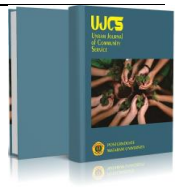
UJCS 6(2) (2025)

Unram Journal of Community Service

https://jurnalpasca.unram.ac.id/index.php/UJCS



Capacity Building for Teachers and Students in Understanding the Concept of Morphological Characters of Honey Bees from Maluku and their Cultivation Technology

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Received: April 28, 2025
Revised: May 27, 2025
Accepted: June 30, 2025
Published: June 30, 2025

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DOI: 10.29303/ujcs.v6i2.1032

Abstract: Science learning, which is often theoretical at SMP Negeri 14 Ambon, is less connected to local biological potential. As a result, teachers and students' understanding of honey bees native to Maluku, both from the morphological aspect to the cultivation technology, is still limited. This service activity aims to increase the capacity of teachers and students on the topic as contextualized science enrichment material. The methods used include counseling, training, and hands-on demonstrations on morphological characters and bee cultivation technology. The results showed a significant increase in participants' enthusiasm and understanding. Teachers obtained new relevant teaching materials, while students were able to connect biology concepts with practical applications. Thus, this pengabdin activity was carried out to integrate local content and increase the relevance of science learning.

Keywords: Teacher Capacity, Maluku Honey Bee, Science Learning, Cultivation Technology.

Introduction

Education is the main foundation in building quality and competitive human resources (Avdiu et al., 2025). In the current era of globalization, improving the quality of education is a must, especially in facing increasingly complex challenges (Johan, 2018). One important focus in science education in junior high school serves to equip students with an understanding of basic scientific concepts, process skills, and scientific attitudes (Vrahara & Jamil, 2021). However, science learning is often faced with challenges, including the limited understanding of deep concepts and the relevance of the material to the local context (Peter et al., 2025). The Ghana study provided information that Integrated science teaching and learning would be improved in rural junior secondary schools. It is recommended that Integrated science teachers be trained to improvise teaching materials using materials in the surrounding environment to teach the subject. This will help students to conceptualize scientific concepts as they interact with the materials (Quansah et al., 2019).

One of the less explored topics is Honey Bees. Moreover, Maluku is one of the best biodiversity in Indonesia that is still sustainable. Therefore this material is suitable to be applied to students. Honey bees (hymenoptera; apadai.) have a very important role in the ecosystem, especially in the process of pollination and honey production. There are two types of honey bees that are often cultivated, namely stinging and stingless honey bees (Leonhardt et al., 2020). In this practicum, we will study the morphological characteristics of both types of bees, which include body shape, size, and structure of important parts such as wings, legs, antennae, and stingers.

Multicultural diversity in Indonesia, especially the Maluku region, local honey bees are a characteristic

How to Cite:
Mercy Papilaya, P., SA Lamerkabel, J., & MJ Tuapattinaya, P. (2025). Capacity Building for Teachers and Students in Understanding the Concept of Morphological Characters of Honey Bees from Maluku and their Cultivation Technology. *Unram Journal of Community Service*, *6*(2), 384–390. https://doi.org/10.29303/ujcs.v6i2.1032

that enriches the values of the life of the Indonesian people, especially the Maluku people (Lamerkabel et al., 2023). Therefore, this diversity must always be preserved, developed and maintained through educational efforts. This is intended so that students are formed in their understanding of the advantages and wisdom in the area where they live (Suwistika et al., 2024). Policies related to the inclusion of local content of honey bee cultivation in the content standards are based on the fact that in Indonesia there are diverse cultures in Maluku, especially the city of Ambon. The school where the education program is implemented is part of the community. Therefore, environmental education programs, especially honey bee cultivation in schools, need to provide learners with broad insights into the specificities of their environment (Avelar et al., 2024). The introduction of environmental, social, and cultural conditions more specifically honey bees to students allows them to be more familiar with honey bee cultivation.

Maluku, as an archipelago rich in biodiversity, has great potential that can be integrated in science learning. One such potential is honey bees. Honey bees are not just honey-producing insects, but also have unique morphological characteristics and cultivation technology that are rich in scientific values. The existence of local honey bees from Maluku, with their unique characteristics, can be a very interesting and relevant object of study to improve understanding of biological concepts, ecology, and even applied technology in the local context.

However, initial observations show that the understanding of teachers and students at SMP Negeri 14 Ambon regarding the morphological characteristics of honey bees from Maluku and their cultivation technology still needs to be improved. The limited learning resources that are specific to local honey bees, as well as the lack of training that focuses on the integration of local potential in science learning, causes this material to not be optimized (Gligorea et al., 2023). In fact, mastery of this concept not only enriches scientific insights, but also fosters appreciation for local natural wealth and the economic potential contained therein (Sumarna & Gunawan, 2022).

Capacity building of teachers and students in understanding the concept of morphological characteristics of honey bees from Maluku and their cultivation technology is crucial. For teachers, this capacity building will equip them with pedagogical knowledge and skills to present science materials in a more contextual, interesting and applicable manner (Darling-Hammond et al., 2020). As for students, this understanding will enrich their learning experience, spark curiosity, develop observation skills, and ultimately improve science learning outcomes (Basar et al., 2021). Therefore, this service was carried out to implement effective capacity building efforts to overcome this understanding gap, so that science learning at SMP Negeri 14 Ambon can run more optimally and be relevant to the existing local potential. The purpose of this service is to increase the capacity of teachers and students in understanding the concept of morphological characterization of honey bees from Maluku and their cultivation technology to support science subjects at SMPN 14 Ambon.

Method

Creativity or creative thinking skills have become important skills to adapt quickly in changing the world of education (Clemente-Suárez et al., 2024). The steps taken to increase the capacity of teachers and students in understanding the concept of morphological characterization of honey bees from Maluku and its cultivation technology to support science subjects at SMPN 14 Ambon are as follows; 1). Analysis of school objectives and characteristics, 2). Analysis of learning resources in this case the results of educational research on the characterization of honey bees from Maluku 3). Analysis of the characteristics of students in the SMPN 14 Ambon area, 4). Determine the learning objectives and content of characterization of honey bees from Maluku, 5). Determine the strategy of organizing the learning content of characterization of honey bees from Maluku, 6). Establishing learning content delivery strategy, 7). Establishing learning management strategies, and, 8). Development of procedures for measuring learning outcomes. Steps (1), (2), (3), and (4) are learning condition analysis steps, steps (5), (6), and (7) are development steps, and step (8) is a learning outcome measurement step of characterization of honey bees from Maluku.

This service program applies a combination training model, namely in-service training in the form of classical exposure and on-the-job learning through direct assistance at the task site. The main objective is to design a learning model on the characterization of typical Maluku honey bees. This model is expected to foster the creative thinking skills of SMPN 14 Ambon students by encouraging curiosity, investigation, and the creation of new knowledge (Ningsih et al., 2020). The activity, which was located at SMPN 14 Ambon, involved collaboration between one lecturer and three doctoral students of Biology Education.

This socialization activity consisted of two main sessions, namely material orientation for 80 minutes (equivalent to 2 hours of lessons) and field practicum in the forest around the school with the same duration. The material delivery used a PowerPoint presentation, while

the field practicum was guided by a Learner Worksheet designed with a Project-Based Learning (PjBL) approach. This PjBL approach emphasizes the active involvement of students, so that they are not just passive listeners, but rather participate directly in the learning process (Zhou, 2023). The learning model we developed focuses on the characterization of native Maluku honey bees using the PjBL approach. In its implementation, lecturers and partner students play an active role in all service activities and apply the knowledge gained in their respective schools. The success indicator of this program is the growth of students' awareness and creativity regarding the characterization of Maluku honey bees through the PjBL method.

To ensure that the program continues to run and develop, a long-term plan is needed. One of the main focuses is effective program management and sustainable partner involvement. The next step is to organize creativity training for students, such as honey bee cultivation, by presenting expert speakers from Biology Education lecturers. The existence of a solid follow-up plan not only facilitates the implementation of the program in the future, but also opens up opportunities for other parties to participate or hold similar programs. The preparation of this plan must be based on an analysis of the potential, strengths, and assets that already exist and will be developed, including human resources that are crucial for coordination and collaboration.

Based on the previous description, the follow-up program will focus on training and mentoring honey bee cultivation for students and teachers at SMPN 14 Ambon. The program will begin with technical guidance on the characterization of Apis cerana honey bees as supporting material for science subjects. Furthermore, the participants will be guided practically through several stages, starting from the construction of bee boxes (stups) and honey extractors, the preparation of all supporting equipment (such as nest combs, box supports, personal protective equipment, levers, and smokers), to the process of catching, routine maintenance, and harvesting honey.

Result and Discussion

This Community Partnership Program (PKM) activity in the form of a workshop with the theme "the concept of morphological characterization of honey bees from Maluku and their cultivation technology to support science subjects at SMPN 14 Ambon," was held on Saturday, May 3, 2025 offline at SMP Negeri 14 Ambon as a partner. The participants of this technical guidance activity amounted to 3 7th grade teachers, SMPN 14 Ambon from all subjects. The event started from 10.00 - 17.00 WIT. The socialization was attended by 3 teachers, and 50 students, with the following schedule: 1) Opening and introduction between the resource person and the workshop participants; 2) Remarks from the principal of SMPNegri 14 Ambon; 3) Entering the workshop core program which consists of 2 sessions, each session is filled by different speakers and materials. 1) Prof. Dr. Pamella Mercy Papilaya, M.Pd with the topic: Cognitive thinking skills in understanding the concept of morphological characterization of honey bees from Maluku and their cultivation technology supporting science subjects); 2) Ir. Jacob. S.A. Lamerkabel, Msi with the topic: Morphological characterization of honey bees from Maluku and their cultivation technology; 3) Frely. P.M.J. Tuapattinaya, S.Pd. M.Pd with the topic: Creative and Innovative Thinking.

After the delivery of material by two speakers, the event continued with a question and answer session guided by the moderator. There were questions represented from each group submitted by the socialization participants, including the question "Why is the queen's life longer than 4 - 6 years and for example, if the queen bee dies, is there a replacement?". The answer is that the queen bee is fed royal jelly throughout her life, while worker bees only get it for the first few days as larvae. Royal jelly affects gene activity and slows down biological aging because royal jelly contains several protein compounds with high presentation, which extends the life of the queen bee significantly (Lamerkabel et al., 2021). When the queen dies or is lost, workers will select some young larvae (less than three days old) and start feeding them large amounts of royal jelly to transform them into pupae and imago as future queens (Anaktototy et al., 2021).

Figure 1. The following is a documentation of the activities of students, and junior high school teachers with resource persons in carrying out project-based learning-based cultivation practices

Table 1. Student Questions and Interviewee Responses to Student Questions

Student	Question	Answer
Student 03	How bees interact with each other in the process of finding and collecting nectar and pollen for food	Bees interact by communicating with dance: Honey bees use a "waggle dance" to inform other bees of the location of rich food sources. Dance patterns tell the direction and distance of nectar and pollen sources as food from the hive (Buchori et al., 2022).
Student 06	What is the name of the bee's communication device	The bee's communication tool is the antenna (Alburaki et al., 2021).
Student 15	How bees use their mouths to extract nectar to become honey"	How bees take nectar by using the Bee Mouth: Honey bees have a suction-type mouth apparatus consisting of a tongue (glossa), labium, and maxillae (mandibles). Bees' tongues are long and flexible, allowing them to reach nectar in deep flowers (Wang et al., 2021).
Student 05	What is the impact if there are no bees and if bees are extinct	Reduced agricultural yields due to pollination failure (Landaverde et al., 2023). ▪ Huge economic losses (Iwasaki & Hogendoorn, 2022) ▪ Threat to biodiversity (Salatnaya et al., 2020) ▪ Instability of ecosystem systems and ecological services (Magbalot-Fernandez, 2022) ▪ Negative impacts on human health (Melia et al., 2024).
Student 20	What causes worker bees to have a short lifespan of only 45 days	▪ Physiological stress due to intensive work ("Development Strategy of Klanceng Honey Livestock (Trigona Sp) in Lubuk Raja, Ogan Komering Ulu District," 2024) ▪ Physiological and genetic changes when switching roles (Lamerkabel et al., 2021) ▪ Age differences depending on season and role (("Natural Honey (Raw Honey): Insights on Quality, Composition, Economic and Health Effects: A Comprehensive Review," 2023)
Student 30	How bee colonies survive	▪ Efficient Division of Labor (Nisa & Kustiawan, 2023) ▪ Colony Thermoregulation (Agussalim et al., 2015) ▪ Defense Against Pathogens and Predators (Salatnaya et al., 2020). ▪ Swarming (Colony Breaking) (Luthfi Hana Fadiah & Ateng supriyatna, 2023)
Student 19	*What is the respiratory system of bees*"	▪ Bees breathe through a spiracle and tracheal system, not lungs or gills. Spiracles are small holes in the body that open into the tracheal network, which branches into smaller tracheola to supply oxygen directly to cells (Joice J.I. Rompas, Hengki J. Kiroh, Martha M.H. Kawatu, 2023) ▪ Honeybees use active ventilation to control breathing. They can move their abdominal muscles to generate pressure that forces air in and out of the tracheal system, especially when flying or in a hot hive Bees (Buchori et al., 2023) ▪ Adaptation to high temperatures and metabolic demands. Since bees engage in highly energy-demanding activities (e.g. flying), their respiratory system has large trachea and ventilation mechanisms to ensure sufficient oxygen supply (Saud et al., 2024). ▪ Breathing is affected by body size and metabolic rate. Studies show that the efficiency of the tracheal system plays an important role in limiting the body size of insects, including bees, as oxygen diffusion becomes less efficient at larger body sizes (Cardillo & Giampaolo, 2025).

Conclusion

The conclusions that can be drawn are as follows: 1) Capacity building of teachers and learners in understanding the concept of environmental awareness of honey bee cultivation at SMP Negeri 14 Ambon is very useful in developing the characterization of honey bees from Maluku as a study material that forms an understanding of the potential in the region, in this case the school environment and the place of residence, is useful for providing attitudes, knowledge, and skills to students so that: 1) get to know and become more familiar with honey bees; 2) have the ability and skills as well as knowledge about honey bee cultivation that is useful for themselves and the community in general; and 3) have attitudes and behaviors that are in line with the values/rules that apply in their area, as well as preserve and develop the noble values of Maluku culture in order to support national development; 2) The program follow-up plan is carried out through training and mentoring students together with teachers in honey bee cultivation by carrying out activities including: (a) Guiding students and teachers to carry out technical guidance on how to cultivate Apis Cerana honey to support local content subjects based on project-based learning at SMPN 14 Ambon; (b) As a learning resource for students; (c) Guiding students and teachers to make boxes (stups) and extractors; (d) Guiding learners and teachers to prepare fishing equipment such as hive combs, box supports, rubber gloves hats & masks, levers, smoker bee brushes; (e) Guiding learners and teachers to prepare fishing equipment such as hats and masks, levers and bee brushes; (f) Guiding learners and teachers to catch bees; (g) Guiding learners and teachers to maintain bees; and (h) Guiding learners and teachers to harvest honey.

Acknowledgments

This activity would not have been possible without the help of several parties involved, therefore the author would like to express his gratitude to the parties who have helped in the implementation of this activity, including:

1. DRTPM, who entrusted the grant funds to our programs.
2. Faculty of Economics UNKRIS who has provided support and guidance.
3. Head of Bina Karya Srikandi, Deuis Anggraini who welcomed our team with open arms..
4. Head of RW 13, H. Sutanto Permadi who has given permission to the team to carry out the activity.
5. Head of RT 05, Briant Lesmana who has given permission and support to our team.

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