

Research Article

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Enhancing astronomy literacy in Indonesia: Evaluating the impact of NASE training programs

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Abstract: Astronomy education in Indonesia faces considerable challenges due to its limited inclusion in the formal curriculum and a shortage of trained educators. The Network for Astronomy School Education (NASE) has played a crucial role in addressing these gaps by organizing structured training programs for teachers. This study evaluates the impact of NASE courses conducted between 2016 and 2024, highlighting their contributions to teacher training, student engagement, and the broader development of astronomy education in Indonesia. Through posttraining questionnaires, the study assesses improvements in teachers' understanding

of astronomy, pedagogical practices, and student interest. The increase in participants' confidence and the successful integration of NASE materials into classroom instruction highlights the program's effectiveness. The study also shows that student engagement increased with more students participating in science fairs and astronomy-related activities. However, participation in international follow-up activities organized by NASE and UNESCO remains limited. Encouraging greater involvement in these initiatives could strengthen Indonesia's presence in global astronomy education and provide valuable networking opportunities.

Keywords: astronomy education, NASE, teacher training

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1 Introduction

Astronomy fosters curiosity and critical thinking, yet in Indonesia, it is not taught as an independent subject throughout primary and secondary education. Instead, it is integrated into other disciplines. In elementary school, particularly in Grade 6, students are introduced to basic astronomical concepts such as the solar system, planets, and comets through science classes. In junior high school, topics related to astronomy appear in both physics (basic optics) and geography (Earth's motion and eclipses). At the senior high school level, astronomy is embedded in physics, covering introductory-level topics such as Newtonian gravity, Kepler's laws, optical instruments, electromagnetic radiation, relativity, and quantum physics. These topics are part of the national high school curricula currently implemented in Indonesia, namely, the 2013 Curriculum (Kurikulum 2013) and the more recent Kurikulum Merdeka (Kementerian Pendidikan dan Kebudayaan 2014, 2024). However, the materials are presented only at a conceptual and elementary level, with limited emphasis on deeper understanding or application.

Despite this limited exposure, astronomy features prominently in the National Science Olympiad (OSN), which includes a specialized category in astronomy. This annual

competition, targeting high school students, serves as the national selection for international events such as the International Olympiad on Astronomy and Astrophysics (IOAA). Indonesia has participated in such competitions since 2003 and has achieved consistent success, including medal-winning performances (Elzulfiah *et al.* 2015, Kementerian Pendidikan dan Kebudayaan 2024). These achievements highlight the strong potential of Indonesian students in astronomy. Nevertheless, to fully support and cultivate this potential, more substantial integration of astronomy into the formal education system is essential. Despite its curricular presence, the content remains limited and often lacks the depth needed to build strong astronomical literacy (Malasan *et al.* 2021).

The International Astronomical Union (IAU) formally established the Network for Astronomy School Education (NASE) in 2009 during its general assembly in Brazil, following a pilot course conducted earlier that year with UNESCO in Ecuador and Peru. NASE was created to train future teachers and re-educate current ones in the field of astronomy, focusing on both content mastery and pedagogical strategies (IAU-NASE 2024). In Indonesia, the first NASE workshop was held in 2016 at the Ma Chung University, Malang. Between 2016 and 2024, a total of seven NASE events were organized, hosted by institutions such as Institut Teknologi Sumatera (ITERA), Lampung in 2018 and 2019, Institut Teknologi Bandung (ITB), Bandung in 2020, Universitas Ahmad Dahlan (UAD), Yogyakarta in 2021, Institut Teknologi Sepuluh Nopember (ITS), Surabaya in 2022, and Universitas Negeri Jakarta (UNJ), Jakarta in 2024 (Pratiwi *et al.* 2025). While most sessions were conducted face to face, the 2020 and 2021 editions were held online due to the COVID-19 pandemic. In 2022, the program adopted a hybrid format, and by 2024, it had returned to a fully face-to-face format.

Geographically, these activities have so far been concentrated in Indonesia's most densely populated islands, namely, Java and Sumatra. Cities in Java such as Malang, Bandung, Yogyakarta, Surabaya, and Jakarta have hosted events, while Sumatra has been represented by Lampung. However, NASE participation is not limited by region, and many attendees have traveled from outside the host cities to join the programs. Across all events, more than 250 participants took part, including school teachers, university students, amateur astronomers, and science communicators.

This study presents findings on the effectiveness of NASE programs in enhancing teachers' competencies and fostering student interest in astronomy. A key objective of the NASE workshops is to encourage participants to engage in follow-up activities and join international campaigns organized annually by NASE in collaboration with UNESCO. These

campaigns, designed as simple yet educationally meaningful experiences, vary in topic each year, such as Measuring the Invisible (2018), Power of the Sun (2019), Parallel Earth (2020), Infrared and Music (2021), Latitude for Traveling and Navigate (2022), Micrometeorites (2023), Messier Challenge (2024), and Sky Colors (2025), which commemorates the International Day of Light. Although open to all global participants of NASE, Indonesian involvement in these follow-up programs remains limited. Expanding participation in such opportunities could significantly strengthen Indonesia's presence in the global astronomy education community.

2 NASE courses in Indonesia (2016–2024)

The NASE course in Indonesia from 2016 to 2024 is presented chronologically across several subsections. The 2016 edition marked its debut, introducing hands-on, culturally contextualized astronomy education. In 2018–2019, regional participation expanded, with more content delivered in Bahasa Indonesia and visits to museums and archaeological sites to highlight local connections to astronomy. During the COVID-19 pandemic, the 2020 and 2021 courses shifted fully online, using virtual observations, simulations, and instructional videos to maintain interactivity. The 2022 edition adopted a hybrid format, combining in-person and online sessions while introducing topics such as observational techniques, stellar evolution, and cosmology. In 2024, the course returned to a fully face-to-face format, featuring new workshops, astronomy-themed field trips, and broader institutional collaboration. Each subsection details the unique aspects of every course, showing how NASE has adapted and evolved in Indonesia.

2.1 NASE course 2016

The first NASE course in Indonesia took place at Universitas Ma Chung, Malang, in 2016, introducing teachers to a curriculum that combined theoretical lectures, hands-on workshops, and educational excursions. Topics included stellar evolution, cosmology, and planetary science, taught by experts from both the IAU and local universities (Ros 2012). The program also included a visit to Candi Badut, Java's oldest Hindu temple, where participants explored ancient astronomical alignments and their historical significance. Although NASE courses are ideally delivered in the local language of the host country, this first Indonesian course was

conducted in English, and the teaching materials were also not yet translated into Indonesian. Nevertheless, a total of 29 participants attended and responded enthusiastically. The success of this initial event introduced the NASE framework to the Indonesian academic and educational communities, sparking ideas for future courses that would be delivered in Bahasa Indonesia with the localized content. Some documentation of this program is shown in Figure 1.

2.2 NASE course 2018–2019

After a brief pause in 2017, the NASE course resumed in 2018 at ITERA, incorporating lessons learned from the inaugural 2016 program. This time, the full NASE curriculum was implemented, consisting of two working groups, nine workshops, and four lectures. The local organizing committee consisted of seven lecturers from ITERA,

representing diverse academic backgrounds such as astronomy, environmental engineering, biomedical engineering, mathematics, and actuarial science. The committee was responsible for facilitating the workshops and working groups, while the lectures were delivered by astronomy lecturers from ITB. Materials were presented in Bahasa Indonesia, with translated and revised PowerPoint presentations, and IAU-NASE instructors were supported by translators from the local committee. The 2018 course was attended by 19 participants, primarily high school teachers and members of amateur astronomy communities, with several attendees coming from outside Lampung.

A key feature of the 2018 course was its educational excursion to the Lampung Museum. The museum's collections spanned several categories including geology, biology, ethnography, and technological artifacts. Guided by museum staff, participants explored historical objects that reflected local astronomical knowledge. For example, the orientation of traditional houses, agricultural tools, and navigational instruments were often based on celestial references. Some activities of NASE Course 2018 are documented in Figure 2.

The following year, the 2019 course was held once again at ITERA with the same organizing team. By then, instructional tools had improved, and all teaching materials were fully localized in Bahasa Indonesia. The course maintained its practical focus and was attended by 23 participants from similar backgrounds as the previous year. In 2019, the astronomy excursion took place at the Pugung Raharjo archaeological site, a location rich with relics from multiple historical periods including the prehistoric, classical Hindu-Buddhist, and Islamic eras. Participants observed how the arrangement of megalithic stones may have followed the positions of celestial bodies, deepening their understanding of archaeoastronomy in the Indonesian context. Selected moments from NASE course 2019 are shown in Figure 3.



Figure 1: NASE participants and instructors (top) and classroom activity (bottom) during NASE 2016 at Ma Chung University (IAU-NASE 2024).

2.3 NASE courses 2020–2021 (pandemic adaptation)

During the COVID-19 pandemic, NASE Indonesia transitioned its workshops to a fully online format in 2020 and 2021. The 2020 course, initially planned as a face-to-face program at Institut Teknologi Bandung, was restructured to accommodate virtual delivery due to health restrictions. This adjustment required significant changes, particularly for hands-on activities. While some demonstrations, such as making simple spectrometers, solar models, and stellar



Figure 2: Introduction to the scale of distance (top), participants constructing a simple sextant (middle), and an astronomy visit to Museum Lampung during NASE course 2018 (bottom).

demonstrator aids, could still be conducted interactively using materials prepared in advance, other activities were replaced with instructional videos accompanied by live explanations from the local committee. The 2020 edition also introduced a new workshop on astrobiology, delivered by an IAU-NASE instructor with live translation, marking the first inclusion of this topic in NASE Indonesia.

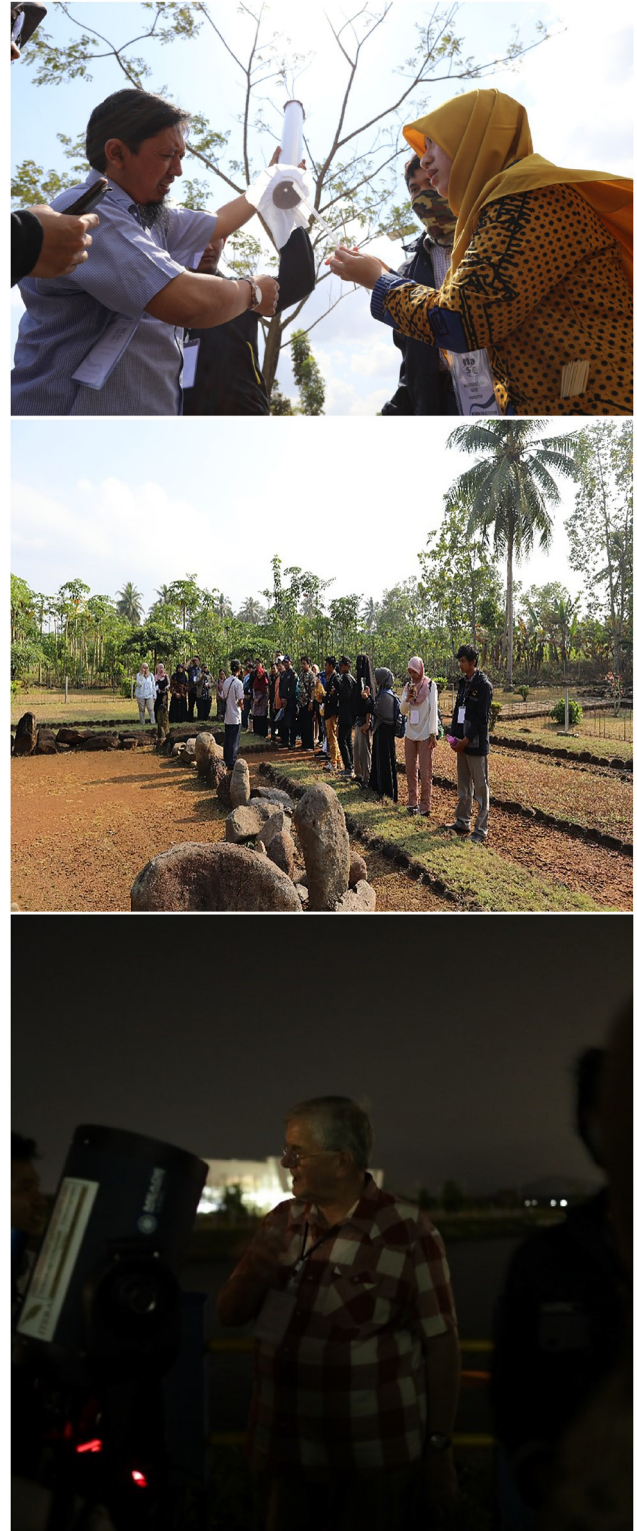


Figure 3: Observation with a pinhole camera (top), an astronomy visit to Pugung Raharjo (middle), and night observation during NASE course 2019 (bottom).

These virtual workshops featured live telescope observations, interactive simulations, and hands-on activities using readily available materials (Pratiwi *et al.* 2022). To retain experiential engagement, the program incorporated virtual sky observations through live-streamed telescope feeds, simulations, and planetarium software. Live observations were conducted using a Meade LX90 8-inch f/10 telescope (focal length 2,000 mm, aperture 200 mm) equipped with a ZWO ASI178MM camera (30 fps, 14-bit ADC, maximum exposure time 1,000 seconds). The telescope was operated from Lampung and connected to a laptop for real-time streaming *via* Zoom, allowing participants to witness the observational process remotely. Celestial targets included Moon, Jupiter, and Saturn, chosen for their visibility and educational value. Simulations were supported by Stellarium, a free and open-source planetarium application that enables users to explore the night sky interactively from any location and time. Although the online format posed limitations such as unstable internet access and reduced tactile engagement, it successfully preserved the experiential nature of NASE activities and demonstrated the adaptability of astronomy education methods in a virtual setting (Malasan *et al.* 2021).

The 2020 course attracted 85 participants from various regions of Indonesia, including areas outside Java and Sumatra such as Sulawesi and East Nusa Tenggara. To support this online delivery, a comprehensive NASE module in Bahasa Indonesia was developed, covering all lectures, and workshops. In 2021, a similar online course hosted by Universitas Ahmad Dahlan engaged 50 participants, maintaining the focus on interactive and culturally relevant learning. Selected moments from both online editions are shown in Figures 4 and 5.

In particular, the success of these online implementations in Indonesia encouraged other countries, including Russia and Bulgaria, to adopt similar virtual approaches in their astronomy education programs (Malasan 2021). While the online approach offered greater accessibility, challenges with interactivity persisted. Nonetheless, these two editions highlighted the flexibility of the NASE model and suggested the potential of hybrid formats for future programs.

2.4 NASE course 2022

Building on the successes of previous years, NASE Indonesia expanded its format in 2022 by implementing a hybrid course hosted by ITS in Surabaya. This iteration combined in-person and virtual components, allowing for

more dynamic interaction while maintaining broader accessibility. The course was facilitated by three instructors from the IAU-NASE team and supported by four local committee members. A total of 20 participants, including 14 who attended in person, came from diverse educational backgrounds such as schoolteachers, undergraduate students, and amateur astronomy communities. The curriculum emphasized data analysis using professional astronomical survey databases and introduced topics such as observational techniques, stellar evolution, and cosmology (Pratiwi *et al.* 2025). Some documentation from this hybrid course is shown in Figure 6.

2.5 NASE course 2024

After a pause in 2023 due to the national transition from pandemic to new-normal conditions, the NASE course in Indonesia resumed in 2024 with a fully face-to-face format. Hosted by Universitas Negeri Jakarta (UNJ), the program welcomed 50 participants, including schoolteachers, students, and amateur astronomy communities. This edition featured 11 hands-on workshops, two working group discussions, and three lectures. Notably, the astrobiology workshop (WS10), which had previously only been delivered *via* video, was demonstrated live for the first time. In addition, a new workshop, WS11 “cosmological timeline,” was introduced, marking the continued expansion of the NASE curriculum with topics relevant to contemporary science education (Pratiwi *et al.* 2025).

To enhance learning beyond the classroom, participants joined a field trip to Skyworld Indonesia, a space-themed educational attraction located in Taman Mini Indonesia Indah (TMII), Jakarta. TMII is a cultural park showcasing Indonesia’s regional diversity, and Skyworld serves as one of its science education centers. At Skyworld, participants explored several astronomy-focused attractions: a digital planetarium featuring immersive cosmic visualizations, a 5D cinema offering interactive space-themed experiences, a space exhibition hall displaying astronomical artefacts, and a “Rocketarium” featuring models of rockets and spacecraft. These activities provided engaging, real-world contexts for applying NASE materials and stimulated public interest in astronomy.

Nighttime observations were conducted in collaboration with the Jakarta amateur astronomy association (Himpunan Astronomi Amatir Jakarta/HAAJ), the city’s pioneering astronomy club. With their guidance, participants used telescopes to observe celestial objects, reinforcing concepts introduced during the workshops. These

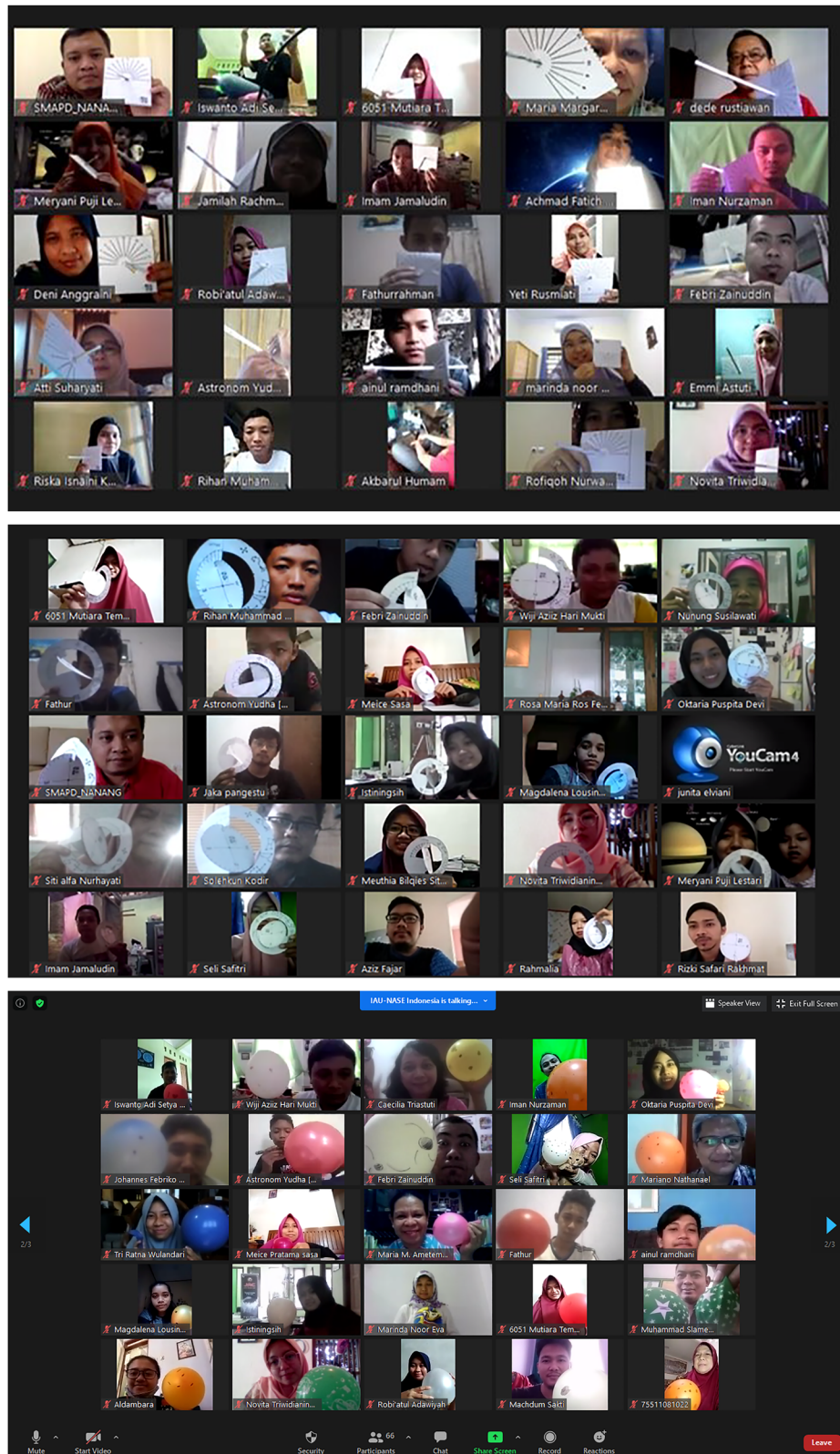


Figure 4: Virtual workshop on sundials (top), movement of stars (middle), and the expansion of the universe (bottom) during NASE 2020.

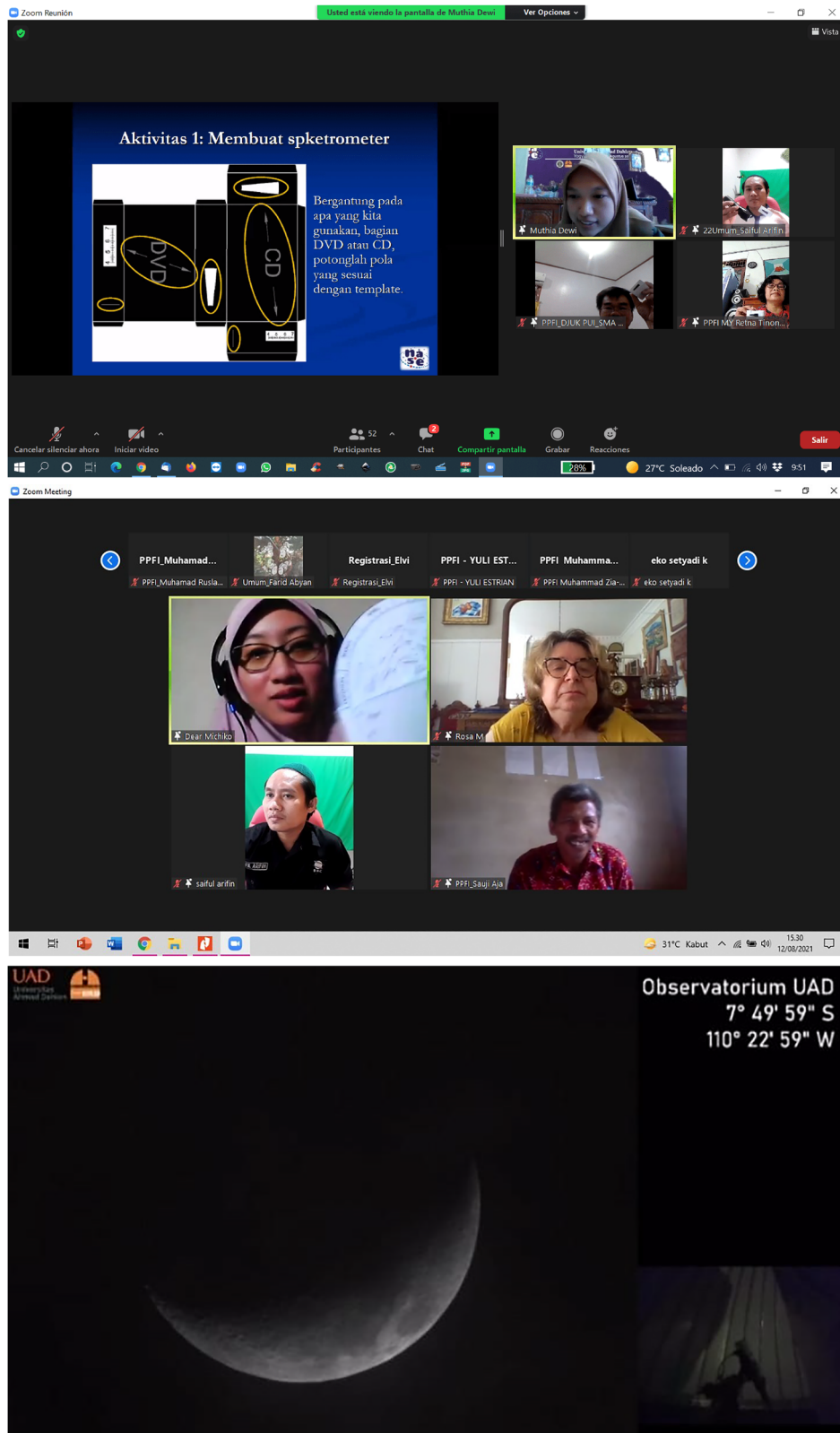


Figure 5: Virtual workshop on making spectrometer (top), moon phases and eclipse (middle), and lunar observation (bottom) during NASE 2021.

collaborative observations highlighted the practical relevance of the NASE program and demonstrated the potential for synergy between formal education and local astronomy communities. Some documentation from the 2024 course is shown in Figure 7.

The 2024 course also reaffirmed the institutional partnership among UNJ, Institut Teknologi Bandung (ITB), Institut Teknologi Sumatera (ITERA), and Universitas Negeri Surabaya (UNESA). This growing inter-university collaboration reflects a sustained commitment to expanding the reach of astronomy education in Indonesia. The increasing number of participants and institutional partners emphasizes national momentum toward inclusive and innovative science outreach programs.

3 Impact and future prospects

Posttraining questionnaires were distributed to assess the effectiveness of NASE programs and measure improvements in pedagogical approaches and student engagement. These questionnaires were intended for all participants of NASE training programs conducted from 2016 to 2024. However, due to contact limitations, only 20 of 276 participants were able to complete the questionnaires. This low response rate is an important limitation to acknowledge, as it may affect the representativeness and generalizability of the findings. One likely reason is that follow-up communication was conducted primarily through email. However, not all participants had active or regularly monitored

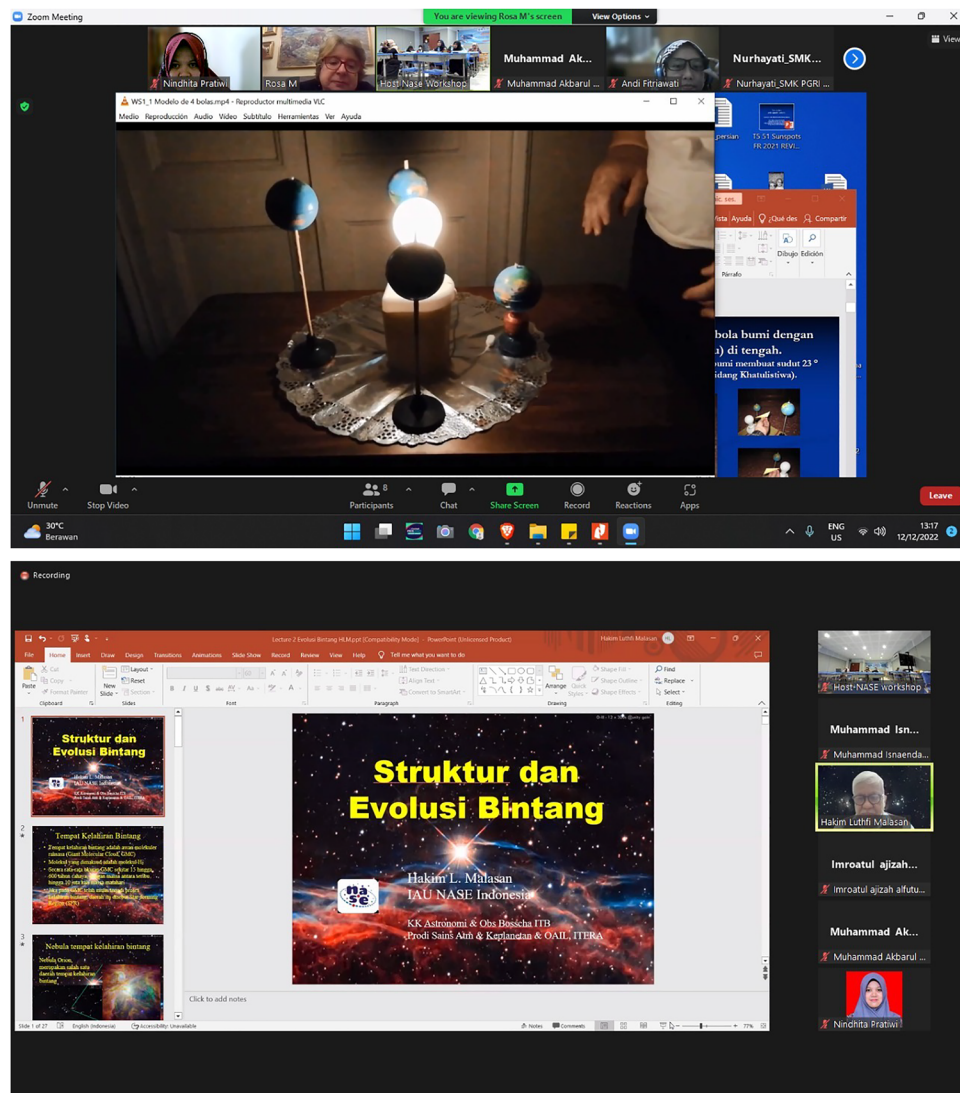


Figure 6: Demonstration of Earth's tilt and seasons (top) and a lecture on stellar structure and evolution (bottom) during NASE 2022.



Figure 7: Workshop on Earth's rotation and revolution (top), solar eclipse simulation (middle), and an astronomy visit to Skyworld (bottom) during NASE course 2024.

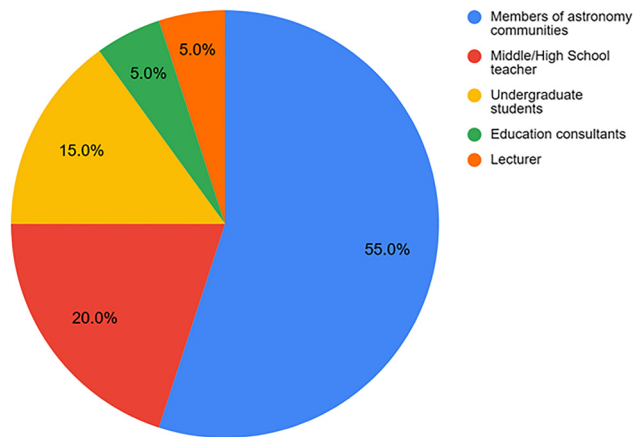


Figure 8: Distribution of participants in NASE astronomy education programs in Indonesia (2016–2024). The majority (55%) are members of astronomy communities, followed by middle/high school teachers (20%), undergraduate students (15%), education consultants (5%), and lecturers (5%).

email accounts at the time of the survey. This issue was particularly pronounced among school teachers, many of whom are not accustomed to using email as a primary communication tool, especially outside of administrative or institutional contexts. As a result, many invitations to participate in the survey may have gone unnoticed or undelivered. This highlights the need for improved post-training engagement strategies, such as collecting alternative contact information, leveraging instant messaging platforms, or distributing surveys immediately at the conclusion of the training sessions when participants are most accessible and engaged.

Between 2016 and 2024, a total of 276 participants attended NASE training programs in Indonesia, including school teachers, university students, and amateur astronomers. While this number demonstrates sustained engagement over multiple

years, it represents only a small fraction of the overall pool of potential science educators in the Indonesian education system. However, it is important to note that the number of teachers who specifically teach astronomy in Indonesia is very limited. Astronomy is not offered as an independent subject in the national curriculum but is instead integrated into general science or physics courses, particularly at the junior and senior high school levels. As a result, most astronomy content is taught by physics teachers, and even then, often only briefly or selectively – for instance, in preparation for science competitions such as the OSN. This means only a small portion of physics teachers regularly cover astronomy topics in their teaching. Given this context, the NASE program's impact is notable, as it targets and reaches a subset of educators who are otherwise underserved in formal training on astronomy content and pedagogy.

Figure 8 illustrates the distribution of participants who completed the questionnaire after the NASE training program. Of a total of 20 respondents, 55% were teachers, reflecting the program's primary target audience of enhancing astronomy education at middle or high school level. In addition, 20% of the participants were undergraduate students, suggesting that the program also attracted interest from younger learners. Another 20% were members of astronomy communities, highlighting the involvement of nonacademic participants who are passionate about astronomy. Moreover, 5% of the respondents were lecturers, indicating some level of engagement from higher education institutions. Finally, 5% of the participants identified as education consultants, showing the program's reach into the broader educational sector. This diverse participant profile underscores the wide appeal and impact of NASE training in fostering interest in astronomy across different educational and professional backgrounds.

Figure 9 illustrates the participants' self-assessed understanding of astronomy concepts before attending

Before participating in NASE, how well did you understand astronomical concepts?
(1 = Do Not Understand, 5 = Fully Understand)

20 responses

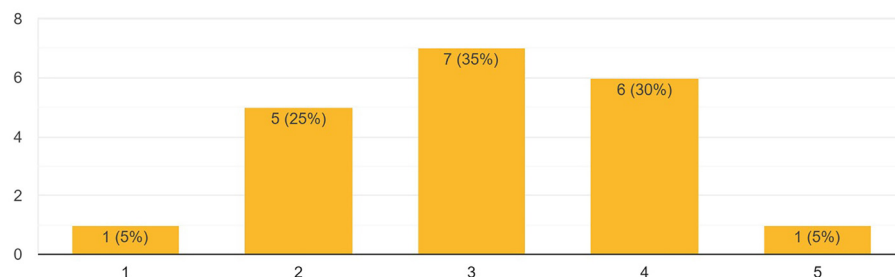


Figure 9: Participants' self-assessed understanding of astronomy concepts before attending NASE training. The majority rated their understanding as moderate (3) at 35%, followed by 30% rating it as 4, 25% as 2, and a small percentage rating it as either very low (1) or very high (5) at 5% each.

After participating in NASE, how well did you understand astronomical concepts?
(1 = Do Not Understand, 5 = Fully Understand)

20 responses

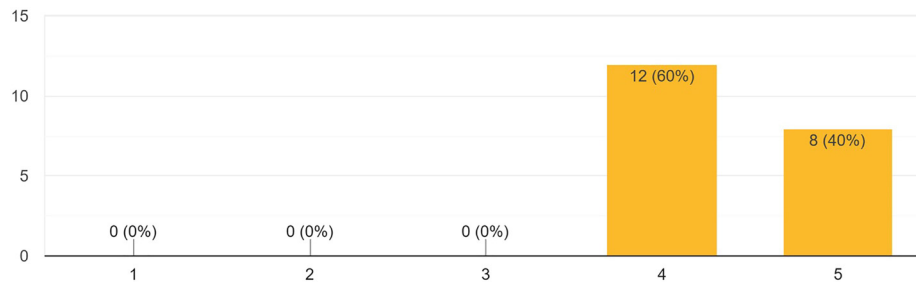


Figure 10: Participants' understanding of astronomy concepts after attending NASE. A significant improvement is observed, with 60% of respondents rating their understanding as 4 and 40% as 5. No participants rated their understanding below 3, indicating an overall increase in comprehension compared to before the program.

the NASE training program. The survey collected responses from 20 participants. The majority, 35%, rated their prior understanding at level 3 (moderate understanding). In addition, 30% rated their understanding at level 4 (fairly good understanding). Meanwhile, 25% reported a lower level of understanding at level 2. Interestingly, only 5% reported having very low or very high understanding, represented by levels 1 and 5, respectively. These results suggest that most participants had a moderate to fairly good understanding of astronomy concepts before the training, indicating that the NASE program targeted participants with varying levels of prior knowledge.

Figure 10 shows the participants' self-assessed understanding of astronomy concepts after attending the NASE training program. Of 20 participants, 60% rated their understanding at level 4 (fairly good understanding), while 40% rated their understanding at level 5 (very good

understanding). Notably, no participants rated their understanding at levels 1–3, indicating that the training significantly improved their comprehension of astronomy concepts. This shift toward higher levels of understanding highlights the effectiveness of the NASE program in enhancing participants' knowledge and confidence in astronomy.

Figure 11 illustrates how easy participants found it to implement the materials from the NASE training in their teaching practice. Of 20 respondents, 45% rated the implementation as very easy (level 5), and 30% found it fairly easy (level 4). Meanwhile, 20% reported a moderate level of ease (level 3). Only 5% found it somewhat difficult (level 2), and none of the participants rated the implementation as very difficult (level 1). These results suggest that most participants were able to integrate the NASE materials effectively into their teaching, indicating that the training provided practical and accessible content.

How easy is it for you to implement NASE materials in your teaching?
(1 = Difficult, 5 = Very Easy)

20 responses

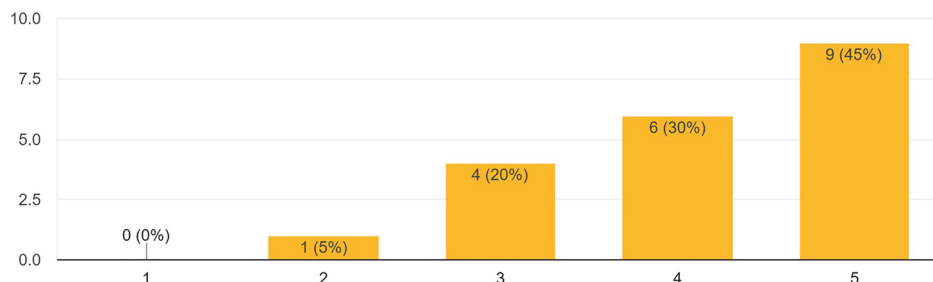


Figure 11: Participants' perceived ease of implementing NASE materials in their teaching. The majority (45%) found it very easy (5), followed by 30% rating it as 4, 20% as 3, and 5% as 2. No participants rated it as very difficult (1), indicating that most educators found the materials accessible and applicable in their classrooms.

After participating in NASE, do you feel more confident in teaching astronomy?
20 responses

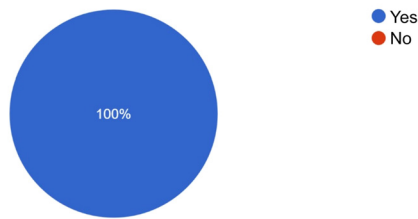


Figure 12: Participants' confidence in teaching astronomy after attending NASE. All respondents (100%) reported feeling more confident in teaching astronomy, indicating the program's effectiveness in enhancing their self-assurance in delivering astronomy-related content.

Figure 12 shows the participants' confidence in teaching astronomy after attending the NASE program. All 20 respondents (100%) answered "Yes," indicating that the training significantly boosted their confidence in teaching astronomy. This unanimous positive response highlights the effectiveness of the NASE program in enhancing not only participants' knowledge but also their teaching confidence.

Figure 13 shows whether participants have taught the astronomy materials obtained from the NASE program to their students. Of 18 respondents, 83.3% reported that they had incorporated the NASE material into their teaching, while 16.7% stated that they had not. This indicates that the majority of participants have successfully transferred the knowledge gained from the program to their students, reflecting the program's practical impact on astronomy education.

Figure 14 illustrates the students' responses to the astronomy material taught by the participants. Of 17 responses, 64.7% of the participants reported that their

Have you taught the astronomy materials obtained from NASE to your students?
18 responses

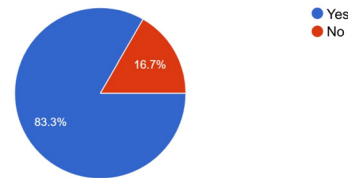


Figure 13: Implementation of NASE astronomy materials in teaching. The majority of participants (83.3%) have taught the astronomy concepts learned from NASE to their students, while 16.7% have not yet done so. This suggests a high level of integration of the program's materials into classroom instruction.

students became more interested in astronomy, while 52.9% indicated that their students actively asked questions and engaged in discussions. In addition, 11.8% of participants mentioned that their students participated in astronomy competitions or activities. Notably, none of the participants reported that there were no changes in student engagement, and 5.9% stated that they only taught or explained the material to individual students. This indicates that the NASE course program has had a positive impact on student interest and engagement in astronomy.

Figure 15 shows the participants' perception of increased student interest in astronomy after attending the NASE course program. Among 18 responses, 44.4% of the participants observed a moderate increase in student interest (rating of 3), 33.3% reported a high increase in interest (rating of 4), and 16.7% noted a significant increase (rating of 5). Meanwhile, 5.6% indicated a low increase (rating of 2), and no participants reported no increase (rating of 1). These results suggest that the

If yes, how did the students respond to the material you taught?
(Multiple choices allowed)

17 responses

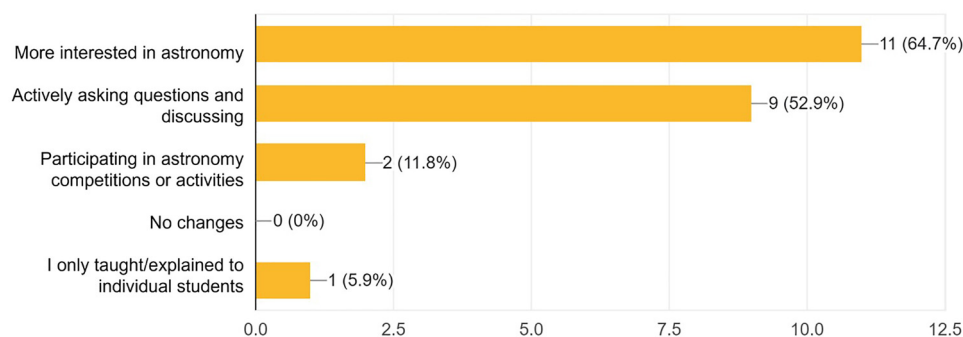


Figure 14: Student responses to astronomy lessons taught by participants. The majority of students (64.7%) showed an increased interest in astronomy, while 52.9% actively asked questions and engaged in discussions. A smaller percentage (11.8%) participated in astronomy competitions or activities, and 5.9% received astronomy explanations individually. Notably, no students showed no change in response.

Do you see an increase in students' interest in astronomy after participating in the NASE program?
(1 = No Increase, 5 = Significant Increase)

18 responses

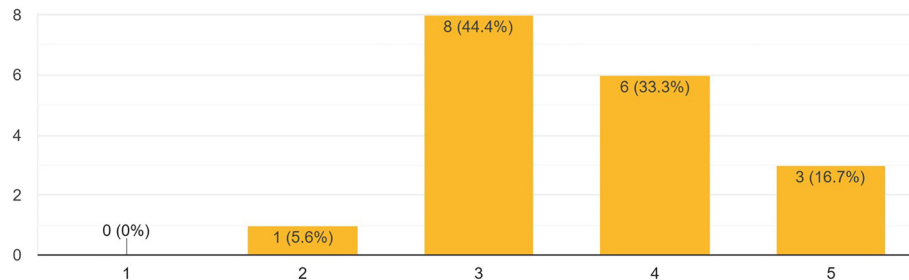


Figure 15: Perceived increase in student interest in astronomy after participating in the NASE program. The majority of respondents observed a moderate to significant increase, with 44.4% rating it as level 3, 33.3% as level 4, and 16.7% as level 5. Only 5.6% reported minimal improvement, while no respondents indicated no increase in interest.

NASE program has positively influenced students' interest in astronomy, with most participants noting at least a moderate to high impact.

Figure 16 shows the percentage of participants who have attended follow-up activities organized by IAU/UNESCO after participating in the NASE program. Of 20 responses, 30% of the participants stated that they had attended such follow-up activities, while 70% reported that they had not. The follow-up activities organized by IAU/UNESCO that participants have attended are IAU Workshop: Dark Skies Tourism 2021, 6th Shaw-IAU Workshop 2024, Asean Astronomy Camp 2025, local astronomy-related activities, regular astronomy training, *etc.*

The impact of NASE courses in Indonesia has been significant. Teachers who completed the training reported improvements in their understanding of astronomical concepts, as well as greater confidence in delivering astronomy-related lessons. Student engagement in astronomy has also increased, with more students participating in science fairs and competitions. However, participation in

NASE-led follow-up activities, such as international campaigns supported by UNESCO, remains low. Encouraging teachers and students to engage more actively in these global initiatives could increase Indonesia's visibility in the international astronomy community and provide valuable networking opportunities. Expanding Indonesian participation in these events would not only enhance personal and professional development but also strengthen the nation's contribution to global astronomy education.

Despite these successes, several challenges remain in both the enrollment process and sustained engagement. Enrolling teachers into NASE programs often relies on institutional outreach and personal networks, which do not always reach educators in remote or under-resourced regions. Many teachers face logistical constraints such as limited travel support, dense teaching schedules, or lack of encouragement from school administrations. Since astronomy is not an independent subject in the national curriculum – typically taught as a small component of physics or science – school leaders may not prioritize training in astronomy-related content. In addition, participation in international follow-up activities has been hindered by language barriers, infrequent email communication, and lack of awareness or incentives. Addressing these issues is essential for broadening the reach of NASE and building a more sustained national presence in global astronomy education initiatives.

Future prospects for the NASE course program in Indonesia include expanding its geographical coverage, particularly to underserved areas, by building collaborations with regional institutions. Developing a hybrid training model that combines online and in-person sessions could further improve access and flexibility. Strengthening partnerships with universities and educational institutions – such as

After participating in NASE, have you ever joined follow-up activities organized by IAU/UNESCO?

20 responses

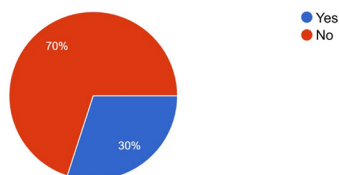


Figure 16: Participation in follow-up activities organized by IAU/UNESCO after attending the NASE program. The majority (70%) of respondents reported not participating in further activities, while 30% indicated that they had.

ITERA, ITB, and UNESA – would enhance the program's sustainability and instructional quality. Finally, designing a more structured follow-up mechanism and providing more accessible channels for postcourse engagement could help boost participation in NASE-led global activities and support the long-term growth of astronomy literacy in Indonesia.

One strategic avenue to realize these goals is through collaboration with the Timau National Observatory, currently under development in East Nusa Tenggara (NTT). Located at the base of Mount Timau in Kupang Regency, this observatory will feature a 3.8-m optical telescope – the largest in Southeast Asia – designed for optical and near-infrared observations (Priyatikanto *et al.* 2023). The project is a joint effort by the national research and innovation agency (BRIN), Kyoto University, and several Indonesian institutions, including ITB and Nusa Cendana University (UNDANA). With its favorable astronomical conditions and commitment to public outreach, the Timau Observatory is well positioned to serve as an educational hub. Integrating NASE courses into its outreach initiatives – through teacher training, student workshops, and community programs – could greatly enhance the reach and impact of astronomy education, particularly in the eastern regions of Indonesia.

4 Conclusion

The NASE course programs conducted in Indonesia between 2016 and 2024 have significantly enhanced astronomy literacy by improving teachers' understanding and boosting student interest in the subject. The increase in participants' confidence and the successful integration of NASE materials into classroom instruction highlights the program's effectiveness. However, low participation in international follow-up activities remains a challenge. Strengthening institutional support, increasing collaboration with local and international organizations, and developing a more structured follow-up mechanism could improve long-term outcomes. Greater engagement in global initiatives would not only elevate Indonesia's standing in the international astronomy community but also foster sustained improvements in scientific literacy and educational quality. In the future, wider geographical coverage of NASE courses in Indonesia will be planned by building collaboration with local resources, especially in remote areas. The planned Timau National observatory in Timor island can provide a good basis to conduct NASE courses beyond Java and Sumatra Islands.

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