Two Decades of Research on Maritime Environmental Education in Social Science: A Systematic Review

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Abstract. This research aims to analyse the maritime environmental education literature in social science in the last two decades. This study used a systematic review by analysing twelve articles that were declared eligible, and analysed using content analysis. The results showed that this study revealed that maritime environmental education focuses on management, competence, and assessment. Management includes operations, motivation, innovation, communication, and application, while competence involves professionalism and personality. Assessment studies knowledge and performance. A strong correlation was found between personality and motivation. Norway and Finland are the main actors in maritime environmental education. The research emphasises maritime environmental education is conducted to support marine ecosystem preservation and coastal community development.

1 Introduction

Maritime environmental education has attracted the attention of researchers, educators, and policy makers due to the emergence of various issues plaguing the environment [1]. Education is considered to be the best solution in resolving maritime environmental issues and problems, for example, addressing pollution in coastal areas and providing knowledge on marine sustainability and preservation. Maritime environmental education has been incorporated in anticipation of the sustainability of the subjects offered and their impact on socio-economic progress [2]. Maritime environmental education involves the understanding, awareness and skills of individuals or groups in conserving, utilising and managing marine resources and coastal environments in a sustainable manner. This is a strategy that humanistically encourages every individual, especially in the educational environment, to contribute to maintaining and preserving the maritime environment.

In recent years, maritime environmental education has been carried out by integrating technology with the maritime environment. [3–5]. Maritime environmental education research focuses not only on aspects of knowledge and awareness, but also on character

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building and environmental ethics. [6]. Community-based programmes, such as 'Eco-Youth Marine,' are examples of efforts to engage the younger generation in concrete actions for marine conservation [7]. In addition, interdisciplinary approaches, incorporating social, economic, and cultural aspects, are beginning to be favoured in maritime environmental education research. [8]. Maritime environmental education becomes a strategy to reduce crime and provide security to the maritime environment [9–11]. Maritime environmental education has great potential to change people's paradigms about the importance of the ocean as a heritage that must be preserved.

Unfortunately, some of the dilemmas for curriculum development, training, and achieving desired learning outcomes in professional environments still focus on knowledge [12]. Lack of teacher training, and low public awareness remain key barriers. While there are initiatives that have promoted awareness of marine environmental issues, learning misconceptions remain [13,14]. The vast amount of literature that has contributed to the resolution of marine environmental problems makes it difficult to identify the gaps. Traditional reviews have not been able to objectively address this issue. Thus, this study uses systematic review analysis to address maritime environmental issues by reviewing previous literature.

Systematic reviews use explicit and reproducible methods to identify, critically appraise, and synthesise the results of primary research studies [15]. Systematic reviews were conducted in the nineties and early 2000s [16]. The systematic review provides an overview of empirical research on the theme/theory/method and synthesises previous studies to strengthen the knowledge foundation [17]. Systematic reviews are usually conducted on specific data [18]. Unlike conventional literature review methods, systematic reviews follow a specific protocol to ensure validity, replicability and objectivity of results. This approach is widely used in various fields of science due to its ability to provide a comprehensive overview of a particular research topic.

This research analyses maritime environmental education using previous literature. Although some previous literature has reviewed maritime environmental education with different research focuses, including focusing on marine education issues, and the use of IoT in marine education. [14,19]. However, there is no research that reviews how maritime environmental education is conducted. This research contributes to providing an understanding of how maritime environmental education is conducted that supports marine ecosystem preservation and coastal community development. It provides a foundation of science and practice that can be implemented to increase community awareness, knowledge and skills related to maritime environmental management.

2 Method

This study used a systematic review to review the maritime environmental education literature. The use of systematic review in this study consisted of several stages, namely (1) determining relevant keywords; (2) determining the database; (3) determining the criteria for relevant articles; (4) article analysis; (5) visualisation and interpretation.

2.1 Research Strategy and Procedure

Researchers started this research by determining relevant keywords. These keywords contain words that can obtain articles on a large scale. Researchers use boolean AND and OR to declare expanding article mining and use symbol (*) to further expand article mining. Article mining is done based on title, abstract, keywords. The keywords used by researchers, namely:

TITLE-ABS-KEY: ((‘environment’) AND (‘educat*’ OR ‘teach*’ OR ‘learn*’) AND (‘maritime’))

In the second stage, the researcher determined the database used to mine the articles. There are two databases that are popularly used because of their credibility, namely Scopus and Web of Science (WoS). This research uses the Scopus database because Scopus has 20% more coverage over time than Web of Science [20].
In the third stage, researchers determined the criteria for the articles. These criteria guide researchers to obtain articles that meet the needs of this study. Some criteria that have been determined by researchers are presented in table 1. In the fourth stage, researchers conducted data analysis. Articles that have been declared feasible will be analysed. The results of data analysis are answers to research questions. fifth stage, researchers visualise and interpret research results.

Table 1. Inclution and exclution criteria

No	Criteria	Inclusion	Exclution
1	Timespand	Time span in 2 decades (2004-2023)	Under 2004 and above 2023
2	Document type	Article	Books, book chapters, proceedings, reviews
3	Subject area	Social science	Outside the subject area of social science
4	Language	English	Articles in languages other than English
5	Access	Open access	Full text not accessible
6	Empirical paper	Field research articles	Results of conceptual or theoretical studies
7	Focus	Maritime environmental education in formal educational institutions of primary, secondary and higher education	Focus is beyond what has been determined

2.2 Data Collection

Data collection utilised The Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA). PRISMA consists of four phases, namely: Identification of articles for review, Screening of articles for review, deciding on study eligibility, Finalising the list of studies for inclusion in the systematic review [21]. The results of data collection using PRISMA are as follows:

a. At the identification stage, researchers obtained 1449 documents.
b. At the screening stage, researchers removed 280 documents because they were outside the timespan, 685 documents because they were not articles, 341 articles because they were outside the subject area, namely social science, and 7 articles were not in English so that 136 articles were obtained.
c. At the eligibility stage, the researcher conducted a manual analysis. The results of the analysis showed that 77 articles could not be accessed, 17 articles were not the result of field research, 28 articles did not match the research focus, and 2 articles were not in English.
d. At the included stage, researchers have found from 136 articles, 12 articles were found to be suitable for analysis.

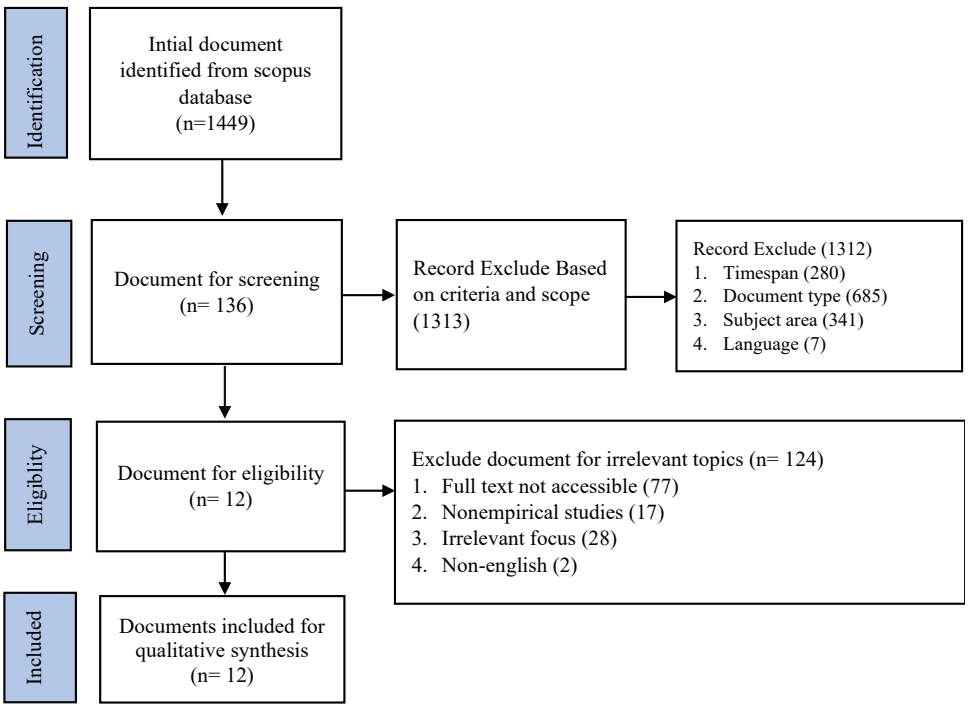

Fig. 1. Data collection process using PRISMA

2.3 Data Analysis

Articles that have been declared suitable for analysis are then analysed using content analysis. Content analysis refers to a systematic process for understanding, interpreting, and interpreting text, image, or other media data that has been collected. This approach is used to identify themes, patterns, and meanings from the data. In this study, the researcher used NVIVO 14 to help the researcher do the coding. In NVIVO 14 there are two types of coding that researchers must do (1) coding nodes. Once the data has been collected, the researcher begins the process of categorisation, which involves establishing thematic codes that represent particular ideas or topics in the data. These codes can be deductive (based on previous theories or hypotheses) or inductive (discovered based on the data itself). This process aims to filter out relevant information from the overall data; (2) coding cases. Coding cases involves the attributes of the article, including year, country, research type, sample size, instrument, data analysis technique, source and quartile [22].

Next, the data visualisation stage from the coding results. Data visualisation was done using word clouds, cluster analysis, project maps and charts. Word cloud as a visual representation of the frequency of words that appear in text or qualitative data in NVivo, word clouds are used to provide an overview of themes or keywords that appear frequently in the dataset. This feature helps researchers identify initial patterns or the main focus of the analysed data. Meanwhile, cluster analysis refers to a visualisation technique used to identify relationships or interrelationships between data elements, such as documents, themes, or codes. In NVivo, this feature helps researchers understand patterns of relationships in qualitative datasets in more depth. We used a Cronbach alpha of 0.7 to visualise the data. Data below 0.7 cannot be visualised in this study. Meanwhile, project map is a visualisation tool in NVivo that allows researchers to create a graphical

representation of the research project. This tool is useful for designing, organising and displaying relationships between research elements, such as themes, codes or data.

Table 2. Relevan Studies

No	Author (year)	Region	Method	Sample (size)	Education level	Instrument	Data analysis	Source	Quartile
1	[25]	Croatia	Survey	Female applicants (349)	University	Interview	N/S	Transactions on Maritime Science	Q3
2	[26]	Croatia	Survey	Student university (225)	University	Questionnaire	N/S	Transactions on Maritime Science	Q3
3	[27]	Montenegro	N/S	Students' university (100)	University	Questionnaire	N/S	Pomorstvo	Q3
4	[28]	Portugal	N/S	Students (131) Teachers (8)	Primary School	Questionnaires Interviews	Descriptive analysis Inductive analysis	Digital Education Review (DER)	Q2
5	[29]	Philippines	Survey	Graduates (100)	University	Questionnaire	N/S	Maritime Technology and Research	Q3
6	[30]	Norway	Experiment	Students' university (18)	University	Questionnaire	N/S	WMU Journal of Maritime Affairs	Q2
7	[31]	Norway	Qualitative and quantitative analysis	Students' university (6)	University	Questionnaires Interviews	N/S	Universal Journal of Educational Research	Q4
8	[32]	Finland	Survey	Students' university (226)	University	Questionnaire	N/S	WMU Journal of Maritime Affairs	Q2
9	[33]	Hong Kong	Survey	Undergraduates (180) and Postgraduates (70)	University	Questionnaire	N/S	WMU Journal of Maritime Affairs	Q2
10	[34]	South Korea	Survey	Korean Maritime Cadets (284)	University	Questionnaire	Descriptive Statistics	Sustainability	Q2

11	[35]	Norway	Experiment	Students' university (11)	University	Questionnaire	N/S	Marine Navigation and Safety of Sea Transportation: Advances in Marine Navigation	Q3
12	[36]	Norway	Survey	Instructures (62)	University	Questionnaire	Descriptive Statistics Confirmatory Composite Analysis (CCA)	Education Sciences	Q2

3 Results and Discussion

Figure 2 shows some important themes that are frequently encountered and directly related to maritime environmental education. Educational institutions are trying to focus on maritime environmental education from an educational aspect. This is important because maritime environmental education is a systematic effort to improve the understanding, awareness and skills of individuals or groups in conserving, utilising and managing marine resources and coastal environments in a sustainable manner [23]. This approach aims to integrate ecological, social, economic and cultural insights related to maritime areas into various levels of formal, non-formal and informal education. [24].

Fig. 2. Content analysis

Figure 3 shows that there is a relationship between the aspects of education as indicated by the correlation value of the Pearson correlation coefficient obtained from the coding results of the maritime environmental education research. Personality and motivation have a Pearson correlation coefficient of 0.83 which is the highest correlation value among other aspects. This value shows that personality is more related to motivation, which confirms that personality is more important in maritime environmental education, placing education as an actor who plays a major role in building motivation. The Pearson correlation coefficient of 0.83 between personality and motivation shows that personality plays a dominant role in driving student motivation. This confirms the importance of building strong character as a foundation for enhancing motivation in maritime environmental education. This finding is consistent with educational theory which emphasises that intrinsic factors, such as personality, influence learning success. Motivation has a strong correlation with knowledge, at 0.7, which confirms that high motivation provides students with opportunities to increase knowledge, indicating that motivation is not only an outcome of the learning process, but also acts as a catalyst for better academic achievement. Performance also has a strong correlation with motivation of 0.81 which confirms that good performance increases motivation while poor performance can decrease motivation. In addition, performance also has a strong correlation with assessment of 0.75 which confirms that good performance leads to positive assessment while poor performance can result in unsatisfactory assessment.

These results provide insights that maritime environmental education needs to focus on developing students' personality and motivation as the main strategy. In addition, it is important to build an educational ecosystem that prioritises performance improvement and provides an assessment system that encourages motivation. These efforts will create a positive cycle that supports continuous learning in the maritime environment.

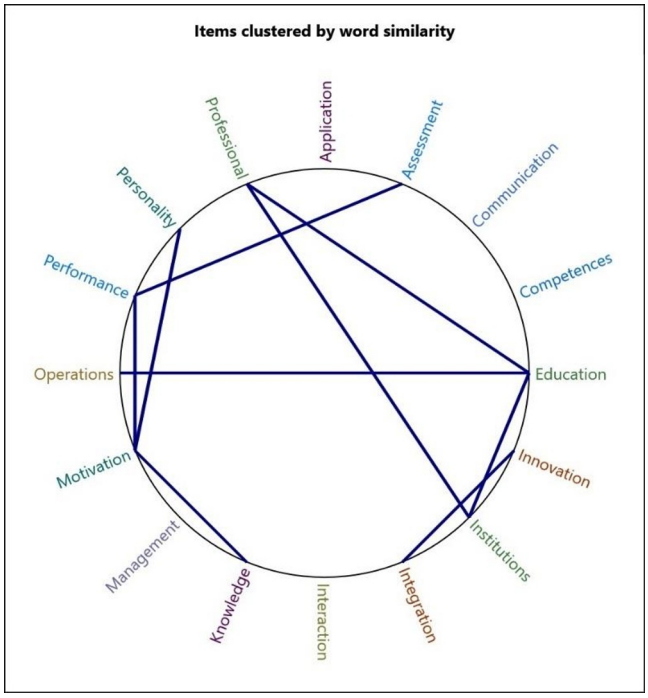

Fig. 3. Correlation analysis

Figure 4 shows that the prioritisation of education aspects in maritime environmental education. Quality education is key to the success of maritime environmental education. Educational institutions need to improve the quality of education by providing services that support student development. The analysis shows that the prioritisation of educational aspects in maritime environmental education focuses on management, competence and assessment. Management is done through organisation, motivation, interaction, integration, innovation, communication and application. Competence is related to professional and personality. Meanwhile, assessment focuses on knowledge and performance. The top priority in maritime environmental education lies in three key aspects: management, competence, and assessment. These three aspects complement each other to create quality education, which is the basis for successful maritime environmental education. The prioritisation of management, competence and assessment reflects a strategic approach to maritime environmental education. Educational institutions need to adopt innovative management strategies, develop programmes to strengthen professional and personal competencies, and implement transparent and outcome-based assessment systems.

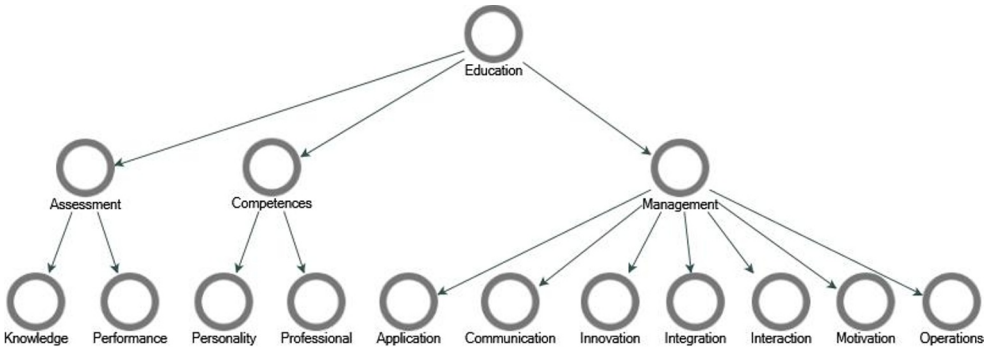

Fig. 4. Analysis of maritime environmental education

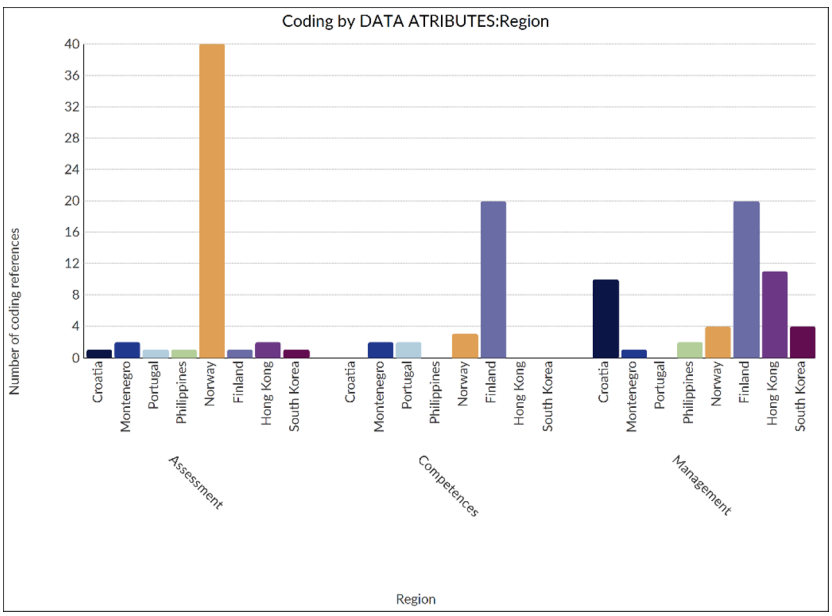

Fig. 5. Analyse aspects of education by country

Figure 5 shows the results of the education spec analysis based on the countries that contributed to the maritime environmental education research. The results show that Norway is the country with the most dominant assessment aspects among other countries. Meanwhile, Finland is the most dominant country that focuses on competence in maritime environmental education. Meanwhile, in the management aspect, Finland is also the most prominent country than others, followed by Hong Kong, Croatia, and South Korea.
The variation in focus between countries provides important lessons on how different approaches can be used to strengthen maritime environmental education. Norway emphasised the importance of evaluation, Finland provided models in competency development and management, while other countries showed flexibility in the management of education. Collaboration and adaptation of best practices from different countries can be a strategy to optimise maritime environmental education globally.

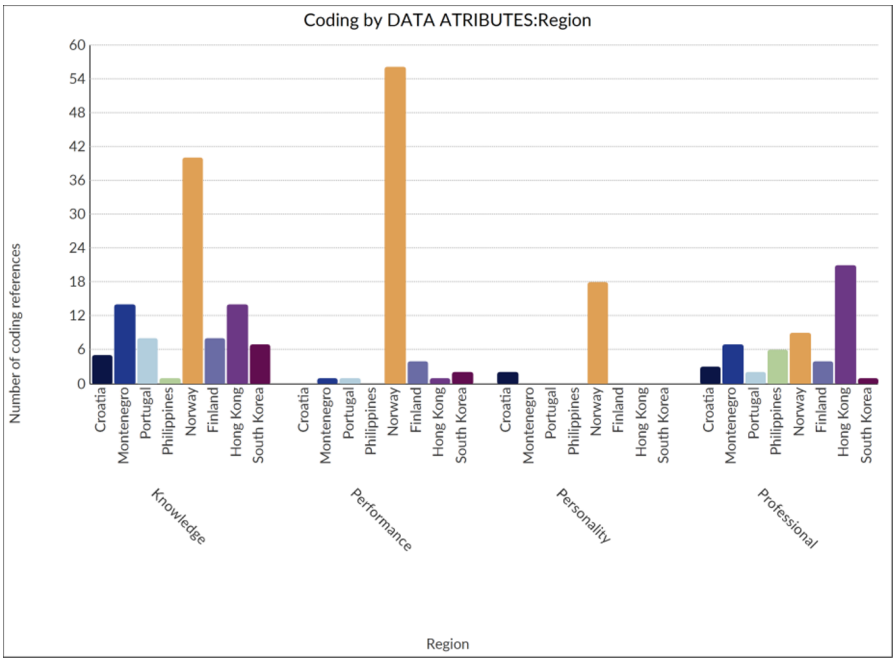

Fig. 6. Analyse the role of competences and assessments by country

Figure 6 shows the actors that play an important role in the competences and assessment aspects in maritime environmental education consisting of knowledge, performance, personality, professional. The findings show that Norway is the main actor in the assessment of knowledge, performance, and personality development compared to other countries. In addition, Hong Kong plays an important role in the assessment of knowledge and professional competence development, followed by Germany and Finland. This shows how actors are involved in competence development and assessment. Maritime environmental education is influenced by the diversity of approaches brought by international actors. Norway exemplifies best practice through a holistic approach, while Hong Kong stands out in its focus on professionalism. Collaborations with countries such as Montenegro and Finland enrich innovation in competence development and assessment. For maritime education at the global level, these results underline the importance of sharing knowledge and practices between countries to improve the quality of education and prepare a competent workforce in the maritime sector.

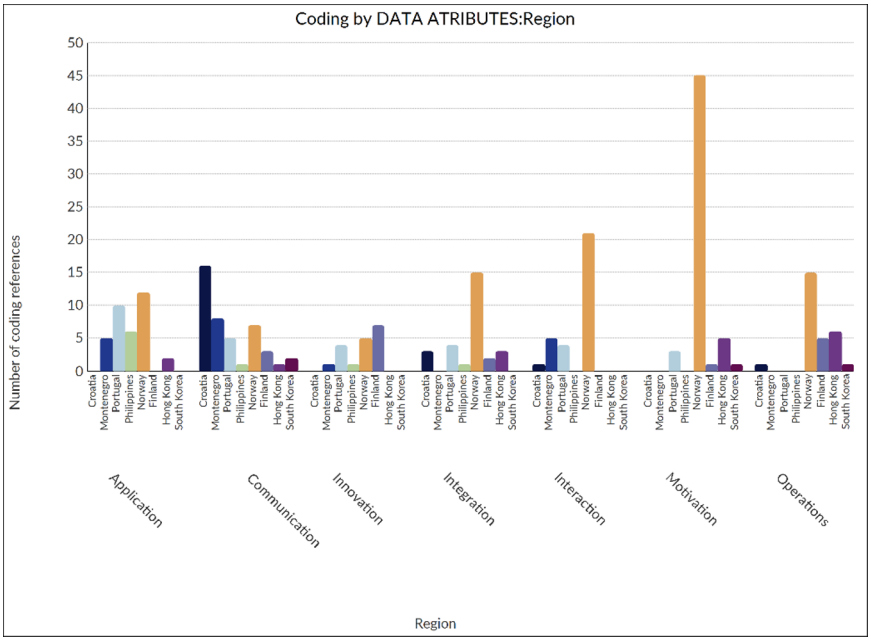

Fig. 7. Analysis of management roles by country

Figure 7 shows the actors that play an important role in management in maritime environmental education consisting of application, communication, innovation, integration, interaction, motivation, operations. Norway as the most dominant actor in application, integration, interaction, motivation, and operations. Meanwhile, Croatia as the most prominent actor in communication, and Finland as the main actor in innovation. These results show how actors manage maritime environmental education in formal education in their countries. Managing maritime environmental education requires a combination of practical application, effective communication and continuous innovation. Holistic approaches such as Norway's can be an inspiration for other countries, while Finland's innovation and Croatia's communication can complement global strategies in maritime environmental education. International collaboration based on each country's strengths has the potential to create a more resilient and adaptive maritime environmental education system.

4 Conclusions and Limitations of the Study

This study conducted a systematic review to analyse the maritime environmental education literature. The research has achieved its research objectives where the results found that the educational aspect is the main theme of maritime environmental education. It consists of management, competence, and assessment. Management refers to operations, motivation, interaction, innovation, communication, and application. Competences refer to professional and personality. Meanwhile, assessment refers to knowledge and performance assessment. The results of the correlation analysis show that personality has a strong correlation with motivation. In addition, Norway and Finland are the main actors in maritime environmental education.

This study has research limitations where this research only focuses on the use of the Scopus database. Future research could use other databases such as web of science, EBSCO, and google scholar. This research may have missed potential articles due to the

limited use of language, namely English. Future research could combine English with other languages to maximise the research results. This research, though, has contributed future research can use empirical data to further expand the study of maritime environmental education in the future.

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