Galuh International Journal of Community Service & Development
Volume I, Issue 2, March 2024, (Page 49-56)
ISSN 3026-1171

Assistance for Adiwiyata school teachers in learning innovation with an integrated STEAM-H approach

Ai Tusi Fatimah[1], Febriani Rahayu[1], Chandra Suparman[1], Ismatal Qisthi Insani[1]
[1]Faculty of Teacher Training and Education, Universitas Galuh, Indonesia

Abstract
Learning innovations to support environmentally friendly behavior in Adiwiyata schools at the technical level are still complained of as difficult for teachers to implement. Integrated STEAM-H (science, technology, engineering, agriculture, mathematics, and health) is a learning approach that can be used by teachers to create innovative learning across subjects. This community service activity was carried out to assist sixth-grade Madrasah Ibtidaiyah Handapherang (equivalent to elementary school) teachers in designing, implementing, and assessing learning using an integrated STEAM-H approach. This mentoring method is carried out through the stages of preparation, implementation, and evaluation. The preparatory stage is carried out through focus group discussions to build learning tools and prepare tools and materials as learning media. The implementation stage is the implementation of the planning stage. Evaluation stage of the entire series of activities. Assistance produces teaching modules across subjects, namely mathematics, and science, building hydroponic project-based learning, providing meaningful learning for students that integrates agriculture, science, mathematics, technology, engineering, and health in a hydroponic vegetable cultivation project. The results of this assistance become a reference for innovative learning at the Madrasah Ibtidaiyah Handapherang to be further developed to support environmentally friendly behavior at Adiwiyata schools.

Keywords: *Adiwiyata school; innovative learning; STEAM-H*

Corresponding author:
Ai Tusi Fatimah
Faculty of Teacher Training and Education
Universitas Galuh
Jl. R.E. Martadinata No. 150 Ciamis, West Java
aitusifatimah@unigal.ac.id

Article history
Received February 6, 2024
Revised February 13, 2024
Accepted February 15, 2024
Published Online February 19, 2024

Cite this article:
Fatimah, A. T., Rahayu, F., Suparman, C., & Insani, I. Q. (2024). Assistance for Adiwiyata school teachers in learning innovation with an integrated STEAM-H approach. *International Journal of Community Service & Development*, *1*(2), 49-56.

INTRODUCTION

Madrasah Ibtidaiyah Handapherang continues to strive to innovate in various activities to support the Adiwiyata school program. Of the many innovations that have been carried out, Madrasah Ibtidaiyah Handapherang still needs learning innovations to support environmental care and cultural movements in schools. This movement is a movement carried out by the Adiwiyata school ((Menteri Lingkungan Hidup dan Kehutanan RI, 2019). This movement can include learning in subjects, extracurriculars, and self-familiarization that integrates the implementation of environmentally friendly behavior in schools and communities, forming work and communication networks, as well as campaigns and publications for environmental care and cultural movements in schools. In the new academic year 2023/2024, the environmental care and culture movement at Madrasah Ibtidaiyah Handapherang is a priority in welcoming the implementation of the independent curriculum.

The learning innovation offered to support the Adiwiyata program at Madrasah Ibtidaiyah Handapherang is STEAM-H (science, technology, engineering, agriculture, mathematics, and health) learning integrated into several subjects. STEAM-H is a multidisciplinary research boundary that is expanded not only to aspects of science, technology, engineering, and mathematics but also adds two other disciplines, namely agriculture and health (Toni, 2014). STEAM-H was then converted to the world of education (Fatimah, Isyanto, et al., 2022b). In this context, STEAM-H is implemented as a cross-subject learning approach. STEAM-H in the context of the Adiwiyata school which is offered in this community service program has relevance in the aspect of implementing environmentally friendly behavior in planting

and maintaining plants. This aspect is related to the agricultural science discipline. Agriculture is an integrator for other scientific disciplines (Vallera & Bodzin, 2020). Planting and maintaining plants in this learning approach can be said to be a contextual integrator of the mathematics and science concepts learned by students. Planting and maintaining plants is a cultivation activity, where the cultivation of a commodity is a contextual and conceptual integrator for science, technology, engineering, mathematics, and health (Fatimah, Isyanto, & Toto, 2023).

The results of the study showed that there is a connection between mathematical concepts and the agribusiness context (Fatimah, Isyanto, et al., 2022a). Based on the results of research on cross-subject relationships showed that mathematics and science concepts are connected to the processing of agricultural products which can encourage teachers' confidence in implementing integrated learning (Fatimah, Isyanto, Toto, et al., 2023). Physics, which is part of science, is also important and is used in agriculture (Toto et al., 2022). Apart from that, mathematics teachers and agricultural expertise teachers also agree that agricultural contexts are contextual integrators that can support student competencies (Fatimah, Isyanto, et al., 2022c). The results of these studies supported that an integrated STEAM-H learning approach can be implemented in Adiwiyata schools which aims to support the Adiwiyata school program.

Initial investigations regarding environmental conditions and the teacher council at Madrasah Ibtidaiyah Handapherang found that there was a lot of potential in the school environment and also adequate teacher quality for implementing learning innovations with an integrated STEAM-H approach. Assistance with the implementation of the STEAM-H approach has been provided to first-grade teachers at Madrasah Ibtidaiyah Handapherang (Rinaldi et al., 2023). This assistance is still limited to preparing tools and materials for hydroponic planting with a wick system. Expanding the scope of implementation needs to be developed in the aspects of planting and maintaining plants. The belief that the integrated STEAM-H approach at Madrasah Ibtidaiyah Handapherang can be implemented is due to experience in implementing planting and maintaining organic vegetables using soil, husk charcoal, and compost as a growing medium in fourth grade (Fatimah, Amam, et al., 2022). The difference between this assistance and the previous activity lies in the student's activity, namely planting and maintaining hydroponic vegetable plants. Through hydroponic media, all scientific disciplines within the scope of STEAM-H can be integrated into mathematics and science subjects.

The potential of the school and the habituation of school residents in planting and maintaining plants is a major capital in implementing this program. Learning with this integrated STEAM-H approach has flexibility regarding hydroponic learning media which still requires exploration in planning, implementing, and assessing learning as an innovation in Adiwyata schools. Thus, this community service program aims to accompany sixth-grade teachers in designing, implementing, and evaluating integrated STEAM-H learning through the activity of planting and maintaining hydroponic vegetables.

METHODS

Assistance activities for the implementation of integrated STEAM-H learning were carried out at Madrasah Ibtidaiyah Handapherang. This school was located in Handapherang Village, Cijeungjing District, Ciamis Regency. This activity focused on assisting sixth-grade teachers in implementing STEAM-H learning from September to December 2023. The sixth grade of Madrasah Ibtidaiyah Handapherang consisted of two classes, namely A and B with a total of 52 students.

This service activity was carried out through the stages of preparation, implementation, and evaluation. The preparatory stage was carried out through focus group discussions to build learning tools and prepare learning media, namely equipment for planting and maintaining hydroponic vegetables. The learning implementation stage was carried out for classes A and B. The evaluation stage was for the entire series of activities starting from the appropriateness of learning equipment, completeness of learning media, smooth implementation, and assessment of learning.

The sixth-grade teachers at Madrasah Ibtidaiyah Handapherang consisted of two people. They designed teaching modules. The community service team directed the connection between learning outcomes and the hydroponics project. Teachers and the community service team prepared tools and

materials for growing vegetables using a hydroponic system. The teacher implemented the teaching module design in class, and the team with the school principal observed the conformity of the teaching module design with implementation. After completing the entire series of activities, reflection to follow-up actions were determined.

RESULTS AND DISCUSSION

At the planning stage, the team agreed that an integrated STEAM-H learning approach would be carried out through project-based learning. The project that would be carried out was planting and maintaining vegetable plants in pipe installations. The vegetable grown was pak choy. Figure 1 below shows the tools and materials used by students as learning media.

Figure 1. Tools and Materials for Planting Bok Choy Vegetables with a Paralon Hydroponic Installation

The team provided two pipe installations, pak choy seeds, nutrient solution, rock wool, and net pots. These tools and materials were introduced at the first meeting with the aim of science learning, namely distinguishing between biotic and abiotic. Students were expected to be able to explain the interdependent relationship between biotic and abiotic components which could influence the stability of an ecosystem in the surrounding environment. At the first meeting, the process of sowing pak choy vegetables was also carried out using rockwool planting media. In mathematics subjects, this first learning achievement is related to the number of elements in the context of determining the number of tools and materials needed to plant pak choy vegetables with the capacity according to the installation of the pipes provided. Next, students observed the process of pak choy seeds becoming sprouts and leaves until they were ready to be transferred to a net pot. The transfer process involved mathematical activities related to measurement and geometry elements. Students were invited to carry out activities to prepare nutrition by first calculating the volume of the pipes. Then, students returned to observe the growth of the plants and cared for them until they were finally harvested. All stages of these activities were guided by student worksheets that focused on mathematics and science learning outcomes (Kemendikbudristek BSKAP, 2022b). Table 1 below describes the learning outcomes of the five phases of planting and caring for vegetables.

Table 1. Learning Outcomes and Student Activities

Phase	Learning Outcomes	Student Activities
1	Students can identify tools and materials for planting hydroponic bok choy in pipes, collaborate in the planting process, and solve mathematical problems to determine the number of tools and seeding materials accompanied by critical reasoning.	- Calculating the number of holes in the installation - Prepare seeds and Rockwool - Carry out seeding
2	Students are able to observe the growth of bok choy plants and count the quantity of sprouts and leaves.	- Calculate the number of seeds that have grown and have leaves - Measuring the height of the pak choy - Describe changes in plant growth - Identify bok choy that can be moved to the net pot in the pipe

Phase	Learning Outcomes	Student Activities
3	Students are able to prepare planting media (nutrient solutions) using number, measurement, algebra, and geometry content accompanied by critical reasoning.	- Measuring the length and diameter of the pipes - Prepare AB Mix solution - Transferring seedlings - Ensure the pump is performing well to deliver nutrient water to all pipes
4	Students are able to observe the growth of pak choy plants and measure plant height and the pH of the nutrient water.	- Measure the height of the bok choy plant - Check the pH of the nutrient water (ensure the pH is between 5.5-6.5) - Describe the physical changes of the bok choy plant
5	Students are able to harvest, weigh the harvest, and calculate the income if the harvest is sold.	- Observe plants that are ready to harvest - Describe plants that are ready to harvest - Weighing the harvest

There was a special characteristic of the design of this teaching module, namely that there was an aspect of *Rahmatan Lil'Alamin* that is integrated with the dimensions of the *Pancasila* profile (Kemendikbudristek BSKAP, 2022a) namely cooperation in planting water spinach for food supplies for human survival and health accompanied by critical reasoning in solving problems. In addition, the teaching modules were designed using project-based learning. This type of learning model was relevant to be implemented at the elementary school level as scaffolding for student development (D'Ambra, 2014)

STEAM-H was attached to the project-based learning stage. In the science aspect, understanding science was a priority in learning activities. Apart from that, the elemental aspects of science skills consisted of (1) observing; (2) questioning and predicting; (3) planning and conducting investigations; (4) processing, and analyzing data and information; (5) evaluating and reflecting; and (6) communicating results. In terms of technology and engineering, hydroponics uses media other than soil to grow vegetables which needs to be introduced to students. In the agricultural aspect, growing vegetables is part of cultivation. In the mathematical aspect, project activities relate to elements of numbers, algebra, measurement, and geometry. In the health aspect, vegetables are certainly a food that is useful for maintaining a healthy body.

The learning tools that had been prepared were then implemented for sixth-grade students. There were five activities according to the plan, namely Introduction to tools, materials, and tools for planting hydroponic pak choy with video playback. This activity led students to knowledge about the interdependent relationship between biotic and abiotic components. Students could also acknowledge the sequence of planting and caring for pak choy until harvest (Figure 2). Below is a student's activity while watching a video of the stages of planting pak choy from preparing tools/materials, and sowing, to harvesting.

Figure 2. Students watch the process of planting pak choy using a hydroponic system

After students understand the tools, materials, and planting bok choy, they sow them. The seeding activity was guided by worksheets that had been designed and prepared by the teacher. With enthusiasm, students carried out seeding and filled in worksheets. Figure 3. Below is a student's activity when sowing pak choy seeds using rock wool media.

Figure 3. Students do the seeding and fill in the worksheet

Students always observed the growth of the seeds and cared for them until they were ready to be transferred into net pots. Furthermore, students also looked after the plants until harvest.

Figure 4. Students maintain vegetables until harvest accompanied by the teacher

The worksheets carried out during the implementation by the students could be completed well by the students. Figure 5 below is an example of student responses to the problems given in the worksheet. Without them realizing it, project activities led them to achieve mathematics and science learning.

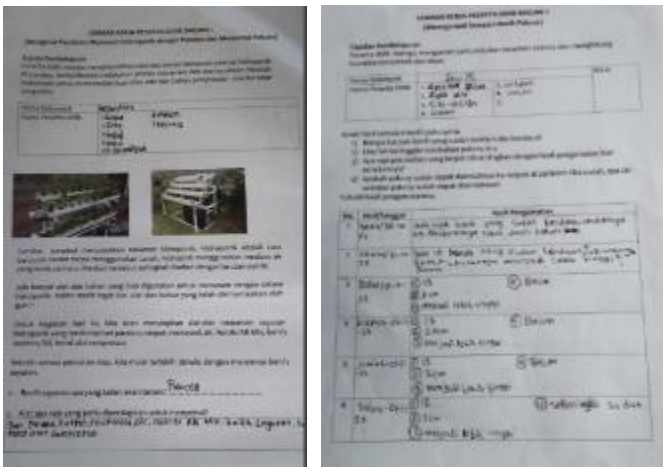

Figure 5. Example of student responses on the worksheet

Evaluation activities were carried out throughout the activity. Before being given to students, the teaching module was validated for content and readability involving two mathematics and science education experts. The validated aspects consisted of general information components, learning objectives, learning activities, and learning assessments. All components were validated in the good category. Peer assessments regarding the learning process regarding the achievement of learning objectives and the suitability of learning stages with their realization are in a good category. Some notes need to be improved according to peer assessment regarding the efficiency of project implementation time. Student response to the project was very good and all students were enthusiastic about carrying out the project. The results of interviews with students showed that this enthusiastic attitude arose from students' excitement because learning was not monotonous only in class. Students also felt that the activity was valuable because it could produce vegetables that could be enjoyed together.

CONCLUSION

The learning innovation carried out in this community service activity was learning with the STEAM-H approach which was implemented in hydroponic project-based learning that integrated mathematics and science in one learning activity. Hydroponic projects led students to integrate several disciplines within the scope of science, technology, engineering, agriculture, mathematics, and health. Teachers were accompanied to design teaching modules and learning media. Teachers were also accompanied to implement the results of their designs. All community service activities ran smoothly and well. This activity also became a reference for innovative learning at Madrasah Ibtidaiyah Handapherang to continue to be developed further in other classes using various hydroponic installations.

Limitations and Future Direction

The description of this learning implementation assistance activity is part of the community service activities carried out throughout 2023. The description of this activity is deemed necessary to be published in more detail for each class. Therefore, this article is limited to presenting data on the implementation of innovative learning in the sixth grade of Madrasah Ibtidaiyah Handapherang. The description of activities presented in this article is expected to contribute ideas at the technical level of implementing project-based learning to support Adiwiyata school programs.

Acknowledgments

Thank you to the Directorate of Research, Technology, and Community Service at the Ministry of Education, Culture, Research and Technology for funding the Community-Based Empowerment Scheme, Community Partnership Empowerment in 2023.

Statement and Declarations

Photos of the activities presented in the figures and all content have been permitted by the Madrasah Ibtidaiyah Handapherang to be published in this article.

REFERENCES

D'Ambra, L. N. (2014). a Case Study of Project-Based Learning in an Elementary School Setting. *Dissertation Abstracts International Section A: Humanities and Social Sciences*, *74*(8-A(E)). http://search.ebscohost.com/login.aspx?direct=true&db=psyh&AN=2014-99031-208&login.asp&site=ehost-live&scope=site

Fatimah, A. T., Amam, A., & Effendi, A. (2022). Utilization of The Yard Through Vegetable Planting Practices Integrated Mathematics for Student at Adiwiyata School. *Pasundan International Og Community Service Journal*, *IV*(1), 1–10. https://doi.org/10.15797/concom.2019..23.009

Fatimah, A. T., Isyanto, A. Y., & Toto. (2022a). *Konteks dan Konsep Matematika di SMK/MAK Agribisnis dan Agriteknologi Sebuah Pengantar Menuju Merdeka Belajar*. Perkumpulan Rumah Cemerlang Indonesia.

Fatimah, A. T., Isyanto, A. Y., & Toto. (2022b). *Pengantar untuk Konversi Pendidikan STEM ke STEAM-H*. Perkumpulan Rumah Cemerlang Indonesia.

Fatimah, A. T., Isyanto, A. Y., & Toto. (2023). Science, technology, engineering, agriculture, mathematics, and health in agribusiness curriculum. *International Journal of Evaluation and Research in Education (IJERE)*, *12*(4), 2316–2326. https://doi.org/10.11591/ijere.v12i4.25665

Fatimah, A. T., Isyanto, A. Y., Toto, & Andriana, B. B. (2023). Paving the way for integrated STEAM-H education in agricultural product processing vocational high school. *Jurnal Pendidikan Vokasi*, *13*(2), 146–157. https://doi.org/10.21831/jpv.v13i2.53861

Fatimah, A. T., Isyanto, A. Y., & Toto, T. (2022c). Integrator Kontekstual untuk Pembelajaran Matematika di Sekolah Menengah Kejuruan Program Agribisnis Perikanan. *Seminar Nasional Penelitian LPPM UMJ*, 1–9. https://jurnal.umj.ac.id/index.php/semnaslit/article/view/14215%0Ahttps://jurnal.umj.ac.id/index.php/semnaslit/article/download/14215/7372

Kemendikbudristek BSKAP. (2022a). Keputusan Kepala Badan Standar, Kurikulum, dan Asesmen Pendidikan Kementerian Pendidikan, Kebudayaan, Riset, dan Teknologi Nomor 009/H/KR/2022 Tentang Dimensi, Elemen, dan Sebelemen Profil Pelajar Pancasila Pada Kurikulum Merdeka. In *Kemendikbudristek BSKAP RI* (Issue 021).

Kemendikbudristek BSKAP. (2022b). Salinan Keputusan Kepala Badan Standar, Kurikulum, dan Asesmen Pendidikan, Kementerian Pendidikan, Kebudayaan, Riset, dan Teknologi Nomor 008/H/KR/2022 Tentang Capaian Pembelajaran Pada Pendidikan Anak Usia Dini Jenjang Pendidikan Dasar dan Jenjang Pendid. In *Kemendikbudristek BSKAP RI* (Issue 021).

Menteri Lingkungan Hidup dan Kehutanan RI. (2019). *Peraturan Menteri Lingkungan Hidup dan Kehutanan Republik Indonesia Nomor 53 Tahun 2019 Tentang Penghargaan Adiwiyata*.

Rinaldi, F. B., Fatimah, A. T., & Adnan, B. A. (2023). Pendampingan implementasi pembelajaran STEAM-H di kelas 1 MIS Handapherang sebagai upaya optimalisasi sekolah Adiwiyata. *Prosiding Seminar Nasional Pengabdian Masyarakat LPPM UMJ*. http://jurnal.umj.ac.id/index.php/semnaskat

Toni, B. (2014). New Frontiers of Multidisciplinary Research in STEAM-H (Science, Technology, Engineering, Agriculture, Mathematics, and Health). In *Springer Proceedings in Mathematics and Statistics* (Vol. 90). Springer. https://doi.org/10.1007/978-3-319-07755-0

Toto, Fatimah, A. T., & Isyanto, A. Y. (2022). Identifikasi Konsep-Konsep Fisika dalam Pembelajaran Berbasis STEAM-H di SMK Agribisnis. *Prosiding Seminar Nasional Fisika*, *1*, 20–30. http://proceedings.upi.edu/index.php/sinafi/article/view/2976/2690

Vallera, F. L., & Bodzin, A. M. (2020). Integrating STEM with AgLIT (Agricultural Literacy Through Innovative Technology): The Efficacy of a Project-Based Curriculum for Upper-Primary Students.

International Journal of Science and Mathematics Education, *18*(3), 419–439. https://doi.org/10.1007/s10763-019-09979-y