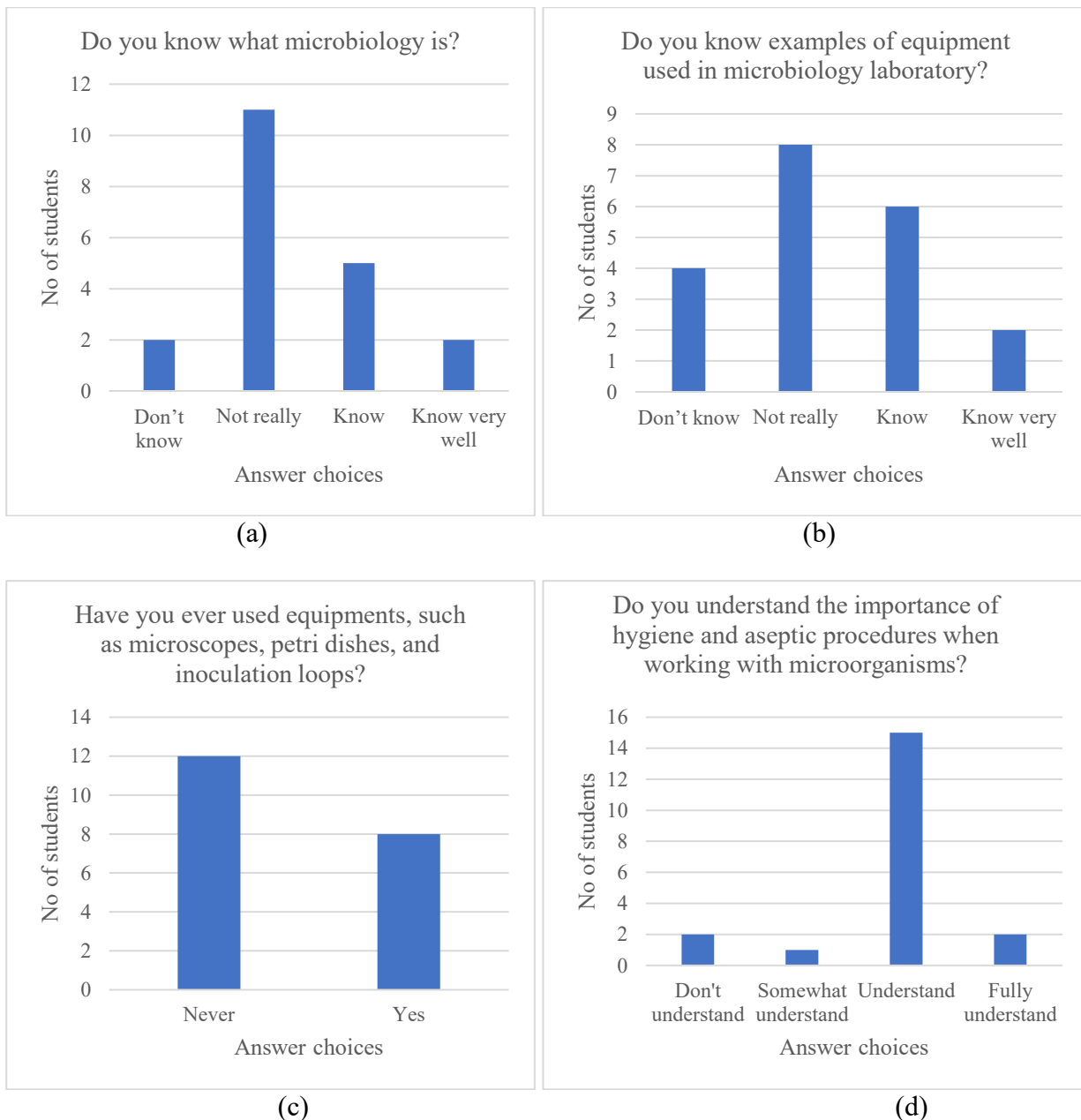


Figure 9. Evaluation responses for the program (a–d): questions asked of participants before the educational activity took place

11 students also rated the activity instructor as explaining the material clearly and engagingly. Nine students strongly agreed with the statement that the activity instructor explained the material clearly and engagingly. The practical activity using the microbiology kit enhanced their laboratory skills. The facilities and equipment used for the activity received an “agree” response from 18 students and a “strongly agree” response from 2 students. A total of 16 students felt more interested in exploring and studying microbiology concepts after this activity, and 4 students strongly agreed with this statement and stated that they learned many new things in this program. Similar to the students’ responses in our program, other researchers added that hands-on laboratory makes they gained new knowledge [17]. Ultimately, hands-on experience is pivotal, particularly for medical vocational students. Other researchers also stated that hands-on experience is visceral because it is a vital component for students to shape their fundamental knowledge and competence for creating a lifelong learning process for preparing them as laboratory professionals in the future [18].

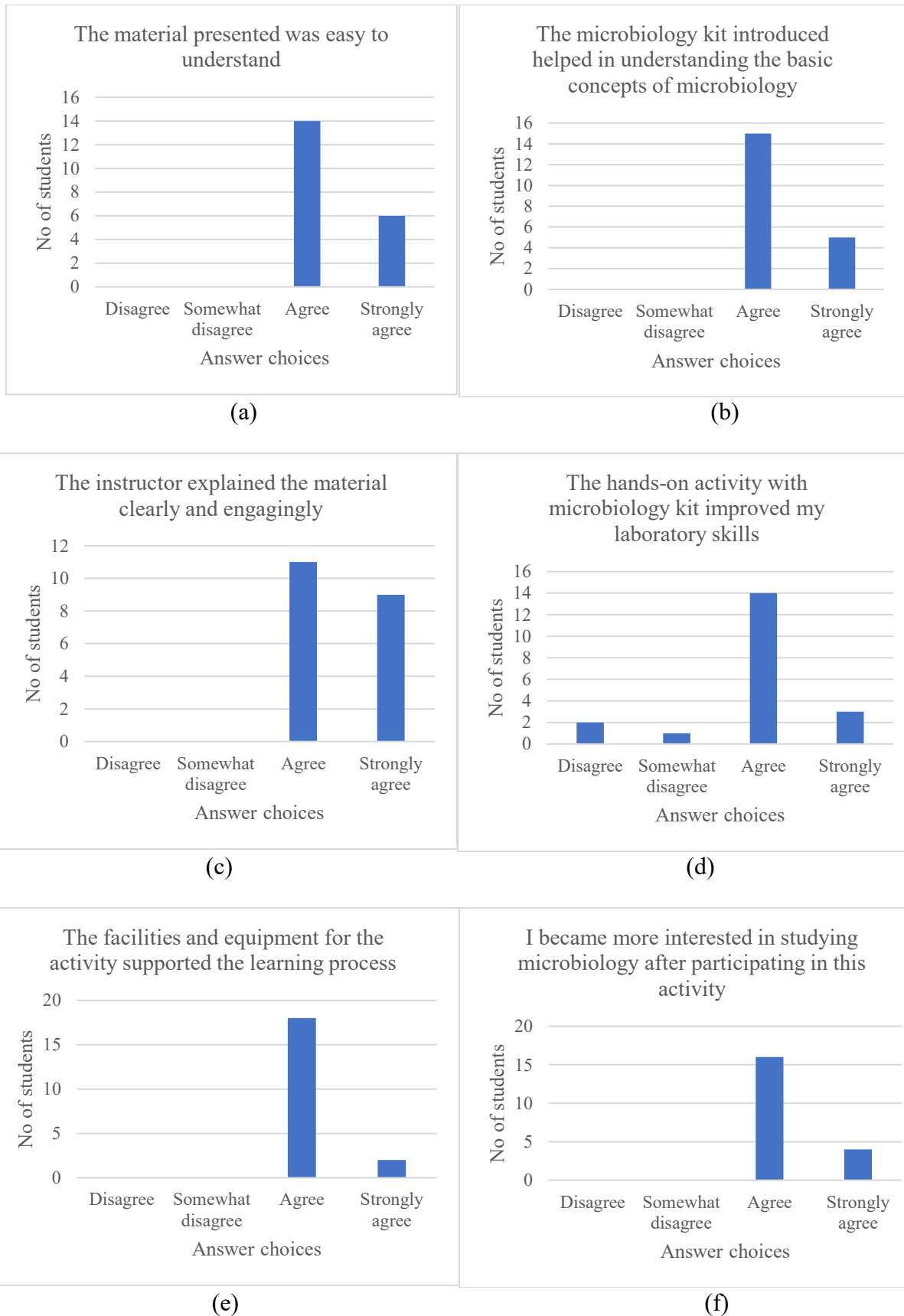


Figure 10. Evaluation responses for the training (a–f): questions asked of participants after the educational activity concluded

4. Conclusions

The CSP titled “Introduction to the Microbiology Kit” for students and teachers at State Vocational High School 6, Ambon City, proceeded smoothly and successfully, receiving a positive and enthusiastic response. This activity also successfully introduced the microbiology kit and its applications in microbiological sample testing through the hands-on sessions provided. Based on evaluation responses (before and after this educational activity program occurred), it was found that the program provided benefits in the form of insights, understanding, and microbiological skills for students to prepare their laboratory skills for school, higher education, and the future workforce. Hands-on microbiology training can help students to have a better and more comprehensive understanding of microbiology work, especially for those schools with limited laboratory facilities, so that they can support vocational competency development. Suggestions proposed for future community service activities include: providing regular guidance on the use of the microbiology kit to enhance students’ competencies and laboratory skills, as well as conducting follow-up CSP in the form of education and hands-on sessions on engaging topics related to microbiology as a continuation of this training initiative.

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