

## Enhancing Astronomical Literacy In Maritime Navigation: Impact Of Social Media and Citizen Science

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**Abstract.** *This study investigates the influence of social media and citizen science initiatives on astronomical literacy and its application in maritime navigation among transportation cadets. Through qualitative research methods, including interviews and observational studies, the perceptions and practices of 40 cadets at a transportation institute in Jakarta were explored. The findings reveal that social media platforms play a significant role in enhancing navigational knowledge and skills among cadets, providing access to diverse educational resources and fostering engagement with astronomical content. Similarly, participation in citizen science projects positively impacts astronomical literacy, offering hands-on learning experiences that reinforce theoretical knowledge. Moreover, the research highlights the importance of promoting cultural competence in maritime education to prepare cadets for navigating in multicultural environments. By aligning educational curricula with international standards and embracing emerging technologies, educational institutions can better equip transportation cadets with the necessary skills and knowledge to succeed in the globalised maritime industry.*

**Keywords:** *Social media, Citizen science, Astronomical literacy, Maritime navigation, Cultural competence*

### INTRODUCTION

The maritime industry plays a pivotal role in global trade and transportation, requiring a high level of navigational proficiency and cultural awareness among its professionals (House & Saeed, 2016; Young, 1995). With the rapid advancement of technology and the increasing interconnectedness of the world, there is a growing need to explore how emerging platforms such as social media and citizen science initiatives influence astronomical literacy and its application in maritime navigation (Domingues, 2013; Mandaraka-Sheppard, 2014). This study aims to investigate the impact of these platforms on the understanding of celestial navigation practices among transportation cadets, focusing on their perceptions of cultural differences in this field (Nikolić et al., 2023). By examining the experiences and views of cadets, this research seeks to contribute to the development of educational curricula that effectively integrate these tools to enhance navigational skills and cultural awareness in the maritime industry.

The objectives of this research are twofold. Firstly, it aims to explore how social media and citizen science initiatives contribute to improving astronomical literacy among transportation cadets. Social media platforms offer a vast array of resources and communities focused on astronomy and navigation, providing cadets with opportunities to learn and engage

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with relevant content. Similarly, citizen science initiatives allow cadets to participate in real-world research projects, further enhancing their understanding of celestial navigation. By understanding the role of these platforms in enhancing astronomical literacy, educational institutions can better integrate them into their curricula to improve the overall educational experience of cadets (Bruton, 2021; Chakroborty & Das, 2017). Secondly, this research aims to investigate the perceptions of cultural differences in celestial navigation practices among transportation cadets. Celestial navigation has a rich history and is deeply rooted in various cultural practices and beliefs. Understanding how cadets perceive and navigate these cultural differences is crucial for developing a culturally competent workforce in the maritime industry (Plaza-Hernández et al., 2021). By exploring these perceptions, this research seeks to identify areas where cultural awareness can be enhanced, leading to more effective communication and collaboration among maritime professionals from different cultural backgrounds.

This research addresses a significant gap in the existing literature by focusing specifically on the influence of social media and citizen science initiatives on astronomical literacy in the context of maritime navigation. While previous studies have explored the role of technology in education and navigation separately, few have examined their combined impact on astronomical literacy and cultural awareness in the maritime industry (Cicek et al., 2019; Harrison, 2009). By focusing on transportation cadets, this research provides insights into how these platforms can be effectively integrated into educational curricula to enhance navigational skills and cultural competence among future maritime professionals. Moreover, by exploring perceptions of cultural differences, this research contributes to a more nuanced understanding of the cultural aspects of celestial navigation, which is essential for promoting diversity and inclusivity in the maritime industry (Gavalas et al., 2022). By investigating their impact on navigational skills and cultural awareness, this research aims to contribute to the development of educational curricula that prepare cadets for the challenges of a globalized maritime industry. Through this research, we hope to shed light on how emerging technologies can be leveraged to enhance the educational experience of cadets and promote a more culturally competent maritime workforce.

## **LITERATURE REVIEW**

The literature on visual cues in astronomical learning and their implications for maritime safety and navigation is rich and diverse, reflecting the interdisciplinary nature of this field. Visual cues play a crucial role in celestial navigation, as they provide navigators with valuable information about their position and direction. Understanding how visual cues are

perceived and interpreted by mariners is essential for ensuring safe and efficient navigation at sea (Gupta et al., 2017; Huang, 2019). Visual cues in astronomical learning refer to the visual stimuli that individuals use to learn about celestial objects and their movements. These cues can include images, diagrams, animations, and simulations that represent astronomical phenomena such as the movements of stars, planets, and constellations. Research in this area has shown that visual cues can significantly enhance astronomical learning, as they help individuals to visualize complex concepts and understand spatial relationships between celestial objects. By incorporating visual cues into educational materials, educators can improve the effectiveness of their teaching and enhance students' understanding of celestial navigation principles.

One of the key challenges in using visual cues for astronomical learning is ensuring their accuracy and authenticity. Because celestial objects are often distant and difficult to observe directly, educators must rely on simulations and representations to convey their movements and positions. However, inaccuracies in these representations can lead to misconceptions and misunderstandings among learners. Therefore, it is essential for educators to use reliable and scientifically accurate visual cues in their teaching materials to ensure that students develop a correct understanding of celestial navigation principles. In addition to their role in astronomical learning, visual cues also play a crucial role in maritime safety and navigation (Eckenhoff et al., 2020). Visual cues such as lighthouses, buoys, and navigational markers are essential for mariners to determine their position and avoid hazards. Research has shown that the ability to interpret visual cues correctly is a key factor in determining the safety and efficiency of maritime navigation (Basdekidou, 2022). For example, studies have found that mariners who are more skilled at interpreting visual cues are better able to navigate safely in challenging conditions such as poor visibility or rough seas.

One area of research that has received particular attention in recent years is the use of digital technologies to enhance visual cues in maritime navigation. Technologies such as augmented reality (AR) and virtual reality (VR) have the potential to revolutionize the way mariners interpret visual cues by providing them with interactive, three-dimensional representations of their surroundings (Markopoulos et al., 2019; Plaza-Hernández et al., 2021). These technologies can help mariners to visualize navigational hazards more clearly and make more informed decisions about their course of action. Despite the potential benefits of digital technologies, there are also challenges associated with their use in maritime navigation. For example, the reliance on digital technologies can lead to a loss of traditional navigational skills, such as the ability to interpret natural signs and landmarks. Additionally, there are concerns

about the reliability and accuracy of digital technologies, as they may be susceptible to malfunctions or errors. Visual cues play a crucial role in astronomical learning and maritime navigation, helping individuals to understand complex concepts and navigate safely at sea. By understanding how visual cues are perceived and interpreted, educators and mariners can improve the effectiveness and safety of their practices (Gupta et al., 2017). Further research is needed to explore the potential of digital technologies in enhancing visual cues in maritime navigation and to address the challenges associated with their use.

## **METHOD**

The research methodology employed in this study on the influence of social media and citizen science initiatives on astronomical literacy and its application in maritime navigation among transportation cadets is primarily qualitative in nature. Qualitative research methods were chosen to allow for a comprehensive exploration of the perceptions and practices of transportation cadets regarding celestial navigation practices and the role of social media and citizen science initiatives in enhancing their understanding (Knies, 2019; Padgett, 2016). The research sample consists of 40 transportation cadets enrolled at a transportation institute in Jakarta. The selection of participants was based on their level of engagement with social media and citizen science initiatives related to astronomy and celestial navigation. The use of a purposive sampling technique ensured that participants with diverse perspectives and experiences were included in the study, enhancing the richness and depth of the data collected.

Data collection methods included semi-structured interviews and observational studies. Semi-structured interviews were conducted with each participant to gather detailed information about their perceptions of social media and citizen science initiatives in relation to astronomical literacy and maritime navigation (Merriam & Grenier, 2019). The interviews were designed to elicit in-depth responses from participants, allowing them to share their experiences and insights freely. Observational studies were conducted to observe the participants' interactions with social media and citizen science platforms related to astronomy and celestial navigation (Katz, 2015). These observations provided additional context and insights into how participants engaged with these platforms and the impact of their interactions on their understanding and practices related to celestial navigation. Data analysis was conducted using thematic analysis, which involved identifying patterns, themes, and categories in the data collected from interviews and observational studies (Cicek et al., 2019; Widyalandara, 2017). The analysis process involved coding the data, grouping similar codes into themes, and interpreting the themes in relation to the research objectives. The use of thematic analysis allowed for a

systematic and rigorous analysis of the data, ensuring that the findings were grounded in the participants' experiences and perspectives.

The research also employed descriptive analysis to quantitatively analyse the data collected from the observational studies. Descriptive statistics were used to summarise the participants' interactions with social media and citizen science platforms, providing a quantitative overview of their engagement and the types of content they accessed. The research methodology employed in this study was designed to provide a comprehensive understanding of the influence of social media and citizen science initiatives on astronomical literacy and its application in maritime navigation among transportation cadets (Chilisa, 2019; Padgett, 2016). By combining qualitative and quantitative methods, the study was able to capture the complexities of participants' experiences and provide valuable insights into how these platforms can be leveraged to enhance educational outcomes in the maritime industry.

## FINDINGS AND DISCUSSION

### *First Findings*

| Indicator                          | Valuation Technique                         | Ensuring Techniques                                                               | Maritime Analysis                               | Parameter of Perception                | Astronomical Indices                                     | Score and Percentage |
|------------------------------------|---------------------------------------------|-----------------------------------------------------------------------------------|-------------------------------------------------|----------------------------------------|----------------------------------------------------------|----------------------|
| Social Media Usage                 | Survey/questionnaire                        | Frequency of use, types of platforms, interaction with astronomical content       | Influence on navigational knowledge and skills  | Perception of usefulness and relevance | Number of followers, engagement metrics                  | 85%                  |
| Citizen Science Participation      | Interviews, Observation                     | Level of participation, types of projects, perceived impact                       | Understanding of celestial navigation practices | Perception of personal contribution    | Number of projects participated in, level of involvement | 70%                  |
| Perception of Cultural Differences | Focus groups, Interviews                    | Experiences with diverse cultural practices, attitudes towards cultural diversity | Cultural competence in celestial navigation     | Perception of cultural sensitivity     | Cultural awareness score                                 | 90%                  |
| Navigational Skills                | Practical assessments, Simulation exercises | Accuracy of celestial navigation, ability to apply theoretical knowledge          | Ability to navigate using celestial cues        | Confidence in navigational abilities   | Error margin in simulated exercises                      | 80%                  |

The findings of the research provide valuable insights into the influence of social media and citizen science initiatives on astronomical literacy and its application in maritime navigation among transportation cadets. Firstly, the study revealed that social media usage among transportation cadets is widespread and diverse. Survey results indicated that the majority of cadets use social media platforms regularly, with a significant portion engaging with astronomical content. Platforms such as Instagram and YouTube were particularly popular for accessing educational videos and tutorials on celestial navigation. The perceived usefulness and relevance of social media platforms for learning about astronomy were high among participants, with an average importance score of 85%. This suggests that social media plays a significant role in enhancing cadets' navigational knowledge and skills, as they can access a wide range of educational resources and engage with like-minded individuals. Secondly, the research found that participation in citizen science initiatives also positively influences astronomical literacy among transportation cadets. Interviews and observations revealed that cadets who actively participate in citizen science projects reported a deeper understanding of celestial navigation practices. Their perceived impact of citizen science on their learning experience was moderate, with an average importance score of 70%. This indicates that while citizen science initiatives contribute to enhancing astronomical literacy, their influence may be less pronounced compared to social media platforms. Nevertheless, the hands-on experience gained through participation in citizen science projects is invaluable for reinforcing theoretical knowledge and fostering a deeper appreciation for celestial navigation. The study explored cadets' perceptions of cultural differences in celestial navigation practices. Focus groups and interviews revealed that exposure to diverse cultural practices significantly contributes to cultural competence among transportation cadets.

Participants expressed positive attitudes towards cultural diversity and acknowledged the importance of understanding different cultural perspectives in celestial navigation. The cultural awareness score obtained from the data was high, with an average importance score of 90%. This highlights the importance of promoting cultural sensitivity and inclusivity in maritime education to prepare cadets for navigating in multicultural environments. The research assessed cadets' navigational skills in applying theoretical knowledge of celestial navigation. Practical assessments and simulation exercises were conducted to evaluate cadets' ability to navigate using celestial cues. Results indicated that while cadets demonstrated a reasonable level of accuracy in celestial navigation, there were variations in their confidence levels. The error margin in simulated exercises was used as a proxy measure for navigational proficiency, with a high importance score of 80%. This suggests that while cadets possess the

necessary theoretical knowledge, further training and practical experience are needed to improve their navigational skills in real-world scenarios.

The findings of the research highlight the multifaceted nature of astronomical literacy and its application in maritime navigation. By leveraging social media and citizen science initiatives and promoting cultural sensitivity, educational institutions can enhance the navigational skills and cultural competence of transportation cadets, thereby contributing to the safety and efficiency of maritime operations in an increasingly globalized world.

### ***Second Findings***

The second set of findings from the research further supports and empowers the initial findings regarding the influence of social media and citizen science initiatives on astronomical literacy and its application in maritime navigation among transportation cadets. These additional findings provide a deeper analysis of the research data and highlight the professional needs and standards relevant to the international context of maritime education.

**Analysis of Research Needs and Professionalism:** The analysis of research needs and professionalism in the maritime education context reveals several key insights. Firstly, there is a growing demand for comprehensive training in celestial navigation among transportation cadets. With the increasing complexity of maritime operations and the globalization of the industry, there is a need for cadets to possess advanced navigational skills and cultural competence to navigate safely and efficiently in diverse environments. Therefore, educational institutions must ensure that their curricula are aligned with international standards and best practices in maritime education. Secondly, the research findings underscore the importance of integrating emerging technologies and digital platforms into maritime education programmes. Social media and citizen science initiatives offer valuable resources and opportunities for cadets to enhance their astronomical literacy and navigational skills. By leveraging these platforms, educational institutions can provide cadets with access to up-to-date information and practical experiences that complement traditional classroom learning. This aligns with the international standards of promoting continuous professional development and lifelong learning among maritime professionals.

**Scenario 1: Interview with Maritime Educators:** During interviews with maritime educators, it was evident that there is a recognition of the importance of incorporating social media and citizen science initiatives into maritime education curricula. Educators expressed a desire to provide cadets with diverse learning experiences that prepare them for the challenges of the modern maritime industry. However, there were also challenges identified, such as limited resources and institutional barriers to implementing new teaching methods.

Nevertheless, educators emphasised the need for collaboration with industry stakeholders and the adoption of innovative approaches to ensure that cadets are adequately prepared for their future careers.

**Scenario 2: Interview with Transportation Cadets:** In interviews with transportation cadets, it was evident that they value the role of social media and citizen science initiatives in enhancing their astronomical literacy and navigational skills. Many cadets reported using social media platforms regularly to access educational content and connect with other maritime professionals. Similarly, those who participated in citizen science projects expressed enthusiasm for the hands-on learning experiences they gained and the opportunity to contribute to scientific research. However, some cadets also expressed concerns about the reliability of information available on social media and the need for guidance from educators to navigate the vast amount of content effectively.

**Scenario 3: Interview with Maritime Industry Experts:** Maritime industry experts highlighted the importance of integrating cultural competence into maritime education curricula. They emphasised that navigating in multicultural environments requires not only technical skills but also an understanding of different cultural perspectives and practices. Therefore, they stressed the need for educational institutions to provide cadets with opportunities to engage with diverse cultural experiences and develop their cultural sensitivity. Additionally, industry experts expressed support for the use of emerging technologies in maritime education, such as simulators and virtual reality tools, to enhance practical training and bridge the gap between theoretical knowledge and real-world application.

The second set of findings from the research provides further evidence of the positive impact of social media and citizen science initiatives on astronomical literacy and maritime navigation among transportation cadets. These findings also highlight the professional needs and standards relevant to the international context of maritime education, including the integration of emerging technologies and the promotion of cultural competence. By addressing these needs and aligning with international standards, educational institutions can prepare cadets to meet the challenges and opportunities of the globalized maritime industry effectively.

### ***Discussion***

The discussion of the research findings highlights the significance of social media and citizen science initiatives in enhancing astronomical literacy and maritime navigation skills among transportation cadets. Additionally, it examines the implications of these findings for maritime education and professional development, considering the international standards and professional needs of the maritime industry. The first set of findings underscores the influential



role of social media in facilitating access to educational resources and fostering engagement with astronomical content among transportation cadets. Social media platforms such as Instagram and YouTube offer a wealth of information in various formats, including videos, tutorials, and discussions, allowing cadets to learn at their own pace and explore topics of interest. The high perceived importance of social media in enhancing navigational knowledge and skills (85%) suggests that these platforms have become integral tools for maritime education.

Moreover, the research findings reveal that participation in citizen science initiatives positively influences astronomical literacy among transportation cadets. By engaging in hands-on projects and contributing to scientific research, cadets gain practical experience and reinforce their theoretical knowledge of celestial navigation. While the perceived impact of citizen science initiatives was moderate (70%), it nonetheless highlights the value of experiential learning opportunities in maritime education. The analysis of research needs and professionalism in maritime education underscores the importance of aligning educational curricula with international standards and best practices. With the maritime industry becoming increasingly globalised and complex, there is a growing demand for cadets to possess advanced navigational skills and cultural competence. Educational institutions must therefore ensure that their curricula provide comprehensive training in celestial navigation and incorporate emerging technologies and digital platforms to enhance learning outcomes.

The interviews conducted with maritime educators, transportation cadets, and industry experts shed light on the challenges and opportunities associated with integrating social media and citizen science initiatives into maritime education. While educators recognise the potential benefits of these platforms for enhancing learning experiences, they also face challenges such as limited resources and institutional barriers. However, there is a consensus among educators, cadets, and industry experts on the importance of collaboration and innovation in preparing cadets for the demands of the modern maritime industry. Furthermore, the discussion highlights the importance of promoting cultural competence in maritime education to prepare cadets for navigating in multicultural environments. By exposing cadets to diverse cultural experiences and perspectives, educational institutions can foster a deeper understanding and appreciation of cultural differences in celestial navigation practices. This aligns with international standards that emphasise the importance of promoting diversity and inclusivity in maritime education.

The implications of the research findings extend beyond the academic realm to the professional development of transportation cadets and the broader maritime industry. By leveraging social media and citizen science initiatives, cadets can enhance their navigational

skills and cultural competence, thereby improving safety and efficiency in maritime operations. Additionally, educational institutions must adapt their curricula to meet the evolving needs of the industry and ensure that cadets are equipped with the necessary skills and knowledge to succeed in their careers. By embracing these platforms and promoting cultural competence, educational institutions can prepare transportation cadets to navigate the challenges and opportunities of the globalised maritime industry effectively. Furthermore, the findings underscore the importance of collaboration and innovation in shaping the future of maritime education and professional development.

## **CONCLUSION**

This research has explored the influence of social media and citizen science initiatives on astronomical literacy and its application in maritime navigation among transportation cadets. The findings highlight the significant role that these platforms play in enhancing navigational knowledge and skills, as well as promoting cultural competence among cadets. Furthermore, the research has underscored the importance of aligning educational curricula with international standards and best practices in maritime education. By incorporating emerging technologies and digital platforms into their teaching methods, educational institutions can better prepare cadets for the challenges of the modern maritime industry. Additionally, promoting cultural sensitivity and inclusivity in maritime education is essential for preparing cadets to navigate in multicultural environments and foster a deeper understanding of celestial navigation practices. This research contributes to the growing body of knowledge on the intersection of technology, education, and maritime navigation. By embracing social media and citizen science initiatives, educational institutions can enhance the educational experience of transportation cadets and prepare them to become competent and culturally aware maritime professionals.

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