# *A Study on Utilizing of Virtual Reality Teaching Materials in Marine Education for Primary School Children in Taiwan*

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**Abstract**
Global awareness of marine education is pivotal, yet Taiwan, as an island nation rich in marine resources, has not garnered the necessary focus in this area. Over the past few years, the COVID-19 pandemic has prompted schoolchildren to gradually adapt to online remote teaching and digital learning tools. Consequently, the importance of designing digital teaching aids and conducting research on teaching sites has become even more pronounced. This study investigates the utilization of virtual reality (VR) teaching materials in marine education for primary school children to address limitations in the learning environment and enhance overall learning motivation. Distilling marine education into five key themes—marine leisure, marine society, marine culture, marine science and technology, and marine resources and sustainability—the study systematically selects video teaching materials tailored for third-grade elementary schools based on these themes. Following a pre-test written assessment, teachers presented both traditional videos and VR headset-enabled videos. Subsequently, a post-test written evaluation and interview were conducted. It is found from written tests, worksheets and interviews that using VR to watch videos significantly improved school children's learning attitudes. At the teaching site, it can also be seen that students use a positive attitude to learn and give back with positive vocabulary. This study highlights the positive impact and promising developmental potential of virtual reality technology in marine education, emphasizing the need for increased attention, further research, and developmental initiatives in this field.

Keywords: Marine Education, Virtual Reality, Digital Learning, Environmental Protection

## Introduction

Researcher grew up in the rural farming and fishing environment of Taoyuan City, Taiwan. Served as a natural and Hakka language teacher at Yong An Elementary School in Taoyuan City and as a full-time counselor for the marine issues group of the Taoyuan City National Education Counseling Corps. Understanding Taiwan's pivotal position in the maritime domain and its abundant marine resources, I advocate for establishing Taiwan as a maritime nation as the foundation for national development. It is crucial to actively engage the populace in comprehending our maritime situation and advantages. With global trends increasingly focusing on maritime issues, nations are actively conducting marine resource surveys, expanding maritime activities, and establishing shared ocean governance. Promoting marine education comprehensively is essential for laying a solid foundation and ensuring its sustainable development.

## Literature Review

Marine education is a significant issue of global concern. Taiwan, with its main island and surrounding islands rich in marine resources, should make greater use of its geographical advantages. However, the general understanding of the ocean within Taiwanese society is still notably lacking. The vast ocean holds a wealth of ecological, historical, and environmental knowledge, such as marine geology, sea temperatures, ocean currents, and biodiversity, all of which have significant impacts on human life and the entire planet's ecology. To realize the ideal of Taiwan as a maritime nation, the most fundamental and long-lasting way to protect it is to earnestly implement marine education.

Contemporary education places a strong emphasis on diversity and interdisciplinary development, which implies that educational tools and strategies will also evolve toward greater flexibility and variety. Technology-integrated teaching, which uses technology as a pedagogical tool, can help students gain a deeper understanding of knowledge and assist in problem-solving, thereby fostering higher learning outcomes.

## Method

This study explores the use of VR materials to enhance the effectiveness of marine education, while comparing the learning outcomes across five key themes in marine education after using VR materials. It examines the feedback from students following the use of a VR-integrated marine teaching module. Using interviews and questionnaires to collect information and data, followed by qualitative and quantitative research, to obtain detailed and in-depth data for analysis and reflection.

## Results

The post-test results showed that in terms of learning outcomes, 85% of the students achieved a certain level of improvement after completing this course module. However, 15% of the students showed no improvement in the test results. The data obtained from this test result may indicate that some students might need additional support strategies in this teaching model, and may require more time to adapt to the diverse module-based learning approach. This situation could be due to individual students not being sufficiently familiar with the teaching module, or it might be a result of differing learning styles, learning needs, or levels of comprehension.

The students' reflections and feedback revealed the positive impact that the teaching activities had on them. Firstly, they became aware of the severity of environmental issues and recognized their responsibility as members of the Earth. This awakening of consciousness is crucial for future environmental protection efforts because only when individuals realize their responsibilities can the accumulation of greater collective power truly drive change. Secondly, they demonstrated a positive attitude and motivation towards learning. Through virtual reality technology and a diverse learning approach, they not only better understood the knowledge but also enhanced their learning capabilities. This positive learning attitude will accompany them throughout their lives, enabling them to continually pursue knowledge and growth. Finally, they expressed hope for the future and a willingness to take action. By understanding the root causes and impacts of environmental issues, they started to consider feasible solutions and indicated their intention to take action to improve the Earth's environment.

## Discussion

In lesson planning, teachers need to thoroughly consider the characteristics of different grade levels, students' learning needs and interests, as well as their familiarity with technology, attitude toward new learning methods, and expectations for learning outcomes. Smart mobile devices and VR tools should be integrated into specific teaching scenarios, with corresponding learning activities and tasks designed. For example, one might design or use a marine biology atlas with augmented reality technology, allowing students to use smartphones or tablets to view virtual marine creatures in the real world. This not only satisfies students' curiosity but also sparks interest in learning about marine biology. The technology-based teaching approach using virtual reality has interactive features, and the immersive environment offers a richer sensory experience. This makes learning more enjoyable while effectively conveying educational content. Especially in terms of visual and spatial learning, VR enables more direct participation, which helps increase engagement. Research has revealed the potential of virtual reality technology in education, particularly in improving learning attitudes. This is crucial for promoting innovative teaching methods to enhance student engagement and learning outcomes.

## Conclusions

The research results have demonstrated the potential of virtual reality (VR) technology in indoor marine education, with positive impacts on both learning effectiveness and attitudes. Such innovative teaching methods are expected to play an increasingly important role in future education. In the evolving environment of technology-enhanced and gamified teaching, VR technology stands out as a promising choice for instructional design materials. Looking at the long-term effects, the application of VR technology in learning has brought about revolutionary changes in marine education. Of particular interest is the long-term impact of VR education on students—whether it can stimulate students' long-term interest and concern for marine issues, and whether this interest will translate into active environmental conservation actions or further research. Innovative teaching methods not only enrich teaching content and enhance learning outcomes but also cultivate students' autonomy and spirit of inquiry. Therefore, it is foreseeable that with the continuous development of VR technology, it will play an increasingly important role in the field of education, providing students with richer and more immersive learning experiences. VR technology has the potential to transcend geographical and cultural boundaries, even enabling participation in international marine education projects. This helps students to gain a broader understanding

of global marine issues, develop comprehensive perspectives, and interact with students from different cultural backgrounds. It can also cultivate practical marine science and conservation skills in students, which can be applied to real-life marine conservation projects, making them active participants in environmental conservation efforts. With the ongoing advancements in technology, it is anticipated that virtual reality will continue to play a key role in the education sector in the future, particularly in addressing environmental and sustainability-related marine issues.

The study investigates the integration of virtual reality (VR) technology into indoor teaching for marine education and its impact on elementary school students' learning. The pre-test results indicate a relatively limited understanding of marine education among elementary school students. However, after the implementation of lesson plans utilizing smartphones and VR tools, significant improvement is observed in post-test results. This suggests that the use of smartphones and VR tools enhances the effectiveness of marine education for students. Regarding learning attitudes, students provide positive feedback in interviews and worksheets, expressing a desire for more opportunities to utilize such teaching methods for various marine education topics in the future.

Virtual reality headsets provide students with immersive learning experiences, enabling them to understand marine ecology, species, and environments without direct exposure to the ocean. Analysis of the interview transcripts and worksheet contents reveals a notable improvement in students' learning attitudes. Students commonly use positive language to provide feedback on the course, demonstrating the positive impact of VR technology on marine education. Improving learning outcomes and attitudes has always been important educational objectives. The interactive and immersive nature of virtual reality technology contributes to improved learning outcomes, making it easier and more enjoyable for students to understand educational content, thus fostering a positive trend in marine education development. As scientific advancements alter living environments, changes in attention and learning attitudes typically reflect in students' active participation and enjoyment in learning. Such positive attitude changes facilitate deeper student engagement and further enhance their learning outcomes.

The development of marine education may vary regionally, leading to differences in prior knowledge among students from different administrative regions and age groups. When conducting marine education on various marine topics for students in different regions and age groups, it is necessary to allow flexibility in adjusting the difficulty of teaching content to achieve better teaching effectiveness. A preliminary exploration of regional differences in marine education reveals several key factors. Students living in coastal areas have more opportunities to interact with the marine environment, while those in inland areas may have fewer such opportunities. Therefore, curriculum adjustments based on geographical location need to be considered. Students also have varying degrees of prior knowledge about marine ecology or marine science, necessitating flexible adjustments to teaching content or methods. Grouping students for instruction is recommended to ensure that each student can benefit from collaborative and differentiated teaching methods during the teaching process.

Considering the learning objectives of marine education at the elementary school level, educators should not only provide knowledge but also focus on cultivating students' interest in and awareness of marine conservation. However, marine issues emphasized in different regions may vary slightly, such as marine pollution, resource management, or ecological conservation. Therefore, educational content should also reflect local needs and resources.

Regional differences in prior knowledge are a reality that marine education needs to address. Through flexible curriculum design and interdisciplinary teaching methods, marine education can achieve better teaching effectiveness in various regions while also fostering students' autonomous awareness of marine conservation, thereby accomplishing the three learning objectives of experiencing the sea, loving the sea, and understanding the sea.

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