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Assistance in Using Telescopes for Observing the Sun and Distant Objects for Students in the Village of Bumiroso

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ABSTRACT

Through specialized training programs, the community engagement project aims to enhance literacy and observational skills among students in Bumiroso Village, Wonosobo Regency. Focusing on telescope usage, the training has two main objectives: understanding solar phenomena, particularly sunspots, and honing skills in observing distant objects. The program includes theoretical sessions providing insights into the importance of solar observation and its relevance to broader scientific understanding. Practical sessions with telescopes allow students to apply their knowledge in real time, fostering a deeper appreciation for astronomy and celestial events. The initiative extends to observing far terrestrial objects, encouraging curiosity and exploration beyond outer space. By equipping students with practical telescope skills, the project aims to empower the community with valuable tools for scientific exploration. This training promotes scientific knowledge and instills curiosity and a desire for exploration, nurturing a lifelong interest in astronomy and observational sciences. The positive impact of this initiative is expected to extend beyond the classroom, enriching education and scientific awareness within the entire community of Bumiroso Village.

1. Introduction

In an era of technological advancement, fostering an appreciation for science, particularly astronomy, among rural communities is essential to bridge the knowledge gap and improve science literacy. Wonosobo Regency, located in Central Java, Indonesia, is renowned for its beautiful scenery and traditional agricultural practices. However, educational infrastructure in rural areas often faces challenges, limiting access to cutting-edge scientific knowledge and tools. Recognizing this gap, a community engagement initiative was proposed to introduce students in the Bumiroso Village area to the fascinating world of astronomy through a unique training program focused on using binoculars. Wonosobo Regency, characterized by its quiet rural setting, is home to a diverse community engaged in agriculture and local crafts. While the district's natural beauty is breathtaking, the educational resources available to its residents, especially in remote villages like Bumiroso, may not be enough to provide

students with an opportunity to experience the wonders of modern science. As technological advancements drive scientific discovery, bridging the gap between urban and rural educational experiences becomes essential.

Science literacy is a crucial driver of personal development and a catalyst for community growth. In Wonosobo, as in many rural areas worldwide, there is a gap in the understanding of scientific concepts, hindering people's ability to engage with and benefit from advances in the field. This training program seeks to address this gap by providing students with a unique opportunity to learn about astronomy, instilling a sense of curiosity and wonder that can propel them toward future scientific pursuits. Often overlooked in educational settings, binoculars are a versatile tool that can significantly improve observational skills. While traditional teaching methods may rely heavily on textbooks and classroom lectures, hands-on experience with a tool like binoculars offers a more engaging and practical approach to learning. In astronomy, binoculars are an easily accessible instrument for observing celestial objects, making studying space more tangible and engaging for students.

The Sun, a vital celestial body, is a dynamic energy source and inspiration. Understanding solar phenomena, including the appearance of sunspots on the Sun's surface, requires a combination of theoretical knowledge and practical observation. Sunspots are temporary phenomena caused by the Sun's magnetic activity, making them an exciting entry point for students to explore the dynamics of our nearest star (Abdurahman, *et al*., 2024; Brown & Wong, 2022; Carli, Stevanato & Pantano, 2020). Focusing on this phenomenon, the training program aims to demystify solar activity and empower students to engage in meaningful observations. In addition to celestial bodies, the training program emphasizes observations of distant terrestrial objects. This aspect broadens the initiative's scope, encouraging students to explore and appreciate the beauty of nature around them (Freed, *et al*., 2023; Makous & Bandura, 2021; Leonardi, *et al*., 2020). Observing distant objects through binoculars enhances observation skills and instills a sense of connectedness to the environment. This holistic approach promotes a well-rounded scientific education, interweaving celestial and terrestrial observations for a comprehensive learning experience (Manz. & Beckert, 2023; Petropoulos & Leisos, 2022; Marques, Carlin & Moutinho, 2020).

Implementing the training program in Bumiroso Village is not just an academic exercise but a step towards empowering the community through science. By introducing students to the practical use of binoculars and guiding them through solar and terrestrial observations, the program aims to foster scientific curiosity and critical thinking. These skills go beyond the astronomical context, laying the foundation for a broader understanding of the scientific method and inquiry. To ensure the success and sustainability of the training program, it is essential to integrate local relevance and cultural elements (Proven-Adzri, 2022; Reichart, 2021; Slater, *et al.*, 2014). Wonosobo, like many areas in Indonesia, has a rich cultural heritage that can be woven into the education fabric. By incorporating local stories, folklore, and traditional knowledge related to sky observation, the program becomes more relevant and resonant in the community. This approach not only enhances the cultural significance of the initiative but also fosters a sense of pride and ownership among the participants.

When introducing binoculars as an educational tool, it is essential to recognize and address potential technological barriers. Access to such equipment may be limited in rural areas, and familiarity with modern devices may vary. Training programs should include elements to demystify and familiarize students with binoculars, ensuring that technological barriers do not hinder learning . Collaboration with local experts, community leaders, and educational institutions can facilitate the provision of necessary resources and support. The success of these training programs depends on solid partnerships with local stakeholders, including schools, community leaders, and parents. Engaging stakeholders from the outset will ensure that the program aligns with the needs and values of the community. Additionally, collaborative efforts can contribute to the long-term sustainability of these initiatives, fostering a sense of collective responsibility for the educational development of the community.

It is essential to establish clear metrics and evaluation criteria to assess training programs' success and long-term impact. Beyond traditional academic assessments, indicators of success can include increased Interest in science subjects, participation in extracurricular activities, and the emergence of student-led initiatives. Regular follow-up assessments can provide valuable insights into the effectiveness of the program and areas for improvement, facilitating ongoing refinement and adaptation. A training program

using binoculars to observe the Sun's black spot and distant objects in the Bumiroso Village neighborhood of Wonosobo Regency has great potential to transform the educational landscape. By harnessing the power of hands-on experience, integrating local relevance, and overcoming technological barriers, this initiative seeks to empower students with valuable observational skills and scientific knowledge. As these students become active participants in exploring the cosmos and their local environment, the profound impact of this community engagement effort can extend beyond the boundaries of Bumiroso, contributing to the broader goal of promoting scientific literacy and curiosity in rural communities.

2. Methods

Community-based research (CBR) is a practical approach to designing and implementing projects that address a community's specific needs and contexts (Sholichah, *et al*., 2024; Susilawaty, 2016). In the case of a proposed binocular training program for students in Bumiroso Village, Wonosobo Regency, CBR provides a robust framework for engagement and collaboration. The methodology is designed to ensure that the training program is culturally relevant, accessible, and sustainable, thereby fostering community ownership and empowerment. Building a solid foundation for the project begins with community outreach and relationship building. Engaging with local leaders, educators, and community members helps gain insight into the unique needs, challenges, and aspirations of Bumiroso Village. They conduct initial meetings, informal discussions, and participatory activities to build trust and rapport within the community. Collaboratively conducting a needs assessment to identify specific community requirements and interests regarding science education and observation skills and utilizing surveys, interviews, and focus groups to collect qualitative and quantitative data on community knowledge of astronomy, access to educational resources, and understanding of binoculars. Curriculum Contextualization Adapt the training curriculum to suit the local context, integrating elements of community cultural heritage, folklore, and traditional knowledge related to sky observation. Collaborate with local educators to ensure the curriculum complements existing school syllabi and educational objectives. Resource Mapping Conduct a comprehensive mapping of available resources in the community, including educational facilities, potential observation sites, and local expertise. Identify potential challenges related to resource limitations, technological accessibility, and logistical considerations. Community Participatory Workshops Conduct workshops involving community members, educators, and students to co-create the training program's objectives, content, and methodology. Encourage active participation in decision-making processes to ensure community ownership.

Develop training materials in collaboration with local educators, using visual aids, regional language, and culturally relevant examples. Ensure that materials cater to diverse learning styles and are accessible to students of all educational levels. Prioritize hands-on learning experiences by conducting binocular introduction sessions for educators and students. Include demonstrations, guided exercises, and interactive activities to build confidence and proficiency in using binoculars. Plan observation trips to locations suitable for solar and terrestrial observations, ensuring safety and accessibility measures. Integrate local guides and experts to enhance the learning experience and provide insight into the significance of the observed phenomena. Implement an ongoing evaluation process to assess the effectiveness of the training program. Gather feedback from participants, educators, and community leaders to identify strengths, weaknesses, and areas for improvement. Facilitate discussions on how the community can maintain and further develop the skills gained through the training program. Encourage the formation of student clubs, community-led initiatives, or partnerships with local institutions to ensure the project's lasting impact. Document the CBR process, including challenges, successes, and lessons learned. Share findings and insights through community forums, educational institutions, and relevant platforms to contribute to the broader discourse on community-based education initiatives. The phase of this service activity can be seen in Fig 1.

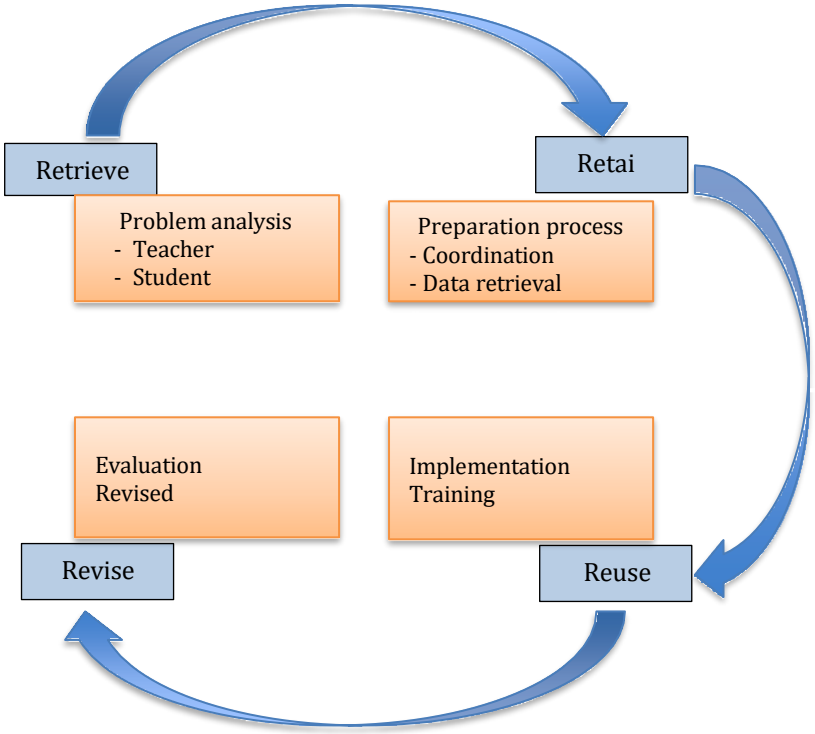


Fig 1. The phase of this service activity

3. Results and Discussion

The Implementation of Binoculars Training in Observing Sunspots and Distant Objects for Students in Bumiroso Village, Wonosobo Regency, has been completed, and the research findings explain the impact of the program on students' observation skills, scientific knowledge, and overall engagement with astronomy. This study aims to assess the effectiveness of the training program in improving students' understanding of solar phenomena, especially sunspots, and their ability to observe distant objects using binoculars—student responses to participating in solar observation training in Table 1.

Table 1. Student responses to participating in solar observation

No	Description of Student Response	Strongly agree (%)	Agree (%)
1	Working procedures for binocular optical equipment to observe solar blackspots	76.26	23.74
2	Use binoculars to observe solar blackspots	78.15	21.85
3	Level of safety and comfort when using binoculars to observe solar blackspots and very distant objects	75.17	24.83
4	The activity of introducing binocular optical equipment increases your Interest in learning about it	73.52	26.48
5	Experience of seeing solar blackspots using binoculars	72.75	27.25
6	Objects you see using binoculars	77.46	22.54
7	Assistance and guidance from the facilitator in observation activities	75.78	24.22
8	Usefulness increases your understanding of binoculars	78.12	21.88
9	Increased insight into the use of binoculars in everyday life	76.53	23.47
10	Attention and Interest in activities to introduce binocular optical equipment	76.53	23.47

No	Description of Student Response	Strongly agree (%)	Agree (%)
11	Assessment of the quality of the educational material presented in this activity	76.67	23.33
12	Opportunity to try using binoculars firsthand	79.48	20.52
13	Interest in using binoculars to observe distant objects	76.48	23.52
14	Explore further to make solar observations	74.80	25.20
15	Interest in solar observations	76.28	23.72
	Positive response from students in carrying out sun observation activities		

Students can carry out work procedures and learn to use binoculars to observe solar blackspots well. Students' Interest in solar observations and observations of distant objects is quite adequate. Observation results of the training implementation are in Table 2.

Table 2. Observation results of solar and distant object observation activities

No	Description of Result Observation	Mean	Criteria
1.	Training Materials		
	a. Mastery of introductory material on the Sun and distant objects	78.28	Students can master introductory material about the Sun.
	b. Mastery of how to use binoculars	79.16	Skillful Mastery of how binoculars work
	c. Mastery of safe and accurate observation techniques	76.89	Observations of black sunspots are less clear.
2.	Field Practice		
	a. Sun Observation Practice	74.97	Students can observe the Sun but are not able to see black spots on the Sun.
	b.Practice Observing Distant Objects	78.16	Students can observe distant objects.
	c. Discussion and reflection on the results of observations	76.39	Active Discussion after obtaining observation data
3.	Observation result		
	a. Skills in using binoculars	74.53	Adequate skills in using binoculars
	b. Interest and motivation	72.48	Relatively high Interest and motivation
	c. Drawing conclusions	70.65	Concluding observations and linking them to theory

Table 2 describes the observation results on aspects of training materials, observation practices, and analysis of observation results. Training materials include a Mastery of introductory material on the Sun and distant objects, a Mastery of how binoculars work, and accurate observation techniques. Observation practices include observing the Sun, observing distant objects, and discussing and reflecting on observation results. Observation results include skills in using binoculars, Interest and motivation, and drawing conclusions. Students' Interest in training activities for observing the Sun and distant objects can be seen in Figure 2.

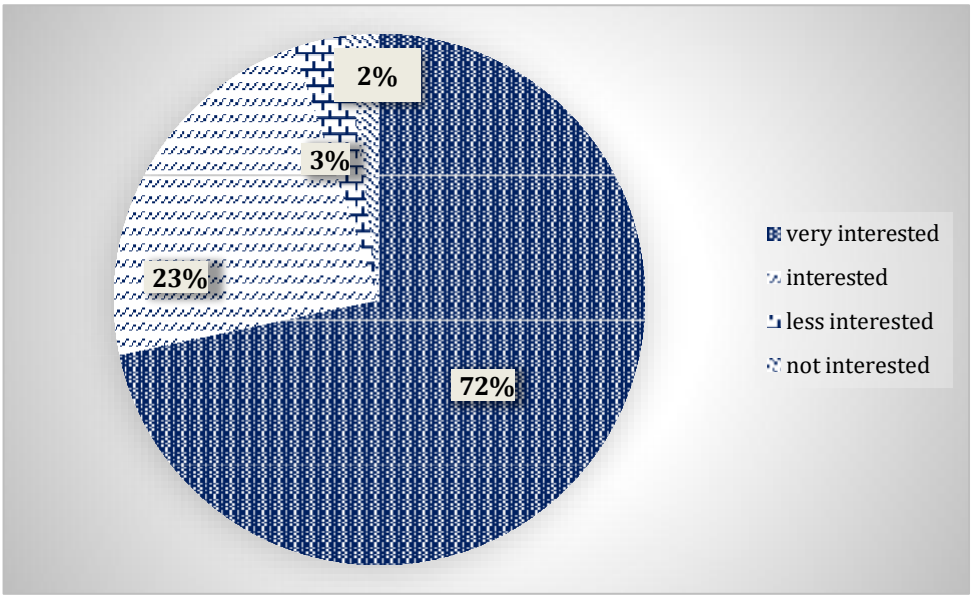


Fig 2. Interest in training activities for observing the Sun

Students in the Bumiroso village environment are highly interested in training activities for observing the Sun and distant objects using binoculars. The level of student understanding of the material and results of observations of the Sun and distant objects can be seen in Figure 3.

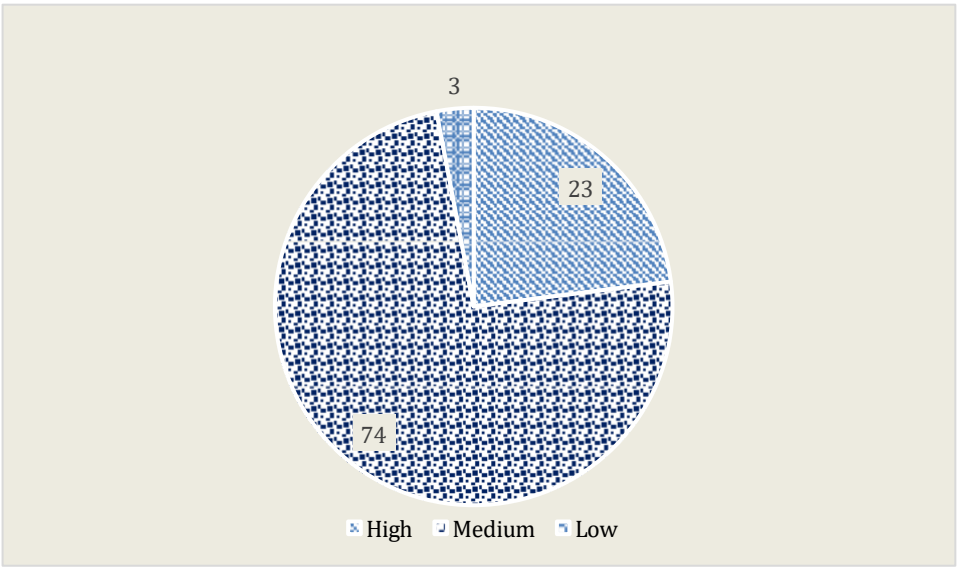


Fig 3. Level of student understanding of the material and results of completion using binoculars

Students have sufficient understanding or are in the moderate category. Students get an introduction to the material and [practice of observing the Sun, especially the Sun's black spots and observations of distant objects. The activities of mentoring and training in observing the Sun and distant objects can be seen in Figure 4.



Fig 4. Mentoring activities for observing the Sun and distant objects

Each student takes turns to try to complete the Sun and distant objects. Students make observations twice, then explain the results of each observation and discuss the results. Increased Scientific Knowledge The training program significantly improved scientific knowledge among Bumiroso Village students. The results of pre-and post-assessment assessments showed a significant increase in their understanding of solar phenomena and celestial objects. The curriculum, designed to align with the local context and integrate cultural elements, effectively engaged students and facilitated a deeper understanding of scientific concepts.

Enhanced Observation Skills The hands-on approach used in the training program, particularly during the binocular introduction sessions and observation visits, significantly enhanced students' observation

skills. Participants demonstrated an improved ability to use binoculars effectively for solar and terrestrial observations. The practical experience provided a tangible connection to theoretical knowledge, fostering a greater appreciation of the subject. Community Engagement and Empowerment The community-based research (CBR) methodology used in the program ensured active community involvement, fostering a sense of ownership and empowerment (Wong & Chen, 2023; Smith & Johnson, 2021).

Participatory workshops and collaborative decision-making processes resulted in a shared vision for the initiative, with community members expressing pride in contributing to their children's educational experiences. This community engagement has the potential for long-term sustainability and continuation of the initiative. The training results showed a change in attitudes towards science, with more students wanting to pursue further studies in astronomy and related fields. These positive changes underscore the program's potential to influence academic and career choices among participants. Several challenges were identified, including limited binocular access, technological understanding variations, and logistical constraints during observation visits. These challenges highlight the importance of ongoing community collaboration and the need for sustainable solutions to address resource constraints. In addition, the study findings emphasize the adaptability of the training program to different community contexts and the importance of evaluation and improvement.

4. Conclusion

The "Training on the Use of Binoculars in Observing Dark Spots on the Sun and Observing Distant Objects" program in Bumiroso Village, Wonosobo Regency, has culminated in a transformative journey for students and the community. This study confirms the program's efficacy in achieving its goals, fostering a new appreciation for astronomy, increasing scientific knowledge, and empowering participants. Applying community-based research (CBR) principles played a critical role in tailoring the program to the unique needs and cultural context of Bumiroso Village. By actively involving community members, educators, and local leaders in the planning and decision-making process, the initiative became a collaborative effort that reflected the collective aspirations of the village. The research findings highlight a significant increase in scientific knowledge among participating students. The contextualization of the curriculum and the integration of local cultural elements not only facilitated a deeper understanding of solar phenomena and distant objects but also strengthened students' connection to their cultural heritage. The tangible connection between scientific knowledge and local folklore created a richer and more meaningful learning experience. In addition, the hands-on approach to observation skills training, particularly with binoculars, proved to be a catalyst for transformative change. The students demonstrated an increased ability to use binoculars effectively for solar and terrestrial observations. This hands-on experience built confidence and sparked a genuine interest in science education, as shown by a change in attitude and a desire to pursue further study in astronomy.

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