



PLANNING MALAYSIA:

Journal of the Malaysian Institute of Planners

VOLUME 23 ISSUE 4 (2025), Page 809 – 824

BRIDGING INTEREST AND POTENTIAL OF ASTROTOURISM IN MALAYSIA: BARRIERS, OPPORTUNITIES, AND STRATEGIES

**Mohd Hafiz Hanafiah^{1*}, Ermy Azziaty Rozali², Roziah Sidik @ Mat Sidek³,
Fariza Md Sham⁴, Muhammad Hafez Ahmat Murtza⁵**

¹ *Faculty of Hotel and Tourism Management,
UNIVERSITI TEKNOLOGI MARA MALAYSIA*

^{2,3} *Faculty of Islamic Studies & Institute of Islam Hadhari,*

⁴ *Institute of Islam Hadhari,*

UNIVERSITI KEBANGSAAN MALAYSIA

⁵ *APADILANGIT SPACE ACADEMY, MALAYSIA*

Abstract

This study examines the emerging astrotourist behavior, perceptions, and expectations by focusing on their interest in astronomy, awareness of astrotourism, amenities, accessibility, activities, and its value chain contributions. Using a cross-sectional design and purposive sampling, 117 responses were collected via face-to-face interviews and online surveys and analyzed descriptively. The study reveals a significant gap between interest (61.5%) and participation (13.7%) in astronomy tourism in Malaysia, driven by barriers like accessibility and awareness. Most respondents stressed the importance of basic astrotourism activities like stargazing and astrophotography. Findings highlight astrotourism's economic, educational, and spiritual value, emphasizing its untapped potential. The study emphasizes targeted marketing, infrastructure, and community engagement to bridge gaps between the products, operators and astrotourists for sustainable astrotourism growth in Malaysia. While demand for astrotourism is emerging in Malaysia, broader engagement requires targeted marketing, enhanced amenities, and competitive offerings.

Keywords: Astrotourism; Barriers; Opportunities; Strategies; Malaysia

¹ Corresponding author. Email: hafizhanafiah@uitm.edu.my

INTRODUCTION

Astrotourism, a rapidly growing niche within special interest tourism, offers travelers opportunities to explore celestial phenomena, connect with the cosmos, and experience the beauty of dark skies. Activities such as stargazing, observing celestial events, visiting observatories, and exploring astronomical heritage sites merge recreational and educational elements, appealing to diverse audiences from amateur enthusiasts to seasoned astronomers (Tapada et al., 2021). Advancements in astronomical knowledge and heightened awareness of light pollution's impact on natural nightscapes have supported the development of astrotourism (Falchi et al., 2016; Ruggles & Cotte, 2010). Recognizing astrotourism's potential to attract high-value, environmentally conscious visitors, destinations increasingly focus on preserving dark skies and promoting astronomical experiences.

However, challenges persist. Light pollution, driven by urban expansion and inadequate policies, significantly compromises dark skies and celestial visibility (Cinzano et al., 2001; Kyba et al., 2015). Additionally, limited infrastructure and accessibility in remote stargazing locations hinder development, as do low awareness levels about astrotourism's economic and educational benefits (Jacobs et al., 2020). These challenges restrict tourist experiences and the contributions of astrotourism to sustainable tourism and community development.

Despite growing interest, research gaps remain. Few studies have deeply examined tourist behavior, perceptions, and expectations related to astrotourism, including their interest in astronomy (Weaver, 2011; Soleimani et al., 2019). Further investigation is needed into the role of awareness campaigns and interpretive programs in enhancing public understanding and the accessibility and amenities required for astrotourism destinations (Ramdlani et al., 2025). Additionally, limited attention has been given to astrotourism's value chain contributions, including its economic impact on rural areas and integration into sustainable tourism strategies (Pašková et al., 2021; van Wyk-Jacobs, 2018).

Malaysia's equatorial position allows visibility of constellations from both hemispheres, enhancing its appeal to astronomy enthusiasts (The Star, 2024a). Certified stargazing sites in Kota Belud, Sabah, and Mersing, Johor, reflect efforts to provide safe and comfortable experiences for astrotourists (New Straits Times, 2019; The Star, 2024a). The Ministry of Tourism, Arts, and Culture has identified astrotourism as a strategic focus, supported by initiatives like Dark Sky Malaysia, which promote sustainable development and train guides (Astro Awani, 2022; The Star, 2024b).

This study examines astrotourist perceptions and expectations, focusing on their astronomy interest, awareness, activities, and value chain contributions to identify astrotourism barriers, opportunities, and strategies. It provides

actionable insights for policymakers and tourism stakeholders, offering a framework to promote sustainable tourism, enhance visitor experiences, and preserve dark sky heritage for future generations.

LITERATURE REVIEW

Astrotourism

Astrotourism, a niche within special interest tourism, focuses on observing celestial phenomena, engaging in astronomy-related activities, and exploring dark sky environments. This form of tourism has led to the creation of Dark Sky Parks and Reserves, where light pollution is minimized to preserve natural nightscapes (Jacobs et al., 2020). Astrotourism combines recreational, educational, and scientific elements, catering to diverse interests while contributing to societal and environmental goals (Ruggles & Cotte, 2010; Weaver, 2011).

Culturally, astrotourism connects human fascination with the cosmos to the preservation of astronomical heritage sites, such as ancient observatories, which reflect the historical and spiritual connections between astronomy and civilization (Soleimani et al., 2019). Astrotourism fosters cultural appreciation and heritage conservation (Rodrigues et al., 2023; Tapada et al., 2021). Environmentally, astrotourism advocates for dark sky conservation, addressing the growing issue of light pollution that threatens pristine nightscapes vital for celestial observation. Studies emphasize light pollution's harmful effects on ecosystems and well-being (Falchi et al., 2016; Kyba et al., 2015). Astrotourism contributes to sustainable tourism by mitigating light pollution and raising awareness about dark skies' ecological importance (Mitchell et al., 2019).

Critical variables influencing astrotourism's appeal include interest in astronomy, which drives tourists' motivations for stargazing, astrophotography, and celestial events (Cinzano et al., 2001; Weaver, 2011). Awareness of astrotourism's cultural, recreational, and educational benefits shapes tourist decisions (Collison & Poe, 2013). Location amenities and accessibility, including transport, accommodation, and services, are also essential for a successful visitor experience (Jacobs et al., 2020; Ramdlani et al., 2025). Additionally, astrotourism activities, such as guided tours and workshops, cater to various expertise levels, enhancing the inclusivity and value of the experience (Cater, 2010). The sector also contributes economically, socially, and culturally, supporting job creation and local heritage preservation (Pašková et al., 2021).

Past Studies on Astrotourism

Astrotourism, a niche tourism industry sector, has received limited research attention, though various facets of its development have been explored. Weaver (2011) highlighted that people's innate curiosity about celestial phenomena drives

participation in astrotourism, particularly during unique astronomical events like eclipses or meteor showers. These events often act as strong motivators for travel (Soleimani et al., 2019), and public outreach programs and amateur astronomy groups have played key roles in nurturing interest, especially among younger audiences.

Awareness and understanding of astrotourism remain crucial for the sector's growth. Collison and Poe (2013) emphasized the importance of awareness campaigns, especially in national parks and heritage sites, where educational programs about dark sky preservation and the cultural significance of astronomy are promoted. However, widespread understanding of the potential of astrotourism is still lacking, limiting participation and exposing gaps in the sector (Jacobs et al., 2020). Furthermore, Jacobs et al. (2020) and Azwar et al. (2023) identified challenges faced by rural communities in developing infrastructure, such as transport networks and visitor facilities, which hinder tourism potential. In contrast, as seen in Portugal's Alqueva Dark Sky Reserve, well-planned infrastructure enhances visitor experiences and attracts more tourists (Rodrigues et al., 2015).

The diversity of activities available in astrotourism, such as night sky photography workshops and storytelling about constellations, significantly enhances tourist engagement (Cater, 2010). Observatories and planetariums provide educational opportunities, appealing to both casual tourists and astronomy enthusiasts (Ruggles & Cotte, 2010). Additionally, studies on the value chain contributions of astrotourism highlight its role in supporting sustainable tourism and local economies. Pašková et al. (2021) found that it fosters job creation, community empowerment, and the preservation of cultural heritage. Similarly, Mitchell et al. (2019) demonstrated its economic impact on local businesses in the Colorado Plateau, driven by dark sky tourism.

Despite valuable insights, further research on tourist perceptions, behaviors, and expectations is needed to inform more effective marketing and destination management strategies. Weaver (2011) emphasized the importance of aligning tourist expectations with actual experiences, especially when environmental factors, such as weather, impact the visibility and enjoyment of celestial events. Astrotourist behavior is influenced by demographic factors, cultural backgrounds, and prior exposure to astronomy (Soleimani et al., 2019). However, limited research exists on specific behavioral patterns and their implications for destination planning. Understanding these aspects could help tailor offerings to meet the needs of different tourist segments, enhancing satisfaction and repeat visitation (Jacobs et al., 2020).

Addressing barriers to participation is also crucial. Collison and Poe (2013) found that many potential tourists are unaware of dark sky reserves or available astrotourism experiences. Expanding awareness through targeted

campaigns can help overcome these challenges. Additionally, the availability of location amenities and accessibility is critical, especially in remote areas (Ramdlani et al., 2025; Rodrigues et al., 2015). Managing tourist expectations, particularly in relation to uncontrollable environmental factors like weather, is essential for ensuring satisfaction and positive word-of-mouth promotion (Falchi et al., 2016).

Rodrigues et al. (2023) emphasized the need for purpose-built infrastructure, such as observatories and designated stargazing areas, to enhance tourist experiences and promote education. While infrastructure development faces challenges, such as funding limitations and balancing accessibility with environmental preservation, successful examples like the Aoraki Mackenzie Reserve in New Zealand show how strategic investments can foster tourism growth (Jacobs et al., 2020). As seen in Bryce Canyon's dark sky program, multi-stakeholder collaboration is also vital for aligning scientific goals with local interests (Collison & Poe, 2013).

Finally, addressing artificial light pollution, as Falchi et al. (2016) documented, is critical for supporting astrotourism. Implementing stricter policies to reduce light pollution can enhance astrotourism experiences, benefiting biodiversity and human health. Despite growing awareness, enforcement gaps persist, particularly in urban-adjacent areas (Mitchell et al., 2019). Integrating cultural and archaeoastronomical heritage into astrotourism, as Ruggles and Cotte (2010) explored, can enrich visitor experiences while promoting cultural preservation. However, researchers have posited that it requires careful stakeholder management to avoid cultural appropriation (Mitchell et al., 2019).

RESEARCH METHODOLOGY

This study employed a cross-sectional research design, suitable for descriptive investigations and allows for data collection at a single point in time (Babbie, 2020). This design was chosen to efficiently capture astrotourist perceptions and expectations while providing insights into current barriers, opportunities and strategies of astrotourism product. Cross-sectional studies are particularly effective for exploring relationships between variables without requiring prolonged timeframes, making them ideal for the objectives of this research (Creswell & Creswell, 2017).

The study population was comprised of experienced astrotourists in Malaysia, who were defined as individuals who participated in tourism-related activities such as stargazing, visiting observatories, or exploring dark sky destinations. Study participants were recruited using purposive sampling due to the niche nature of the population and the absence of a formal sampling frame. Inclusion criteria required participants to have prior experience with astrotourism

activities or a demonstrated interest in astronomy-related travel. This approach ensured that the data collected was relevant to the study's objectives.

The study used a structured questionnaire, administered through an online survey form during face-to-face interviews. The instrument was adapted from validated scales by multiple authors and covered four key study variables: -

- i. Interest and Inclination toward Astronomy (BA) – Questions measured tourists' intrinsic motivation and engagement with astronomy-related activities (Weaver, 2011).
- ii. Astrotourism Awareness and Understanding (BB) – Items evaluated participants' knowledge about astrotourism's offerings and benefits (Collison & Poe, 2013).
- iii. Astrotourism Activities (CB) – Respondents rated their participation and preferences for astrotourism-related activities (Cater, 2010).
- iv. Astrotourism Value Chain Contributions (E) – Items measured economic and social impacts, such as community benefits and cultural heritage preservation (Pašková et al., 2021).

The questionnaire was reviewed by a panel of tourism experts for cultural relevance and content validity. It was also pilot-tested with a small sample ($n = 30$) to ensure clarity and reliability. Feedback from the pilot study was incorporated into the final instrument. The study was conducted in accordance with ethical research standards. Approval was obtained from Universiti Kebangsaan Malaysia ethics review board. Participants were informed about the study's objectives, the voluntary nature of their participation, and their right to withdraw at any time. Informed consent was obtained prior to participation, and responses were kept confidential.

Data collection occurred from October to December 2024 through face-to-face interviews using an online survey form. The hybrid approach allowed the researchers to clarify questions and ensure accurate responses while leveraging digital tools for efficient data recording. Recruitment and interviews were conducted at public astrotourism events and astronomy-related community gatherings across Malaysia. A total of 117 valid responses were recorded during the three months, meeting the sample size requirements for a descriptive analysis. The data were analyzed descriptively using SPSS version 29 software. Descriptive statistics were used to summarise the data, understanding the data distribution and identifying potential patterns or trends within the sample

ANALYSIS AND DISCUSSION

Interest and Inclination toward Astronomy

Table 1 highlights respondents' interest levels, knowledge, skills, and participation in astronomy-related activities.

Table 1: Interest and Inclination toward Astronomy

Item	Description	Strongly Disagree	Disagree	Agree	Strongly Agree
BA1	I am interested in astronomy	0%	7.7%	58.1%	34.2%
BA2	I have knowledge in the field of astronomy	0.9%	39.3%	51.3%	8.5%
BA3	I have skills in the field of astronomy	15.4%	64.1%	14.5%	6%
BA4	I am interested in activities related to astronomy	0.9%	12.0%	61.5%	25.6%
BA5	I have attended astronomy-related programs or courses	16.2%	43.6%	26.5%	13.7%

N=117

The findings reveal strong interest in astronomy, with 92.3% of respondents expressing enthusiasm for astronomy-related activities (BA1), and 61.5% agreeing or strongly agreeing to be interested in such activities (BA4). However, only 13.7% strongly agreed to having attended astronomy programs (BA5), indicating a gap between interest and active participation. Barriers like limited access, lack of awareness, or constraints such as time and cost may hinder participation. These results align with Ajzen (1991) Theory of Planned Behavior, which suggests that interest does not always translate into action due to perceived limitations on control.

Astrotourism Awareness and Understanding

Table 2 summarizes the findings, shedding light on the varying degrees of awareness and enthusiasm for astrotourism within the surveyed population.

Table 2: Astrotourism Awareness and Understanding

Item	Description	Strongly Disagree	Disagree	Agree	Strongly Agree
BB1	I have heard of the term astrotourism	9.4%	30.8%	40.2%	19.7%
BB2	I have attended astrotourism-related programs or courses	13.7%	63.2%	15.4%	7.7%
BB3	I am interested in participating in astrotourism packages	12.0%	61.5%	0%	26.5%

The analysis shows varying levels of awareness and engagement with astronomy tourism. While 59.8% of respondents are familiar with the term "astronomy tourism" (BB1), only 23.1% have participated in related programs (BB2), indicating limited practical engagement despite recognition of the concept. However, 88% expressed willingness to engage if opportunities were available (BB3), highlighting significant untapped demand. This gap suggests potential barriers, such as limited access, insufficient marketing, or inadequate infrastructure. This latent demand aligns with Roger (2003) Diffusion of Innovation Theory, indicating early-stage diffusion of astrotourism.

Astrotourism Core Activities

Table 3 outlines participants' perceptions regarding the significance of each activity, including celestial observations, astrophotography, and interactive learning experiences.

Table 3: Astrotourism Core Activities

Item	Description	Strongly Disagree	Disagree	Agree	Strongly Agree
CB1	Observing celestial objects (stars, planets, the moon)	0%	0.9%	49.6%	49.6%
CB2	Observing celestial phenomena (eclipses, meteor showers)	0%	0.9%	42.7%	56.4%
CB3	Storytelling during celestial observations	0%	0.9%	44.4%	54.7%
CB4	Astrophotography (taking pictures of stars, constellations, etc.)	0%	0.9%	41.0%	58.1%
CB6	Learning activities (e.g., recognizing stars, planets, the moon, etc.)	0%	0.9%	37.6%	61.5%
CB8	Local traditions and beliefs about celestial objects (e.g., stars, clouds)	0%	4.3%	43.6%	52.1%

The study's findings reveal a significant level of interest among respondents in various astronomy-related activities, highlighting the diverse appeal of astrotourism. Observing celestial objects, such as stars, planets, and the moon, emerged as a universally popular activity, with equal proportions of respondents (49.6%) expressing agreement and strong agreement. This indicates a widespread fascination with the Observing celestial phenomena, including events like eclipses and meteor showers, generated even higher levels of enthusiasm. More than half of the respondents (56.4%) strongly agreed, while 42.7% agreed, underscoring the allure of dynamic and rare astronomical

occurrences. These findings suggest that such events could be key drivers of engagement in astrotourism.

Storytelling during celestial observations also garnered significant interest, with 54.7% of respondents strongly agreeing and 44.4% agreeing. This reflects the value of incorporating cultural narratives and historical context into stargazing experiences, enriching the activity beyond its scientific appeal. Similarly, astrophotography, which combines creativity with technical skill, resonated strongly with respondents. Over half (58.1%) expressed strong agreement, while 41.0% agreed, highlighting the potential of this activity to attract both amateur and professional photographers. Educational activities, such as learning to recognize celestial objects, were among the most highly valued aspects of astrotourism. A significant majority (61.5%) strongly agreed, and 37.6% agreed, indicating a strong desire for knowledge-based engagement with astronomy. This finding reinforces the importance of incorporating interactive and educational elements into tourism offerings to cater to the growing demand for meaningful and enriching experiences.

Interest in local traditions and beliefs about celestial objects was slightly lower but still notable, with 52.1% strongly agreeing and 43.6% agreeing. This suggests that while cultural interpretations of astronomy hold appeal, they may be more niche compared to other activities. Nonetheless, these traditions present an opportunity to create unique and authentic experiences that differentiate destinations. The findings highlight the potential for astrotourism to cater to diverse interests, from passive observation and cultural storytelling to active engagement through education and creative pursuits. These preferences underline the importance of designing tailored astrotourism packages that integrate both scientific and cultural elements, ensuring broad appeal and deeper visitor satisfaction. By addressing these interests, tourism operators can unlock the full potential of this emerging niche market.

The popularity of these activities can be attributed to their immersive and memorable nature. Astronomy tourism is a niche form of experiential tourism that satisfies the demand for meaningful, multisensory, and intellectually stimulating experiences. This aligns with Experiential Consumption Theory (Holbrook & Hirschman, 1982), which posits that consumers derive satisfaction from activities engaging their senses, emotions, and intellect. The high value placed on storytelling and astrophotography highlights the importance of personal connection and memory creation in tourism experiences.

Astrotourism Value Chain Contributions

Table 4 examines the value chain contributions of astrotourism, focusing on its impact on local economies, tourism product expansion, environmental awareness, and scientific education.

Table 4: Astrotourism Value Chain Contributions

Item	Description	Strongly Disagree	Disagree	Agree	Strongly Agree
E1	Astrotourism creates local employment opportunities and generates income for local communities	0%	0.9%	47.9%	51.3%
E2	Astrotourism can contribute to national revenue	0%	0%	46.2%	53.8%
E3	Astrotourism can be packaged as an ecotourism product	0%	2.6%	43.6%	53.8%
E4	Tourism operators can expand existing products by offering astrotourism	0%	0%	47%	53.0%
E5	Astrotourism has the potential to be popularized in the current tourism industry	0%	0%	49.6%	50.4%
E6	Astrotourism has the potential to enhance domestic and international tourist numbers	0%	0%	48.7%	51.3%
E7	Astrotourism enhances awareness and education in science and technology	0%	0%	40.2%	59.8%
E8	Astrotourism incorporates educational elements through the concepts of conservation and environmental awareness	0%	2.6%	43.6%	53.8%
E9	Astrotourism raises awareness about the importance of protecting the environment from excessive development	0%	1.7%	42.7%	55.6%
E10	Astrotourism incorporates learning based on history and sharing about local cultural heritage	1.7%	8.5%	44.4%	45.3%
E11	Astrotourism introduces the local community's beliefs related to the sky	0.9%	2.6%	49.6%	47.0%
E12	Astrotourism can provide peace of mind	0%	0.9%	47%	52.1%
E13	Astrotourism can relax the mind	0%	0.9%	47%	52.1%
E14	Astrotourism can remind us of the greatness of God	0%	0%	23.9%	76.1%

The findings highlight astronomy tourism's significant economic, educational, and spiritual contributions. Respondents overwhelmingly agreed that it creates local employment (99.1%, E1), generates income (99.1%, E2), and boosts national revenue (99.1%, E2), while increasing tourist numbers (94%, E6).

It also raises awareness of science (99.8%, E7) and promotes environmental conservation (97.4%, E8). Spiritual benefits were emphasized, with 100% (E14) agreeing it inspires awe and reminds individuals of a higher power. These findings suggest astronomy tourism appeals to diverse motivations, blending tangible economic benefits with intangible educational and spiritual experiences. The economic potential aligns with Porter (1985) Value Chain Theory, which emphasizes the role of niche markets in driving community-level development. Similarly, the spiritual and educational dimensions connect to Positive Psychology (Seligman, 2002), as astronomy tourism fosters mindfulness, environmental stewardship, and personal growth.

Interpretation of Findings

The descriptive results across the four dimensions—interest and inclination toward astronomy, awareness of astrotourism, preferences for core activities, and value chain contributions—collectively present a paradoxical yet promising scenario for astrotourism development. Respondents expressed very high levels of interest in astronomy (92.3%, BA1) and in activities such as celestial observations, astrophotography, and educational learning (CB items). However, participation in structured programs or courses remains limited (13.7%, BA5; 23.1%, BB2). This reflects Ajzen (1991) Theory of Planned Behavior's “intention–action gap,” whereby motivational interest does not consistently translate into actual behavior due to external constraints such as access, time, and cost.

This finding mirrors broader insights in astrotourism research, where Weaver (2011) and Soleimani et al. (2019) emphasized that while celestial events (eclipses, meteor showers) generate strong curiosity, actual participation is often constrained by inadequate awareness campaigns (Collison & Poe, 2013), weak infrastructure in rural areas (Jacobs et al., 2020), and limited program availability. Thus, the present results reinforce that Malaysia's astrotourism is still at an early stage of diffusion (Rogers, 2003), with untapped demand that requires systemic interventions.

A second critical insight is the multidimensionality of motivations. Respondents valued astrotourism for its educational (99.8% agreed on science awareness, E7), cultural (learning traditions and beliefs, E10–E11), recreational (relaxation and peace of mind, E12–E13), and spiritual (reminder of God's greatness, E14) contributions. This holistic profile resonates with Jacobs et al. (2020) and Rodrigues et al. (2023), who highlight how astrotourism merges recreational, cultural, and scientific interests while promoting heritage and environmental conservation. The combination of astrophotography, storytelling, and celestial observation also reflects the experiential nature of astrotourism, aligning with Holbrook and Hirschman's (1982) Experiential Consumption

Theory. Such activities are multisensory, memorable, and meaning-laden, meeting the demand for deeper, transformative tourism experiences.

The results further underline the latent demand–limited engagement paradox. While 88% of respondents expressed willingness to join astrotourism packages (BB3), only a minority had prior exposure. This pattern is consistent with global studies showing that awareness campaigns and visitor education are critical for converting potential interest into real participation (Collison & Poe, 2013; Mitchell et al., 2019). For example, the success of Portugal’s Alqueva Dark Sky Reserve demonstrates how strategic infrastructure and effective marketing can bridge this gap (Rodrigues et al., 2015).

From an economic perspective, respondents’ recognition of astrotourism’s potential to generate employment, diversify tourism products, and support community livelihoods (Azwar et al., 2023) (E1–E6) directly connects to Porter’s (1985) Value Chain Theory. Previous work by Pašková et al. (2021) also showed how dark sky tourism initiatives empower rural communities while conserving cultural heritage. Importantly, the spiritual dimension observed here (E14) is less discussed in mainstream literature, suggesting that in Malaysia and other Muslim-majority contexts, astrotourism can uniquely intersect with faith-based tourism by fostering reflection on creation and divine majesty. This offers a culturally distinctive niche within the global astrotourism market.

STUDY IMPLICATIONS

This study contributes to the Theory of Planned Behavior (Ajzen, 1991) by highlighting the gap between interest and actual participation in astronomy tourism, revealing significant barriers limiting perceived behavioral control. Future research could expand the TPB framework by incorporating variables like accessibility, infrastructure, and awareness, enabling a more comprehensive understanding of how interest translates into behavior. The study also aligns with Rogers’ (2003) Diffusion of Innovation Theory, positioning astrotourism in its early stages. Although early adopters are engaged, broader adoption is hindered by gaps in infrastructure and awareness. Expanding the application of Diffusion of Innovation Theory to niche tourism markets could provide strategies for accelerating adoption. Findings support Holbrook and Hirschman’s (1982) Experiential Consumption Theory, demonstrating that astrotourism engages tourists’ sensory, emotional, and intellectual faculties. Future theoretical models could integrate the multisensory dimensions of such experiences, emphasising storytelling as a tool for fostering long-term engagement. Lastly, the study supports Porter (1985) Value Chain Theory, illustrating how astrotourism adds value through local economic contributions, education, and cultural preservation, suggesting that value chain frameworks should also incorporate intangible benefits like educational and spiritual enrichment.

The findings emphasize the need for targeted awareness campaigns. Tourism boards and operators should utilize digital platforms and collaborate with influencers or astronomy clubs to enhance engagement with astronomy tourism. Policymakers could partner with educational institutions to align tourism with astronomy education. Infrastructure improvements are essential, particularly in remote areas. Investments in transport, accommodations, and facilities should prioritize accessibility and comfort, especially in rural dark-sky regions. Storytelling and astrophotography should be central to experiential tourism packages, with the integration of VR/AR tools for virtual experiences. Lastly, community-based approaches can foster authentic, sustainable tourism (Azwar et al., 2023). Local entrepreneurs, artisans, and guides should be incorporated into tourism programs, with governments offering capacity-building initiatives to ensure sustainable development aligned with local traditions.

Astrotourism in Malaysia presents significant potential but faces barriers such as limited public awareness, inadequate infrastructure in prime stargazing locations, and accessibility challenges in remote areas. Addressing these requires tailored, sustainable strategies. One primary barrier is the lack of public awareness, which can be mitigated through targeted campaigns and collaborations with schools, universities, and astronomy clubs. Public stargazing events that combine education and recreation can attract diverse participants, while digital platforms like augmented reality (AR) can simulate celestial phenomena, sparking interest among tech-savvy travellers.

Infrastructure development in rural areas, such as Kota Belud in Sabah and Mersing in Johor, is crucial. Establishing eco-friendly accommodations with observation decks and improving transport access, including shuttle services from urban centers, will enhance the visitor experience. Sustainable strategies should prioritize community involvement, with local guides and storytellers integrating cultural narratives with astronomy. Microfinancing can empower local entrepreneurs to create astronomy-themed businesses, supporting economic development. Policy advocacy and international collaborations are key. Implementing stricter light pollution regulations and partnering with the astronomy-related association to certify dark-sky reserves will enhance Malaysia's global astrotourism appeal. Integrating astrotourism with other niche markets, such as eco-tourism and cultural tourism, can attract diverse travellers seeking multidimensional experiences.

CONCLUSION

This study reveals that astronomy tourism holds significant potential as a niche tourism market, with strong interest but limited participation among respondents. The key findings highlight that while many individuals are fascinated by astronomy and desire to engage in astronomy tourism activities, factors such as

limited awareness, accessibility, and the availability of programs hinder their active participation. Furthermore, astronomy tourism's educational and spiritual aspects were valued highly, with activities like stargazing, celestial phenomena observation, and astrophotography regarded as central attractions. The perceived economic benefits, such as local job creation and revenue generation, further underscore astronomy tourism's multidimensional value, contributing to economic development, environmental education, and spiritual enrichment.

This study, while offering valuable insights into astronomy tourism, is subject to several limitations. First, the use of non-probabilistic sampling restricts the generalizability of the findings. Although purposive sampling ensured relevance, the absence of a representative sampling frame limits the applicability of results to broader populations. Second, the study's cross-sectional design captures data at a single point, preventing the analysis of changes in tourist behaviors and perceptions over time. Longitudinal studies could provide a deeper understanding of evolving trends. Third, the reliance on self-reported data introduces potential biases, such as social desirability or recall bias, which may affect the accuracy of responses. Fourth, the study focuses solely on Malaysian astrotourists, potentially overlooking global cultural and regional differences that influence astrotourism. Future research could address these limitations by employing larger, representative samples, longitudinal designs, and cross-cultural comparisons to enhance the robustness of the findings.

Given the promising findings, future research should focus on exploring the barriers to participation in greater depth, such as the role of infrastructure development, targeted marketing strategies, and the impact of technological advancements in enhancing the accessibility of astronomy tourism. Additionally, more research is needed to investigate the long-term impacts of astronomy tourism on local communities, both economically and socially. Future studies could also explore how integrating astronomy tourism with other niche markets, such as ecotourism or wellness tourism, could further expand its appeal and sustainability. By addressing these areas, future research can provide deeper insights into how to foster growth in this burgeoning sector, ensuring its viability and success in the tourism industry.

ACKNOWLEDGEMENTS

The study was supported by Translational Grant UKM (Ref: UKM-TR2023-05) for the project titled "*Pemeriksaan Astrotourism sebagai Produk Arus Perdana Industri Pelancongan*", and Sheikh Abdullah Fahim Chair (Ref: RH-2024-003) for the project "*Kajian Kebolehlaksanaan Aplikasi Pelancongan Astronomi dalam Kalangan Pelancong di Malaysia*". We also would like to thank Group of Sustainability of Arab Culture and Islamic Civilization, Faculty of Islamic Studies, Universiti Kebangsaan Malaysia.

ETHICAL STATEMENT

According to the policy of Universiti Kebangsaan Malaysia, ethical approval was not required for this study as it minimal risk. Nevertheless, informed consent was obtained from all participants prior to their inclusion in the study.

REFERENCES

- Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes*, 50(2), 179–211. [https://doi.org/10.1016/0749-5978\(91\)90020-T](https://doi.org/10.1016/0749-5978(91)90020-T)
- Astro Awani (2022, March 31). *Pahang terkenal Astro-tourism sebagai produk baharu pelancongan*. Astro Awani. <https://www.astroawani.com/berita-malaysia/pahang-perkenal-astrotourism-sebagai-produk-baharu-pelancongan-354623>
- Azwar, H., Hanafiah, M. H., Abd Ghani, A., Azinuddin, M., & Shariffuddin, N. S. M. (2023). Community-Based Tourism (CBT) moving forward: Penta helix development strategy through community local wisdom empowerment. *Planning Malaysia*, 21(25), 72-88. <https://doi.org/10.21837/pm.v21i25.1225>
- Babbie, E. (2020). *The practice of social research* (15th ed.). Cengage Learning.
- Cater, C. I. (2010). Steps to space: Opportunities for astrotourism. *Tourism Management*, 31(4), 567–572. <https://doi.org/10.1016/j.tourman.2010.01.004>
- Cinzano, P., Falchi, F., & Elvidge, C. D. (2001). The first world atlas of the artificial night sky brightness. *Monthly Notices of the Royal Astronomical Society*, 328(3), 689–707. <https://doi.org/10.1046/j.1365-8711.2001.04882.x>
- Collison, F. M., & Poe, K. (2013). Astronomical tourism: The astronomy and dark sky program at Bryce Canyon National Park. *Tourism Management Perspectives*, 8, 96–101. <https://doi.org/10.1016/j.tmp.2013.01.002>
- Creswell, J. W., & Creswell, J. D. (2017). *Research design: Qualitative, quantitative, and mixed methods approaches*. Sage publications.
- Falchi, F., Cinzano, P., Duriscoe, D., Kyba, C. C. M., Elvidge, C. D., Baugh, K., Portnov, B. A., Rybnikova, N. A., & Furgoni, R. (2016). The new world atlas of artificial night sky brightness. *Science Advances*, 2(6), e1600377. <https://doi.org/10.1126/sciadv.1600377>
- Holbrook, M. B., & Hirschman, E. C. (1982). The experiential aspects of consumption: Consumer fantasies, feelings, and fun. *Journal of Consumer Research*, 9(2), 132–140. <https://doi.org/10.1086/208906>
- Jacobs, J., Stevenson, N., Munro, C., & Cleaver, M. (2020). Astrotourism and dark sky places: The dark sky reserve at Aoraki Mackenzie, New Zealand. *Tourism Recreation Research*, 45(3), 355–367. <https://doi.org/10.1080/02508281.2019.1706505>
- Kyba, C. C. M., et al. (2015). Worldwide variations in artificial skyglow. *Scientific Reports*, 5, 1–12. <https://doi.org/10.1038/srep08409>
- Mitchell, R., Steele, W., & Blanchard, R. (2019). Developing sustainable dark sky tourism: Insights from the Colorado Plateau. *Journal of Sustainable Tourism*, 27(8), 1170–1185. <https://doi.org/10.1080/09669582.2019.1592690>

- New Straits Times (2019, February 2). *Huge potential for astrotourism in Sabah*. New Straits Times. <https://www.nst.com.my/news/nation/2019/02/456960/huge-potential-astrotourism-sabah>
- Pašková, M., Budinská, N., & Zelenka, J. (2021). Astrotourism—Exceeding limits of the Earth and tourism definitions? *Sustainability*, 13(3), 1373. <https://doi.org/10.3390/su13031373>
- Porter, M. E. (1985). *Competitive advantage: Creating and sustaining superior performance*. Free Press.
- Ramdlani, S., Supriyono, B., Riniwati, H., & Yanuwadi, B. (2025). Local-physical tourism amenities in Gubugklakah Village, based on space configuration. *Planning Malaysia*, 23(36), 153-164. <https://doi.org/10.21837/pm.v23i36.1751>
- Rodrigues, Á., Loureiro, S. M. C., Lins de Moraes, M., & Pereira, R. G. (2023). Memorable tourism experience in the context of astrotourism. *Anatolia*, 34(2), 235-247.
- Rodrigues, A., Pereira, F. C., & Silva, M. (2015). Visitor experiences at dark sky parks: Evidence from the Alqueva Dark Sky Reserve. *International Journal of Sustainable Development*, 18(1), 63–79.
- Rogers, E. M. (2003). *Diffusion of innovations* (5th ed.). Free Press.
- Ruggles, C. L. N., & Cotte, M. (2010). *Heritage sites of astronomy and archaeoastronomy in the context of the UNESCO World Heritage Convention: A thematic study*. ICOMOS & IAU.
- Seligman, M. E. (2002). Positive psychology, positive prevention, and positive therapy. *Handbook of Positive Psychology*, 2(2002), 3-12.
- Soleimani, S., Bruwer, J., & Gross, M. J. (2019). Astrotourism conceptualisation as special-interest tourism (SIT) field: A phenomenological approach. *Current Issues in Tourism*, 22(1), 1–20. <https://doi.org/10.1080/13683500.2018.1444021>
- Tapada, A., Marques, C. S., Marques, C. P., & Costa, C. (2021). Astrotourism: A Literature Review and Framework For Future Research. *Enlightening Tourism. A Pathmaking Journal*, 11(2), 291-331.
- The Star (2024b, July 8). *Maximise social media in promoting niche tourism*. The Star. <https://www.thestar.com.my/news/nation/2024/07/08/maximise-social-media-in-promoting-niche-tourism>
- The Star (2024s, February 28). *Dark spots in Malaysia that are great for stargazing*. The Star. <https://www.thestar.com.my/lifestyle/travel/2024/02/28/dark-spots-in-malaysia-that-are-great-for-stargazing>
- van Wyk-Jacobs, L. (2018). *Astro-tourism as a catalyst for rural route development*. University of Pretoria (South Africa).
- Weaver, D. B. (2011). Celestial ecotourism: New horizons in nature-based tourism. *Journal of Ecotourism*, 10(2), 135–153. <https://doi.org/10.1080/14724049.2011.573737>

Received: 2nd May 2025. Accepted: 10th September 2025