Service Learning in Astronomy Outreach: Engaging Secondary School Students in Malaysia

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DOI: https://dx.doi.org/10.47772/IJRISS.2025.903SEDU0055

Received: 19 January 2025; Accepted: 23 January 2025; Published: 26 February 2025

ABSTRACT

Service learning has emerged as a promising pedagogical approach to engage secondary school students in astronomy outreach initiatives within the multicultural context of Malaysia. Grounded in the diverse cultural tapestry of Malaysia, this study examines the impact of service learning in promoting active citizenship and community involvement among secondary school students. Through collaborative projects, hands-on activities, and experiential learning opportunities, students embark on a journey of exploration and discovery, connecting classroom knowledge with real-world applications in astronomy. The outcome of this endeavor includes increased student participation, enhanced scientific literacy, and a deeper appreciation for cultural diversity within Malaysian society. A set of questionnaires were distributed to 120 participants who involved in the service-learning program. The result show that 95% of the respondents agreed that their got positive impact, new knowledge and enhance their innovation perception from the knowledge sharing and hands-on activities. In conclusion, by empowering students to take ownership of their learning and contribute meaningfully to their communities, service learning in astronomy outreach has the potential to inspire the next generation of scientists, leaders, and global citizens.

Keywords - astronomy, service learning, outreach, student, secondary school

INTRODUCTION

The notion of astronomy can encourage a sense of wonder and interest which explains the reason it can be of great use in teaching children. In countries like Malaysia where there are campaigns to endorse the STEM subjects, the combination of learning astronomy with the service-learning projects makes for an interesting method of education. Service learning is an effective instructional method that combines community service with academic education, which aims to instill civic engagement and useful skills in students [3]. In the field of STEM education, service learning becomes an effective tool that allows for the fusion of theory and practice. Such is the very field of Astronomy that can be effortlessly used to spark interest in children and to boost such programs. If partnership programs are built with content of astronomy and outreach programs, teachers could create programs that not only generate interest in children towards science but also generates interest towards cultural engagement and active citizenship.

Malaysia being a multicultural nation is a good starting point for the implementation of service-learning programs which center around astronomy. There are many blind spots in understanding the outcomes of such programs in the context of the Malaysian diverse culture and its efforts to develop in the education space. The Malaysian Education Blueprint 2013-2025 strives to prepare students for 21st century challenges by teaching critical and creative thinking, thinking and engaging in teamwork, communication, and technical skills concentrated on STEM subjects [8]. Learning through service in astronomy responds these national educational aspirations, taking care of the socio-cultural aspects too.

Service Learning

Service learning to popularize astronomy among Malaysian secondary school students was explored through various initiatives aimed at enhancing engagement and understanding of scientific concepts. These programs not only promote academic knowledge but also community involvement and personal growth of students.

Research has previously shown that service learning significantly improves students' engagement and learning experience. Service learning promotes both academic and personal growth and is regarded as a revolutionary method of education, as noted by [4]. Programs based on service-learning principles have been shown to improve scientific literacy and motivate students to join STEM workforce in the area of astronomy outreach [2]. This is further evidence that service learning can be an answer to the problem of the decreasing interest in STEM among young population globally.

In Malaysia, even though there are attempts to enhance STEM education, the lack of resources available to various underserved communities especially rural areas remains a big obstacle. SULAM Initiative: The Service-Learning University of Malaysia (SULAM) program for example has integrated community service with academic learning to significantly improve students' knowledge and skills, especially in financial planning [6].

Astronomy education supported with service-learning programs can address this issue by providing active and engaging character space resources to areas with insufficient resources for science. Science can be brought closer to students through stargazing, workshops, hands-on activities, and projects which eventually lead to an inspiring sense of discovery. For example, the Astronomy Extracurricular Activities that conducted by Universiti Teknologi Malaysia implemented a service-learning approach that included astronomy talks, workshops, and stargazing events, resulting in more than 80% of primary school students gaining a deeper understanding of astronomy concepts [9].

The incorporation of cultural elements into astronomy outreach significantly enhances the relevance and attractiveness of these initiatives. For example, integrating Malaysian folklore and legends associated with celestial bodies offers a distinctive method to link scientific principles with cultural traditions. This strategy not only enriches the educational experience but also fosters cross-cultural understanding and appreciation. This paper intends to investigate the implementation and outcomes of service-learning programs in astronomy outreach targeted at secondary school students in Malaysia. Through the analysis of case studies, program frameworks, and impact evaluations, this research aims to offer insights and recommendations for educators, policymakers, and stakeholders who are interested in utilizing service learning as a means to advance STEM education and community involvement. The results underscore the potential of such programs to motivate the upcoming generation of Malaysian scientists, leaders, and global citizens, thereby contributing to both national and international progress in STEM education and outreach.

Service learning in astronomy encompasses a systematic methodology that combines educational goals with service initiatives. This framework is comprised of three interrelated stages: educational aims, community involvement, and reflection and evaluation [15], [17]. A visual depiction of this framework can be found in Fig 1.

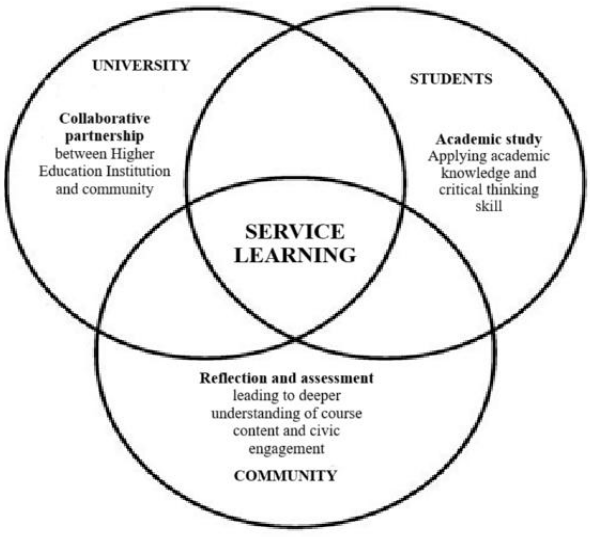

Fig. 1 The service-learning conceptual framework (Adapt from [15])

(1) Educational Aims consist of:

a. Fundamental Concepts: Students are introduced to essential topics in astronomy, including the solar system, constellations, celestial navigation, and introductory astrophysics.

b. Skill Acquisition: Students acquire skills in operating telescopes, utilizing astronomy software, and analyzing astronomical data.

c. Collaborative Learning Environment: Workshops and interactive sessions promote learning through peer collaboration.

(2) Community Involvement:

a. Outreach Initiatives: Students develop and implement outreach programs such as stargazing events, interactive exhibitions, and educational presentations for the local community.

b. Educational Resources: Development of astronomy kits, posters, and booklets designed for various age demographics.

c. Inclusivity Initiatives: Special programs aimed at bringing astronomy education to underserved communities and schools.

(3) Reflection and Evaluation:

a. Personal Development: Students reflect on their learning experiences through journals or presentations, considering their contributions to the community and the enhancement of their knowledge.

b. Effectiveness Assessment: Surveys and feedback tools are utilized to evaluate the success of the outreach programs and to identify opportunities for improvement.

c. Mentorship Roles: More experienced students provide guidance to younger participants, fostering a sustainable cycle of learning and community service.

This organized framework ensures that service learning in astronomy is both educational and beneficial for students and the community alike.

Implementing Astronomy Outreach Programs

Implementing astronomy awareness programs in Malaysia involves a strategic approach that combines partnerships, training and innovative methodologies. To begin with, partnerships with local organizations, such as National Planetarium are essential. These collaborations provide critical resources that are hard to obtain in schools, such as telescopes, educational materials, and expertise. By pooling resources, these partnerships enable outreach programs to reach a broader audience, especially in underserved communities.

The next step will be training and workshops to equip students with the skills to effectively organize off-site events. These sessions will focus on practical skills such as using telescopes, using astronomy software and giving public presentations. In addition, the seminars on effective communication and interactive educational methods are preparing students to interact with various viewers, guarantee that information and propaganda activities are also educational and comfortable.

Public projects make up the centre of these programs.

These projects are designed to address specific needs, such as organizing public stargazing nights. For instance, mobile observatories can bring the wonders of the night sky to remote areas, offering people an opportunity to experience astronomy first hand.

At the same time, educational kits designed for different age groups ensure that even those with no prior experience in astronomy can participate meaningfully. Another key element in implementing awareness programs is the introduction of technology [18]. Tools such as virtual planetarium, expansion reality, online platform applications, etc., can easily access and attract astronomy to technical generations [18].

With virtual planetarium, students can explore the universe from the class, and application applications revive heaven objects and improve their educational experience. Additionally, online platforms can be used to conduct virtual stargazing sessions, expanding the reach of these programs beyond geographical boundaries.

Finally, sustainability is a key factor. Regular feedback from participants and community members helps refine and improve the program, and mentoring opportunities, where more experienced students guide newcomers, ensure the continuity of these efforts. With a focus on education, collaboration and innovative solutions, the astronomy outreach programme can foster a lasting interest in science among Malaysian students whilst fostering a sense of community engagement and responsibility.

Program Evaluation Model

Kirkpatrick's training evaluation model provides a solid foundation for evaluating the effectiveness of education initiatives such as the Malaysian Astronomy Service-Learning Program. The model comprehensively evaluates student engagement, knowledge acquisition, behaviour change, and long-term impacts through systematic evaluation of four levels: reaction, learning, action, and outcome [12], [13], [14]. Below we provide a detailed description of the assessment methods used at each level in the context of astronomy outreach.

(a) Reaction Assessment

At this level, the model evaluates students' immediate reactions to the interaction program. Feedback focuses on how engaging, relevant, and enjoyable they find the activities. Secondary school students are more likely to respond positively if outreach activities are interactive and relevant to their everyday lives, such as stargazing sessions, hands-on activities with telescopes, and lessons on the cultural and scientific aspects of astronomy [12].

(b) Learning Assessment

This level assesses the knowledge and skills acquired by students during the program. In the context of popularization of astronomy, the learning outcomes might include understanding celestial phenomena, recognizing constellations, applying astronomical concepts to everyday observations, etc [13].

(c) Behaviour Assessment

At this stage, the main precautions are paid, regardless of whether students have learned what they have learned in everyday life or university classes. For example, are students starting to observe the night sky independently using the applications and tools presented during the program? Are they more likely to integrate astronomy into their school projects or their scientific fair submissions? [14]

(d) Result

The final level assesses the broader impact of the outreach initiative on students and their community. For example, has the program increased students' interest in science, technology, engineering and mathematics? Did this stimulate many schools by integrating astronomy into science programs? Did this improve the knowledge of astronomy in Malaysia's cultural heritage and scientific development? [12]. A set of questionnaires were distributed to 120 participants who involved in the service-learning program. The questionnaires were process using statistical software.

RESULT AND DISCUSSION

A questionnaire containing nine questions was distributed to the participants. The questions were designed to

gather information about the effectiveness of this project. Respondents should provide their answers based on the "Likert" scale. Scale 1 represents indicators of strong disagreement with their perception and awareness of the importance of this project. On the other hand, scale 2 represents an indicator of their disagreement with the perception and awareness of the importance of this project. Next, a scale of 3 shows an uncertain indicator of their perception, and awareness of the importance of the project. A scale of 4, on the other hand, shows an indicator of agreement on their perception, and awareness of the importance of this project. Last but not least is a scale of 5, where the indicators strongly agree on the evaluation of this project.

The questionnaire was distributed to all participants. The participants have answer all of the questions and returned the questionnaire for analysis. The participants consisted of 42.5% (n=51) male participants and 57.5% (n=69) female participants. Based on the knowledge acquisition, overall result shows that, the measurement of the participants' knowledge level about this technology (Fig. 2) is 95% (n=114) of the participants did not know astronomy before participating in this program. Meanwhile, almost 5% (n=6) of the participants knew little about astronomy. As noted in [6], service-learning programs like SULAM have been effective in bridging resource gaps in underserved communities.

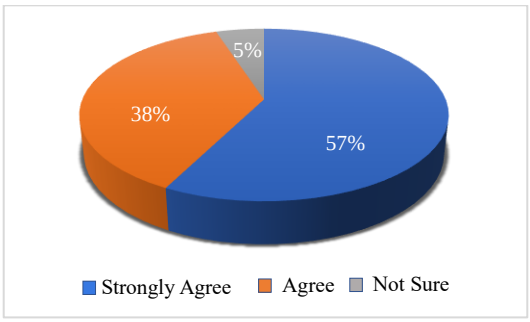

Fig. 2 The level of knowledge of participants on the knowledge presented

Next, based on the student engagement in this program, a total of n=120 or 100% of participants agreed and strongly agreed that this program is very important in enlightening them related to astronomy and they are ready to deepen this knowledge to be applied in their daily lives as shown in Fig. 3. This related to [4] who has highlighted the balanced approach of service learning in integrating academic knowledge with community engagement. The increased scientific literacy and engagement among Malaysian secondary students align with global findings that service learning motivates students toward STEM careers and improves their understanding of science concepts.

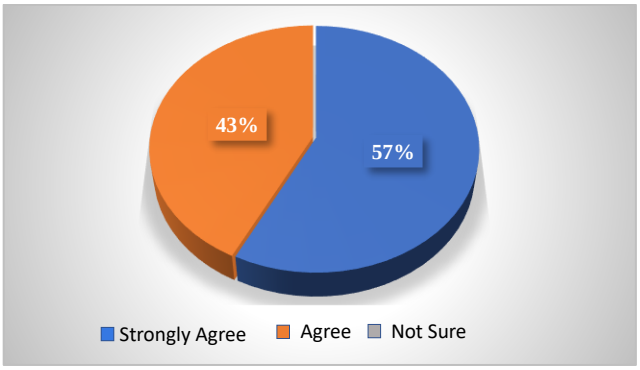

Fig. 3 Participants' views on the programs that have been implemented

Based on behaviour change in Fig. 4, a total of 95% (n=114) of participants agreed to give positive feedback on the changes in this program, compared to 5% (n=6) of participants who were uncertain. Meanwhile, 100% (n=120) of the participants indicated that they had mastered some or all of the skills in this technology/method – see Fig. 5. The finding show that the integration of Malaysian folklore in astronomy outreach, as discussed in your study, parallels findings by [9], where cultural relevance in astronomy education significantly enhanced student interest and participation. This approach strengthens cross-cultural appreciation and contextual learning.

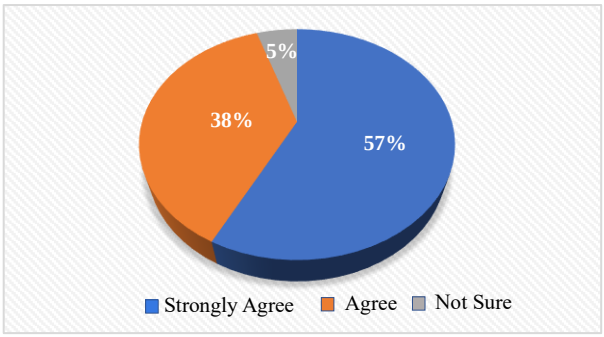

Fig. 4 Participants' responses to the program that has been implemented

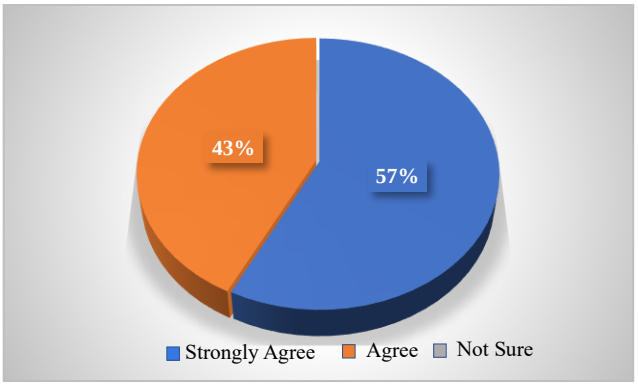

Fig. 5 Participants' views on the mastery of knowledge that has been they get from the

Furthermore, for long-term impacts as shown in Fig. 6, 97% (n=116) of the participants will continue to adopt the innovations resulting from this project and 3% (n=4) of the participants are still unsure to use the innovations that have been delivered. Meanwhile, a total of 120 (100%) participants showed that they had acquired the desired skills – please refer to Fig. 7 below.

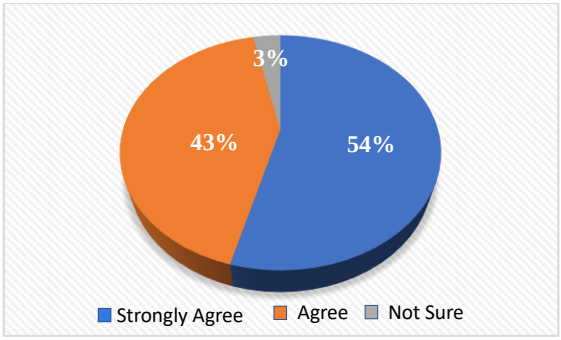

Fig. 6 Participants' views on the direct use of the innovations that have been implemented from this project.

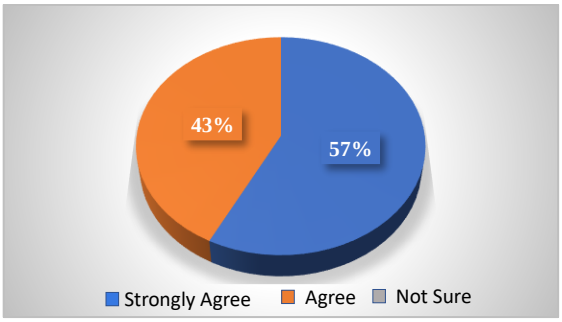

Fig. 7 Participants' views on the mastery of knowledge they have gained from the program

Based on Fig. 8, a total of 114 (96%) participants will continue to maintain this change and will continue to apply the knowledge that has been conveyed through this program. Next, 114 participants or 95% of

respondents benefited economically from the above changes – see Figure 8. Meanwhile, based on Fig. 9, 114 (95%) participants benefited from the changes obtained after the program.

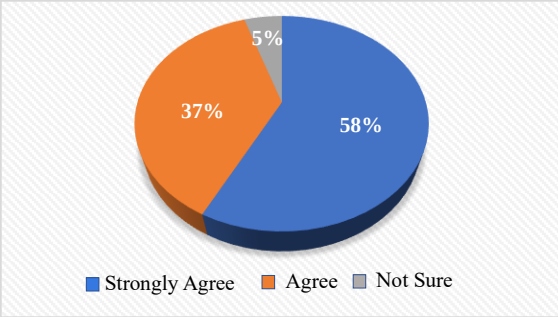

Figure 7: Participants' views on the retention of dominance knowledge they have gained from the program.

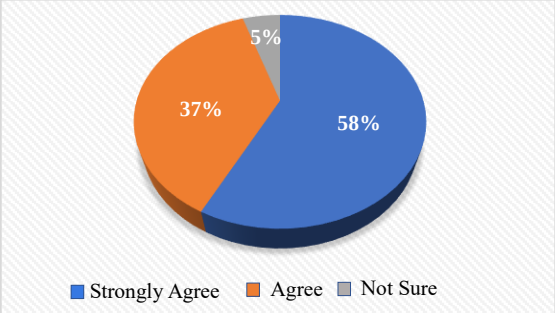

Figure 8: Participants' views on the economic benefits they have Earn from the program

CONCLUSIONS

The Astronomy Service-Learning Initiative, which engages secondary school students in Malaysia, has demonstrated great potential as an effective educational tool to stimulate interest and participation in astronomy among young students. By integrating service-learning and hands-on astronomy activities, the program successfully bridges the gap between theoretical knowledge and real-life applications, promoting a deeper understanding of science and its relevance to everyday life.

The program emphasizes active participation and contextual learning and is particularly suited to the educational needs of secondary school students. Through structured sessions, students will gain an understanding of key astronomy concepts, tools and techniques including celestial navigation, telescope operation and stargazing techniques. In addition to technical knowledge, this program proposes critical thinking, problem solving issues, and important curiosity for STEMs education and learning throughout their lives.

Participants' comments have a very positive response and emphasize the success of programs in creating a comfortable and efficient educational environment. Hands-on activities and interactive sessions played a key role in maintaining students' interest and deepening their understanding of complex astronomy concepts.

Moreover, the evaluations of the program revealed significant improvements in participants' knowledge and skills, highlighting the program's educational effectiveness. This change in behaviour demonstrates the program's ability to spark a lasting interest in science and help develop future STEM enthusiasts. The program's broader societal impact is also noteworthy. By nurturing astronomy among young learners, this initiative promotes stem education and contributes to Malaysia's efforts to create scientifically literary society. The success of the program emphasizes the importance of activities that enhance the awareness of achieving these purposes, and provides similar initiative models in other areas.

In conclusion, the service-learning initiative in astronomy outreach is a powerful example of how innovative educational approaches can inspire students, enhance learning, and foster long-term engagement in science. Its

success can be attributed to its participant-centred design, cultural relevance, and emphasis on practicality. To have a greater impact, future iterations of the programme could expand to include more schools, develop partnerships with educational institutions, and integrate new technologies such as virtual reality or augmented reality to enrich the learning experience. With sustained efforts and continuous improvement, this outreach initiative has the potential to transform the way astronomy is taught and learned, creating a new generation of scientifically literate and astronomy-enthusiastic students in Malaysia.

ACKNOWLEDGMENT

We would like to thank to those who has contribute idea and guide us to accomplish the mission of this study. This research is financially supported by the Malaysia Ministry of Higher Education and Universiti Teknologi Malaysia who has been directly support this study with the Fundamental Grant Universiti Teknologi Malaysia (No. Q.J130000.3852. 23H06) and Centre for Industry and Community Networking (CCIN) which has funded this project was given a grant (UTM KTP-RIG) 2024, CE/204/00092. We extend our heartfelt gratitude to the Secretariat of the IAU Pro-Am Sub-Community Education Sub-Working Group for their invaluable support and guidance throughout this study. Their dedication and expertise have been instrumental in shaping the vision and execution of this project. We deeply appreciate their efforts in fostering collaboration and innovation in astronomy education and outreach.

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