



Outreach and education of children on the 2023 hybrid solar eclipse in Southwest Papua

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| ARTICLE INFO | ABSTRACT |
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| <p>Article history Received: 2024-01-02 Revised: 2024-02-05 Accepted: 2024-03-26 Published: 2024-03-27</p> <p>Keywords Astronomy Observation Outreach Solar Eclipse Southwest Papua</p> | <p>On April 20, 2023, the Southwest Papua region was the areas crossed by a hybrid solar eclipse. This outreach aims to enhance the community's understanding and awareness regarding the safety of solar eclipse observation by conducting observations at several locations in Southwest Papua. The solar eclipse education and observation Program was successfully implemented in 6 Regencies/Cities in Southwest Papua. This activity was carried out using mini-lectures, pinhole training, and joint eclipse observations. In general, this program can increase public understanding and awareness regarding the safety of observing solar eclipses, with the training participants' response score being 79.92% in the good category. Apart from that, this program has succeeded in touching and opening people's insight into this fascinating natural phenomenon through widespread publication in the mass media, both regional and national.</p> |
| <p>Kata Kunci Astronomi Gerhana matahari Papua Barat Daya Pengabdian Masyarakat Pengamatan</p> | <p>Sosialisasi dan edukasi anak mengenai gerhana matahari hybrid 2023 di Papua Barat Daya. Pada tanggal 20 April 2023, wilayah Barat Daya Papua menjadi wilayah yang dilintasi gerhana matahari hibrida. Sosialisasi ini bertujuan untuk meningkatkan pemahaman dan kesadaran masyarakat mengenai keamanan pengamatan gerhana matahari dengan melakukan observasi di beberapa lokasi di Papua Barat Daya. Program Edukasi dan Observasi Solar Gerhana berhasil dilaksanakan di 6 Kabupaten/Kota di Papua Barat Daya. Kegiatan ini dilakukan dengan menggunakan kuliah singkat, pelatihan lubang jarum, dan observasi gerhana bersama. Secara umum program ini dapat meningkatkan pemahaman dan kesadaran masyarakat mengenai keselamatan pengamatan gerhana matahari, dengan skor respon peserta pelatihan sebesar 79,92% dengan kategori baik. Selain itu, program ini berhasil menyentuh dan membuka wawasan masyarakat terhadap fenomena alam yang menakjubkan tersebut melalui publikasi luas di media massa, baik daerah maupun nasional..</p> <p style="text-align: right;">Copyright © 2024, Raharja, et al This is an open access article under the CC-BY-SA license</p> <div style="text-align: right;">  </div> |

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INTRODUCTION

One of the approaches to implementing the SDGs related to education can be identified in Sustainable Development Goal number 4. This goal directs efforts toward ensuring universal access to inclusive quality education and supports lifelong learning opportunities for all individuals (Safitri et al., 2022). In Indonesia, implementing the Sustainable Development Goals (SDGs) Program is a part of the effort to enhance and promote the well-being of society. One critical aspect is improving the quality of the education sector (Humaida et al., 2020).

Currently, the depiction of education in Indonesia indicates that the quality of education in this country still needs to catch up to the targets set in the SDGs. Education in urban areas performs better than in rural, remote, and economically disadvantaged regions (3T), including Papua (Nurfatimah et al., 2022). The challenges of education in Papua are not only limited to the lack of infrastructure in the region but also encompass issues related to the quality of education. Quality aspects, including teaching standards and student capabilities, have yet to reach the expected levels (Pribadi, 2017).

Being the largest island in Indonesia, Papua currently encompasses six provinces, one of which is Southwest Papua. This province is the result of the division of the West Papua province and officially became the 38th province in Indonesia in 2022. With a total area of 39,167 km², the section is divided into five districts and one city (Kemendagri, 2023). However, the region still faces challenges in terms of remote accessibility and limited educational infrastructure, hindering the provision of equitable education for all children in Southwest Papua.

On April 20, 2023, the Papua region was the areas crossed by a hybrid solar eclipse. This type of eclipse consists of two types: partial solar eclipse and total solar eclipse (BMKG, 2023). In Southwest Papua, a hybrid solar eclipse will not occur, but there will be a partial solar eclipse with approximately 90.58% coverage of the Sun and a Magnitude of 0.9228. The eclipse duration will be 3 hours, 7 minutes, and 35 seconds, starting at 12:10:59 and reaching its peak at 13:47:11 before ending at 15:18:34 (Time And Date, 2023). This solar eclipse phenomenon presents a significant opportunity to enhance the scientific interest of children in Southwest Papua, thus contributing to improving the quality of education in this region.

Knowledge about natural phenomena, such as solar eclipses, still needs to be improved among the communities in Southwest Papua. Therefore, an educational program on eclipse observation is necessary to help enhance understanding of science and cultivate interest in the field, particularly among children and adolescents. Students' grasp of the solar eclipse is predominantly shaped by scientific explanations and Islamic religious perspectives, which have been part of their learning since elementary school (Haristiani, 2017). Solar eclipse education can also contribute to improving the scientific literacy of the community, teaching practical scientific concepts, and involving the public in observing natural phenomena, thus aiding in the development of critical and analytical thinking skills (Buxner et al., 2021) (Haristiani et al., 2018)(Kurniawan et al., 2020) (Amartiwi, 2023). Hands-on experiences with natural phenomena could greatly enhance the interest of young learners in pursuing fields related to science (Fatima, 2016).

Furthermore, providing guidance on the safety of solar eclipse observation is crucial. Directly looking at the Sun during an eclipse without proper eye protection can lead to permanent eye damage (Mujab, 2014). Education about the correct eye protection equipment and safe methods for observing an eclipse is vital to prevent injuries and health issues (Mardiani & Boediman, 2021). Another potential avenue for development is utilizing solar eclipses as a tourist attraction for regions within the eclipse path (Haristiani et al., 2016). Solar eclipse educational programs can offer local communities the opportunity to promote their culture and the natural tourism potential of the area.

Based on the background of the issue, the researcher is interested in conducting outreach activities through the education and observation of the 2023 hybrid solar eclipse in Southwest Papua. This outreach aims to enhance the community's understanding and awareness regarding the safety of solar eclipse observation by conducting observations at several locations in Southwest Papua. The expectation is that this engagement will stimulate the community's interest to delve deeper into the universe and expand their knowledge about the world of astronomy.

Previous research aims to increase awareness of the 2016 solar eclipse among school students in Sorong. This activity took place in several schools in Sorong Regency and involved various activities such as mini lectures, pinhole training, and observing using sun glasses. The results of the research show the enthusiasm of students and teachers, at least one school held solar eclipse observations on the day of the eclipse (Raharja & Pramudya, 2016). Another study aims to correct misunderstanding by educating the public about how to safely enjoy partial and total solar eclipses. The research was carried out by educating about the solar eclipse at six Palu high schools, while another observatory at Ma Chung University, Malang, provided a filtered telescope for viewing (Rachmadian et al., 2016). Based on two previous studies, this research focuses on education, pinhole training, and collaborative observation with residents at various points throughout districts and cities in Southwest Papua. Different from previous research, this research has a wider scope. This is done when an actual eclipse occurs, so that residents can make direct observations immediately after being given pinhole education and training.

METHOD

In general, the design of the Education and Observation of the 2023 Hybrid Solar Eclipse in Southwest Papua is as follows is shown in Figure 1.

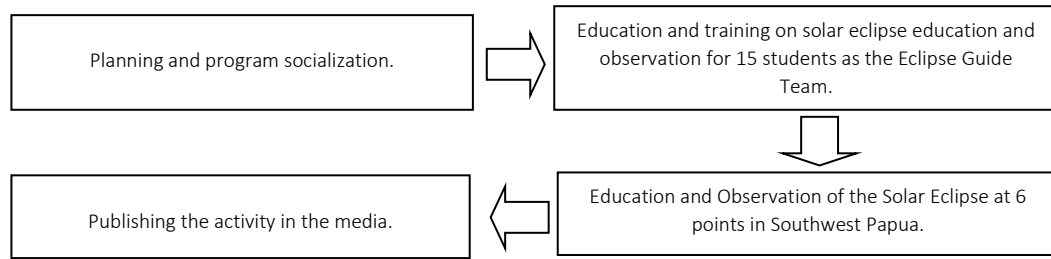


Figure 1. Design of the Education and Observation Process of the 2023 Hybrid Solar Eclipse.

The respondents of this program are children from Southwest Papua covering Sorong Regency, Sorong City, Tambraw Regency, South Sorong Regency, Maybrat Regency and Raja Ampat Regency. The audience comes from elementary school age children. Before conducting the education and observation activities, an eclipse guide team of 15 UNIMUDA Sorong students will be formed and provided with training, including: a) eclipse education, b) pinhole device creation, and 3) eclipse observation. Subsequently, these 15 students will be distributed to the six designated areas of observation as shown in Figure 2 below:

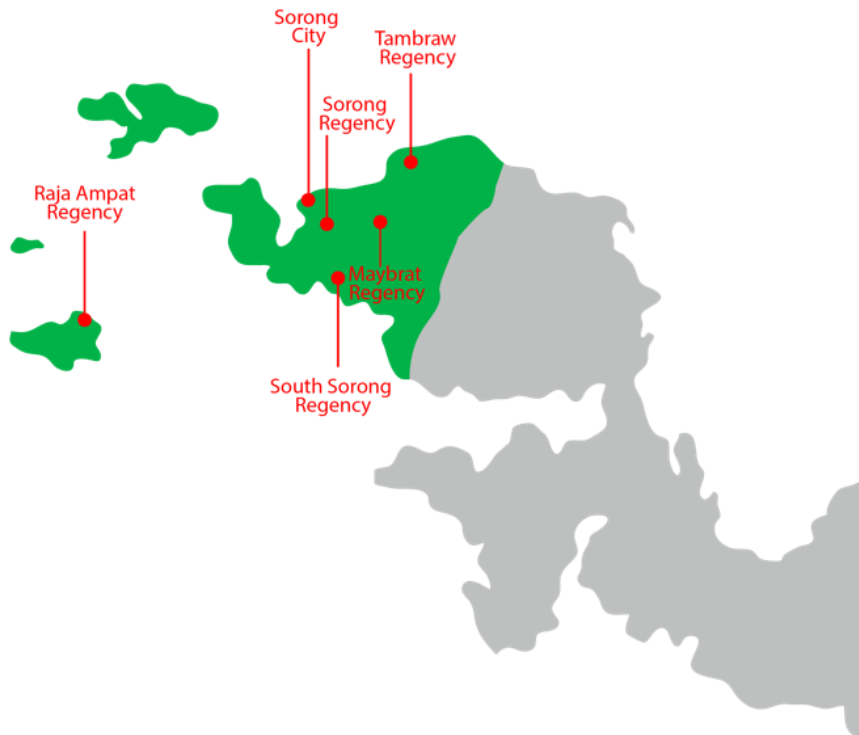


Figure 2. Six locations for observing the eclipse in Southwest Papua

From these observed areas, the team will conduct outreach to the residents and children of Southwest Papua from various backgrounds. This outreach will have several approaches, including mini-lectures, pinhole workshops, and field observations. These approaches ensure that the community gains practical experience learning astronomy, particularly about solar eclipses.

Mini Lecture

The Mini Lecture session will provide participants with essential knowledge about solar eclipses, including their causes, types, and the significance of the upcoming hybrid solar eclipse. This segment will serve as a foundational understanding for the subsequent activities.

Pinhole Workshop

In the Pinhole Workshop, participants will have the opportunity to create pinhole viewing devices, which are simple but effective tools for safely observing the solar eclipse (Maithong & Pancharoen, 2020). The eclipse workshop served as

an opportunity to enhance education in astronomy (Sebben, 2019). Experts will guide participants through the process, explaining how the pinhole works and how to use it for observation correctly.

Field Observation

During the Field Observation, participants will gather at selected observation points across districts and cities in Southwest Papua. Equipped with the pinhole devices they created, they will directly observe the solar eclipse. Experts will be present to provide guidance, ensuring safe and accurate observations. This hands-on experience will allow participants to witness the unique phenomenon firsthand and apply the knowledge gained from the Mini Lecture.

The data collected in this program includes documentation of activities, photos of the eclipse using a pinhole, and participant training responsiveness questionnaires. The indicators and statements provided in the questionnaire are indicated in Table 1.

Table 1. Participant Training Responsiveness Questionnaire

| Indicators | Statements |
|--------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------|
| Understanding of Solar Eclipse | 1. My understanding of the solar eclipse phenomenon has increased after attending this training. |
| | 2. I feel more knowledgeable about the types of solar eclipses after attending this training. |
| | 3. This training helped me understand the factors that influence the occurrence of a solar eclipse. |
| | 4. The content presented in this training provided clear explanations about the process of a solar eclipse. |
| | 5. After attending this training, I am more confident in explaining the concept of a solar eclipse to others. |
| Awareness of Safety in Solar Eclipse Observation | 6. This training provided important information on safely observing a solar eclipse. |
| | 7. After attending this training, I feel more cautious about the health risks of observing a solar eclipse. |
| | 8. The material presented in this training helped me understand the importance of eye protection when observing a solar eclipse. |
| | 9. After attending this training, I feel more prepared and know how to observe a solar eclipse safely. |
| Personal Benefits of the Training | 10. This training provided adequate explanations on how to avoid health risks while observing a solar eclipse. |
| | 11. This training has increased my interest in further understanding astronomy. |
| | 12. I am motivated to seek more information about natural phenomena, including solar eclipses. |
| | 13. After attending this training, I have gained new helpful knowledge in everyday life. |
| Training Quality | 14. This training makes me feel closer to astronomy and science. |
| | 15. The instructor in this training provided explanations in an easily understandable language. |
| | 16. The duration of this training was sufficient to cover all the presented materials. |
| | 17. This training provided ample opportunities for interaction and asking the instructor questions. |
| | 18. I am satisfied with the content provided in this training. |
| | 19. I recommend this training to friends or family interested in solar eclipses. |
| | 20. Overall, I am satisfied with my experience attending this solar eclipse education and observation training. |

Scores for each questionnaire are obtained using the Likert scale formula as follows:

$$P = \frac{S}{N} \times 100 \quad (1)$$

where,

P = Percentage

S = Total obtained score

N = Total maximum possible score

The scores is then converted into interval categories as shown in Table 2.

Table 2. Likert Scale Index

| Percentage (%) | Definitions |
|----------------|-------------|
| 80 – 100 | Excellent |
| 60 – 79 | Good |
| 40 – 59 | Uncertain |
| 20 – 39 | Fair |
| 0 – 19 | Poor |

RESULTS AND DISCUSSION

Planning and program socialization

This stage will be carried out in March 2023 by setting program goals and objectives. This involves identifying the program's primary purposes, such as increasing understanding of solar eclipses, and determining the intended audience, such as children or the general public. Furthermore, mini-lecture and pinhole training materials will also be developed and

delivered to the community (Figure 3). This stage also determines the schedule and location of observations, equipment, technology required, security measures, and permits. Apart from planning, the team also carried out program outreach, which involved creating effective promotional materials, making announcements on social media as in Figure 3, and sending invitations to potential participants.



Figure 3. Announcement poster on social media

Eclipse Guide Team Observation Training

The eclipse guide team observation training was held on April 11, 2023, at the Malak Building, UNIMUDA Sorong Campus (Figure 4). It was attended by 15 students from the Science Education Study Program, PGSD, and PAI. This training aims to equip participants with skills as competent guides in disseminating information and awareness about solar eclipses to the public. The activity contained material about the 2023 Hybrid Solar Eclipse, followed by training in making pinholes as a simple eclipse observation tool which are illustrated in Figure 4. Afterward, participants received material on observing an eclipse properly and correctly. At the end of the session, the participants were given sunglasses and a grant from the Center for Astronomical Studies (PASTRON) of Ahmad Dahlan University, which will be used at the location during the solar eclipse.



Figure 4. Eclipse Guide Team Observation Training

Education and Observation of the Solar Eclipse at 6 points in Southwest Papua

This activity was held simultaneously on April 20, 2023, involving the community in 6 districts and cities in Southwest Papua, as in Figure 5.



Figure 5. Implementation of the program at several points in Southwest Papua

The students in each observed areas are guided by students who have been given eclipse guide training. The team takes three approaches: mini workshop, pinhole training, and field observations. The results of activities in this are summarized in Table 3.

Table 3. Program Implementation Results

| No. | Location | Pinhole Education and Training | Number of participants | Results Participant Responses (%) | Solar Eclipse Observation |
|-----|----------------------------------------|--------------------------------|------------------------|-----------------------------------|---------------------------------------|
| 1. | Mariat Pantai, Aimas, Kabupaten Sorong | implemented | 20 | 78.50 | implemented |
| 2. | Rufei, Sorong Barat, Kota Sorong | implemented | 12 | 79.17 | implemented |
| 3. | Mega, Moraid, Kabupaten Tambrauw | implemented | 13 | 78.85 | implemented |
| 4. | Arne, Ayamaru Utara, Kabupaten Maybrat | implemented | 14 | 80.36 | implemented |
| 5. | Sira, Saifi, Sorong Selatan | implemented | 13 | 80.38 | implemented |
| 6. | Fafanlap, Misool Selata, Raja Ampat | implemented | 11 | 82.27 | Not implemented, due to rainy weather |

Based on Table 3, pinhole education and training can be implemented well with 83 participants involved who are residents and children at the observation location. However, as the eclipse observation time approached, there was 1 location, namely in Raja Ampat Regency, which experienced rainy weather, so direct observation of the solar eclipse could not be carried out. In the response questionnaire scored 79.92% in the good category. The questionnaire results indicate a highly successful solar eclipse education and observation training. Participants showed significant improvement in understanding the solar eclipse phenomenon and types, with enhanced confidence in explaining these concepts. The training effectively addressed safety concerns, leading to increased awareness of health risks and the importance of eye protection during observations. The program not only sparked a greater interest in astronomy but also motivated participants to seek additional knowledge about natural phenomena

The questionnaire responses were carried out after participants had observed the solar eclipse. The distribution of response and location indicator assessments can be seen in Figure 6 below:

Based on Figure 6, on the understanding of the solar eclipse indicator, the average score is 82.98 in the very good category. In the Awareness of Safety in Solar Eclipse Observation indicator, 78.76% was obtained in the good category. In the Personal Benefits of the Training indicator, the average score was 78.89% in the good category. Meanwhile, the training quality indicator obtained a score of 79.05% in the good category. For the final assessment score, the training participants' response score was 79.92% in the good category. The assessment results indicate positive feedback for the solar eclipse observation and education training. Participants demonstrated a strong understanding of the solar eclipse phenomenon, while safety awareness during observation and personal benefits of the training were also rated positively. The overall quality of the training received satisfactory evaluations. The final assessment, based on participants' responses, confirms the training's effectiveness in enhancing understanding, safety awareness, and personal benefits.

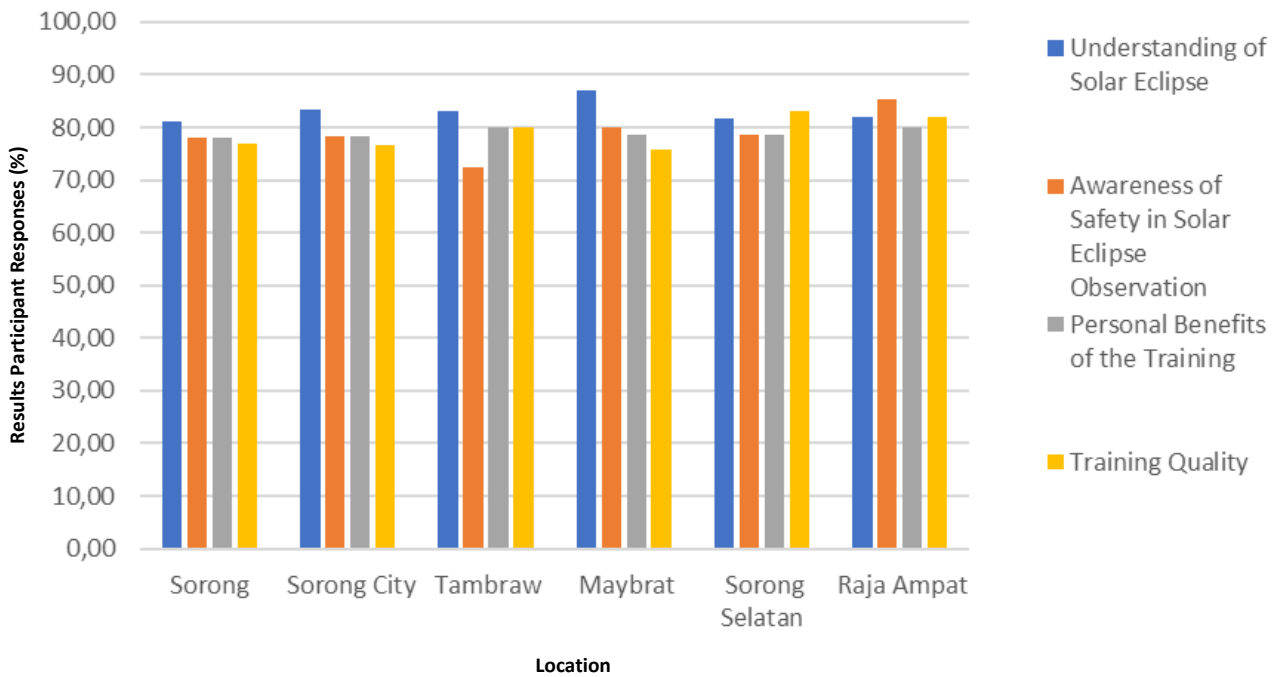


Figure 6. Results of scoring four indicators at six observation locations

Publishing the activity in the media

The solar eclipse observation activity succeeded in touching and opening people's insight into this fascinating natural phenomenon through widespread publication in the mass media, both regional and national. Media coverage helps increase public interest and participation in observing solar eclipses safely and correctly and strengthens awareness of the importance of scientific education about natural phenomena. This activity was successfully published in 5 mass media at national and regional levels. The results of media publications at this stage are shown in Table 4.

Table 4. List of mass media publications

| Media | Type | Levels | Link |
|--------------------|------------|----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Detik.com | Electronic | National | https://www.detik.com/susel/berita/d-6682880/mahasiswa-unimuda-sorong-pantau-gerhana-matahari-dengan-alat-sederhana |
| Suara muhammadiyah | Electronic | National | https://suaramuhammadiyah.id/2023/04/20/unimuda-sorong-dan-uad-kolaborasi-pengamatan-gerhana-matahari-di-papua-barat-daya/ |
| Metro TV | Television | National | https://www.metrotvnews.com/play/NrWCZBxB-mahasiswa-unimuda-sorong-buat-alat-dari-kardus-untuk-amati-gerhana-matahari |
| TribunSorong | Electronic | Regional | https://sorong.tribunnews.com/amp/2023/04/20/gunakan-alat-seadanya-unimuda-sorong-buka-10-titik-pemantauan-gerhana-matahari |
| Radar Sorong | Electronic | Regional | https://www.radarsorong.id/gunakan-alat-sederhana-unimuda-sorong-ajak-masyarakat-amati-gerhana-matahari/ |

CONCLUSION

The Solar Gehana Education and Observation Program was successfully implemented in 6 Regencies/Cities in Southwest Papua. This activity was carried out using mini-lectures, pinhole training, and joint eclipse observations. In general, this program can increase public understanding and awareness regarding the safety of observing solar eclipses, with the training participants' response score being 79.92% in the good category. Apart from that, this program has succeeded in touching and opening people's insight into this interesting natural phenomenon through widespread publication in the mass media, both regional and national. The success of this program shows the importance of scientific education about solar eclipses and contributes to increasing public awareness and interest in this rare and interesting natural phenomenon. This program is also a good example of similar activities that can be done in the future to increase public understanding of other natural phenomena.

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