ISSN 2055-0286
Advances in Social Sciences Research Journal; Vol. 13 No. 04 (2026) (67-83)
https://doi.org/10.14738/assrj.1304.20213

A Teaching Practice Study on Applying the CIPP Evaluation Model to Investigate Marine Conservation Lesson Plans and Teaching Aid Practices in Taiwan

Wei-Hsin Cheng[1] & Lan-Ting Wang[2]

1. Graduate Student, Department of Visual Communication Design, Tainan University of Technology, Taiwan
2. Associate Professor, Department of Visual Communication Design, Tainan University of Technology, Taiwan

Abstract: This study, grounded in teaching practice research, explores the design principles and application value of teaching aids and lesson plans in marine conservation education. Using the CIPP evaluation model as the analytical framework, it summarizes the design characteristics of teaching aids and lesson plans in marine conservation education in recent years and further develops self-made interactive teaching aids for marine conservation education. Through literature analysis, this study collected relevant literature on marine conservation education, ocean literacy education, gamified teaching, and students' cognitive development, and conducted CIPP analysis on three cases of marine conservation education from the four dimensions of context, input, process, and product to examine their instructional design and implementation effectiveness. The findings show that the design of interactive teaching aids and lesson plans for marine conservation education should emphasize students' cognitive developmental needs, transform marine conservation knowledge into learning materials that are easier to operate, and incorporate storytelling, gamification, and situational contexts in order to enhance students' learning motivation, interaction, and participation. This study completed a series of marine conservation teaching aids, including an interactive simulation box, a handheld whale teaching aid, and magnetic interactive devices. Through the design and implementation of these self-made interactive marine conservation teaching aids, as well as multiple revisions of materials, structure, and functions, a tabletop game-based teaching aid with display value, interactivity, educational significance, and operational stability was gradually developed. This study not only responds to the practical needs of marine conservation education in teaching settings, but also, through the processes of teaching aid design, implementation, and reflection, develops interactive instructional materials for teaching practice, which may serve as a basis for future classroom trials and further improvement of teaching aids.

Keywords: CIPP, Taiwan, Marine Conservation Education, Teaching Aids, Teaching Practice Study

INTRODUCTION

In recent years, studies on marine conservation education have increasingly emphasized that instructional design should not be limited to knowledge transmission alone, but should also incorporate interactive experiences, situational engagement, and action-oriented learning in order to enhance students' understanding of and engagement with marine issues. Leitão, Yao, and Guimarães (2025) applied an augmented reality board game to ocean literacy instruction, and the results showed that it helped improve students' performance

in terms of knowledge, awareness, attitudes, and action participation, indicating that gamified and interactive instructional media have positive effects on marine education. Brenes-Cuevas, Ruiz, and Garrido-Pérez (2025), meanwhile, implemented a localized card game featuring marine organism images in classroom teaching, and pointed out that such visualized and contextualized teaching aids can effectively increase student participation and promote their understanding and expression of marine conservation concepts (Leitão et al., 2025; Brenes-Cuevas et al., 2025).

In terms of instructional model development, Schio and Reis (2024) proposed a basic education model for fostering ocean citizenship, emphasizing the integration of ocean literacy, systems thinking, citizen science, and action practice, so that students can move from knowledge acquisition to the development of responsibility and conservation-oriented action. This study suggests that the focus of marine conservation education lies not only in imparting marine knowledge, but also in cultivating learners' attention to, identification with, and actual participation in marine issues (Schio & Reis, 2024).

Pazoto, Duarte, and Silva (2024) pointed out that the promotion of ocean literacy education in schools often faces problems such as insufficient curriculum integration, limited professional support for teachers, and a lack of teaching resources, highlighting the critical role of teaching materials and teaching aid design in the implementation of marine education. These findings indicate that the development of teaching aids combining interactivity, operability, and contextualization can help teachers effectively transform marine conservation content within limited classroom time and enhance students' learning motivation and participation (Pazoto et al., 2024). Relevant studies generally support the use of gamified, contextualized, and interactive teaching aids as important media for marine conservation education, and affirm their value in enhancing learning motivation, knowledge comprehension, and conservation awareness. Therefore, this study adopts the CIPP framework to analyze teaching aids and lesson plans in marine conservation education and further develops self-made interactive teaching aids, which demonstrates both solid theoretical grounding and practical significance (Leitão et al., 2025; Schio & Reis, 2024; Pazoto et al., 2024).

Studies in Taiwan have indicated that the original purpose of marine conservation education arose from environmental changes such as marine pollution and ecological degradation. More than 40% of the world's population lives in coastal areas and is threatened by extreme climate conditions (Chen & Chang, 2025). In Taiwan, marine conservation education has been promoted for more than two decades. It was initially rooted in the school system by the Ministry of Education and has gradually expanded toward the wider popularization of marine conservation education for all citizens. Its core concept focuses on the spirit ofcean "tizenship" emphasizing that individuals should not only possess knowledge and competencies related to marine environmental protection, but also develop a sense of social responsibility for actively participating in decision-making and action. Research findings have also confirmed that even short-term intervention can significantly promote tendencies toward behavioral change (Chen & Chang, 2025).

The purposes of this study are as follows: (1) This study organizes the processes and outcomes of teaching aids and lesson plans that have been applied in marine conservation education based on the collected samples. (2) By using the CIPP framework to analyze context, input, process, and product, this study summarizes their characteristics and implications, which may serve as references for subsequent designers. (3) Based on the

derived principles of teaching aid design, this study further designs and produces a series of teaching aids for marine conservation education, which will be used in subsequent field testing in schools.

LITERATURE REVIEW

Discussion of Marine Conservation Education

The core of marine conservation education lies in cultivating students' ocean literacy (Wu, 2025), with the aim of establishing national standards for marine conservation education and fostering globally aware citizens with a strong sense of the ocean. According to the indicators proposed by the Center for Ocean Sciences Education Excellence (COSEE), the internationally recognized definition of ocean literacy is "an understanding of the ocean's influence on humans and humans' influence on the ocean," and its evaluation criteria include three major indicators (Liu, 2025). The international ocean literacy framework has also established seven essential principles as the foundation for educational development (Liu, 2025): the Earth has one big ocean with many features; the ocean and life in the ocean shape the features of the Earth; the ocean has a significant influence on weather and climate; the ocean makes Earth habitable; the ocean supports a great diversity of life and ecosystems; the ocean and humans are inextricably interconnected; and the ocean is largely unexplored. These principles move beyond viewing the ocean as an isolated body of water on the Earth's surface, instead emphasizing global interconnections, cycles, and food chains, while strengthening the relationship between the ocean and living organisms (Wu, 2025).

In order to transform the ocean literacy framework into practical instruction, the Lawrence Hall of Science at the University of California, Berkeley developed the Ocean Science Sequence (OSS) curriculum to promote ocean literacy education. Taiwan has also adopted OSS as a benchmark for developing ocean literacy teaching materials for schools and social education institutions, and has sought to establish itself as a demonstration and training base for promotion in Asia. Marine conservation education emphasizes learning and application in real-life contexts, and its thematic areas are divided into marine recreation, marine society, marine culture, marine science and technology, and marine resources and sustainability (Liu, 2025). Marine-related issues can be integrated across disciplines rather than being confined to a single field. Up to the present, the education sector continues to promote marine conservation education and the cultivation of ocean literacy. In addition, the Ocean Affairs Council's four-year plan (2025–2028) also emphasizes the enhancement of public ocean literacy through inquiry-based and hands-on teaching approaches.

Discussion of Students' Educational Needs

During the transition from the early stage of computational thinking to the stage of concrete operational thinking, students move from basic literacy to the ability to organize extended ideas and express them in a structured manner. This developmental stage is also an important period for cultivating abstract thinking, and the learners at this stage are mainly students (Hsiao, 2016). Based on fundamental logical cognitive abilities such as ordering and classification, their thinking gradually develops into more logical and systematic forms, while the construction of logic is rooted in concrete personal experience (Hsueh & Li, 2018; Kuang, 2025). In terms of cognitive development, students at this stage are already able to

understand and follow complex rules and logic, and can use computational thinking to solve problems across different domains (Hsiao, 2016; Chen, 2020). However, if the amount of knowledge is arranged too densely, involves too many elements, or requires multiple stages of reasoning, younger students may still experience excessive cognitive load or distraction, which can result in unclear learning goals (Hsiao, 2016; Kuo, 2023).

In light of the above cognitive characteristics, students gradually shift from relying primarily on intuition and imagery to depending more on concrete operations and rules. Therefore, abstract or specialized knowledge still needs to be translated into concrete, perceptible, or operable learning materials or physical teaching aids, allowing students to acquire knowledge through images and pictures retained by the senses. Their learning needs also gradually move toward the cultivation of organizational and integrative abilities (Li & Yang, 2018). Based on individual experience, students are able to organize rules and solve concrete problems, sequence problems or tasks, and apply inductive principles to resolve them, while gradually understanding the reversibility of logic in the process (Li & Yang, 2018). In addition, the transmission of knowledge should be built upon students' prior knowledge, and in visual design, clear fonts, vivid colors, and appropriate images can be used to attract students' attention (Kuo, 2015), which also reflects the functional role of textbook illustrations as summarized by various scholars. Furthermore, gamified educational approaches provide teachers with an alternative to one-way instruction. Such approaches positively support the development of cognitive structures and knowledge acquisition by transforming serious, anxious, and goal-oriented states into enjoyable, pleasant, and process-oriented experiences through play and humor. In this way, learning pressure can be reduced, and students' roles can shift from passive receivers of knowledge to active explorers in the learning process.

Discussion of Gamified Educational Models and the CIPP Evaluation Theory

passivGamified educational models have a positive effect on the development of cognitive structures and knowledge acquisition, helping to reduce learning pressure while transforming students' roles from passive recipients of knowledge into active explorers through gameplay (Lu, Chu, & Lu, 2013). In addition, Kolb's experiential learning cycle, proposed in 1984, serves as a widely recognized theoretical framework for exploratory learning models (Chen, 2012). This framework consists of a cyclical process of experience, reflection, generalization, application, and return to experience. The CIPP model is widely used to guide decision-making, support accountability, and enhance understanding of the object under study. It emphasizes the processes of evaluating, describing, obtaining, reporting, and applying information related to the strengths and value of the subject being evaluated. Within the analytical framework, the CIPP model is divided into four major evaluation dimensions (Li, 2017; Li, 2023):

(1) Context: This dimension defines the environmental background, identifies the needs, problems, and opportunities of the target group, diagnoses the difficulties revealed by those needs, and determines whether the goals adequately reflect the needs of the evaluated subjects, thereby supporting planning decisions.

(2) Input: This dimension evaluates alternative implementation strategies, as well as whether human, material, financial, and budgetary resources can support them,

thereby helping decision-makers select the most appropriate design and schedule for the program and make structural decisions.

(3) Process: This dimension involves continuous monitoring, recording, and feedback during implementation, allowing evaluators to track progress and resource utilization, identify difficulties, obstacles, or unintended side effects in a timely manner, and make immediate adjustments, thereby supporting implementation decisions.

(4) Product: This dimension measures, interprets, and judges the achievements of a program by comparing actual outcomes with expected objectives, confirming both intended and unintended effects, and providing decision-makers with information to determine whether the program should be continued, revised, refocused, or terminated.

CIPP evaluation is grounded in core values (Lin, 2022; Li, 2023) and features a cyclical evaluative function that helps decision-makers obtain accurate information and achieve favorable outcomes. In practical application, it also demonstrates a high degree of flexibility, as the four evaluation types may be used simultaneously or independently according to actual needs (Li, 2017). In recent years, the CIPP model has therefore been widely applied across diverse fields, including social and administrative fields, animal ethics policy, orphanage services, and volunteer service programs, all of which make use of systematic examination, cyclical evaluation, and policy improvement. The following section presents how the CIPP evaluation framework is applied in this study to the issues under discussion and analysis (see Figure 1).

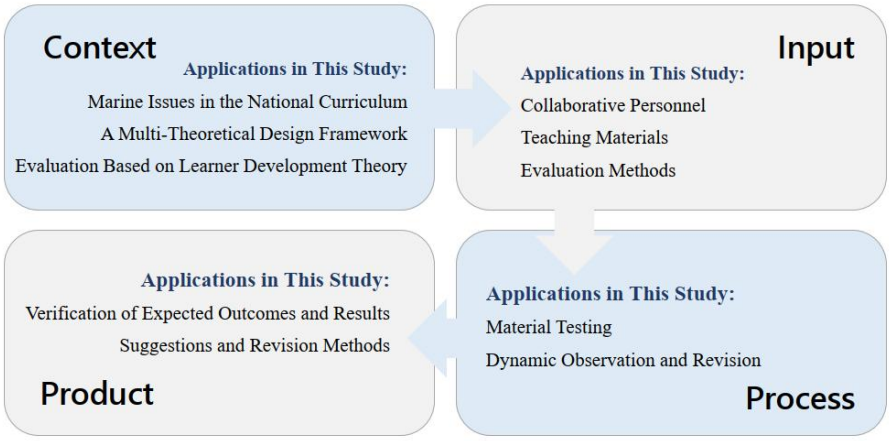


Figure 1: Application Topics of This Study Based on the CIPP Evaluation Framework

(Source: This study, 2026)

RESEARCH METHOD

This study aims to investigate the application effectiveness of teaching aids and lesson plans in marine conservation education for students. A literature review method was adopted to collect, organize, and analyze relevant studies on lesson plans and teaching aid design applied in educational settings, thereby establishing the theoretical foundation of this research. The research focus is mainly on the field of marine conservation education, with

students as the primary target group. The research methods, procedures, and expected outcomes are divided into the following four steps according to the research theme:

(1) Relevant studies in the fields of marine conservation education and ocean literacy education were collected, including journal articles, master's and doctoral theses, and conference papers in related fields.

(2) The collected samples were analyzed and organized using the CIPP evaluation model, and a literature analysis was conducted on the selected educational processes.

(3) Based on the previously organized results regarding the effectiveness of teaching aids and lesson plans in marine conservation education, design principles were proposed as the theoretical basis for subsequent empirical research.

(4) Based on the derived teaching aid design principles, this study further designed and produced a series of teaching aids for marine conservation education, which will serve as the basis for subsequent field testing in schools and for the inclusion of social benefit evaluation.

ANALYSIS AND PRACTICE OF TEACHING AIDS IN MARINE CONSERVATION EDUCATION

Analysis of Teaching Aids in Marine Conservation Education

The literature collected in this study was derived from teaching experiments conducted in educational settings. Based on the CIPP evaluation framework, case analyses were carried out. The subjects of analysis focused on the thematic educational fields of marine conservation education and ocean literacy, with related teaching aids and lesson plans serving as the primary instructional media. Their effectiveness and educational processes were examined, and the organized results are presented in Table 1 to Tables 3.

Table 2: CIPP Evaluation Summary of a Marine Conservation Education Case (II)

Using Lin Chin-Hung's (2025) "Paper Circuit Design" Lesson Plan as an Example	
Context	Integrated learning was adopted by combining paper circuits with the bioluminescence of marine organisms in instruction. From a theoretical perspective, students' fine motor skills were still developing, and the principles of physical circuits needed to be transformed into intuitive concepts.
Input	The instruction was led by the researcher in collaboration with the homeroom teacher, balancing teaching professionalism and classroom order. PowerPoint presentations and paper circuit kits were used, and the instructional process covered motivation arousal, component learning, production, and display of student work. Multiple assessment methods were adopted to examine learning outcomes.
Process	During the course, the use of paper circuit materials verified their low-threshold accessibility and safety. PowerPoint presentations assisted students in understanding abstract circuit concepts, while discussion and repeated testing guided them to independently identify and solve problems.
Product	The actual results were consistent with the expected objectives, including the development of scientific literacy, interdisciplinary integration, and problem-solving ability. The lesson plan adopted simplification and storytelling of concepts as its core design principles. It was also suggested that more opportunities for work presentation be added to strengthen students' oral expression and logical organization skills.

(Source: Lin Chin-Hung, 2025; Reanalyzed and compiled by this study using the CIPP framework, 2026)

Table 2: CIPP Evaluation Summary of a Marine Conservation Education Case (I I)

Using Lu Shu-Ru et al.'s (2013) "Genius Little Angler: Development of a Digital Tabletop Game" lesson plan as an example	
Context	Digital gamified learning was integrated to enhance motivation, requiring highly interactive materials and digital media. The design also needed to address possible gender differences in learning effectiveness and the integration of physical, three-dimensional, and digital teaching aids.
Input	One teacher guided the instruction, while five science experts and teachers examined reliability and validity. The content was linked to the Taiwan Fish Database, and observation focused on whether students could complete group competition and QR Code extended learning smoothly.
Process	The lesson followed a 5-minute explanation, 40-minute competition, and 15-minute test structure. The durability of the teaching aids and the smooth operation of mobile devices were also evaluated, with adjustments made based on field testing and immediate feedback.
Product	The results exceeded expectations by increasing students' interest in the ocean, strengthening marine sustainability concepts, and reducing gender stereotypes. However, boys were more likely to become overly excited during gameplay, suggesting the need for more non-textual guidance in future design.

(Source: Lu, Chu, & Lu, 2013; Reanalyzed and compiled by this study using the CIPP framework, 2026)

Table 3: CIPP Evaluation Summary of a Marine Conservation Education Case (I I I)

Using Du Ming-Ruei's (2025) "Project-Based Curriculum Based on Dewey's Educational Philosophy" lesson plan as an example	
Context	The lesson plan followed the marine education curriculum and applied Dewey's learning-by-doing and project-based learning concepts. Students created marine debris collection tools, though limited prior experience and insufficient reflection might affect deeper learning.
Input	The teacher guided instruction, operation, and reflection. Materials such as popsicle sticks, rivets, and hot glue were used, and structured worksheets supported the learning process.
Process	A three-week course was implemented through observation and worksheet records, with adjustments made according to students' learning conditions.
Product	The results generally met expectations. Students completed and operated the tools successfully, improved attention and discussion, but the depth of reflection remained limited.

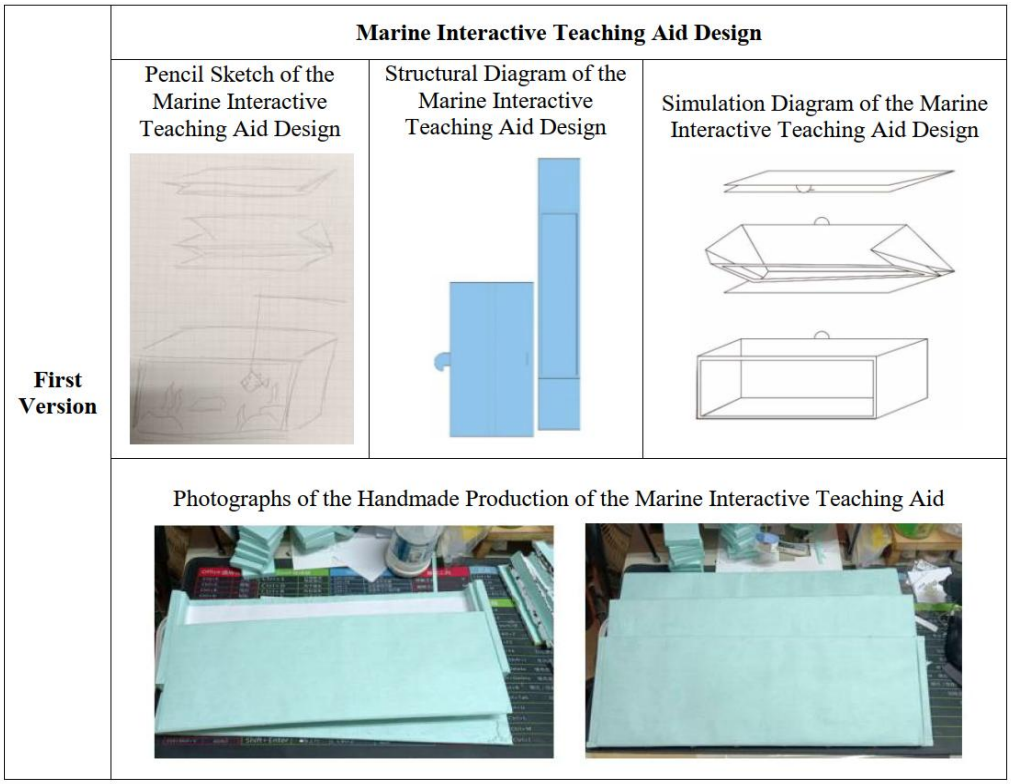
(Source: Du Ming-Ruei, 2025; Reanalyzed and compiled by this study using the CIPP framework, 2026)

This study analyzed the above three cases of teaching materials and teaching aids, all of which were designed and implemented around the theme of marine conservation education to ensure the applicability of teaching aids and lesson plans in real teaching settings. The findings indicate that intuitive concepts understandable to students, combined with highly interactive and gamified learning input, require prior consideration of learners' developmental stages. These lesson plans all integrated available resources with practical classroom conditions, and their teaching outcomes included the use of mobile devices and three-dimensional teaching aids to create a gamified learning environment. Learning outcomes were further reflected through tangible products, competitions, reflective sharing, and paper-based assessments. The instructional process emphasized students' problem-solving abilities and reserved appropriate time to strengthen the connection between students and the learning content. The results of this analysis show that teaching aids can effectively simplify marine conservation concepts, convey ocean literacy, align with instructional objectives, and enhance students' learning motivation.

Practical Implementation of Interactive Teaching Aids in Marine Conservation Education

Based on the analysis of the three cases, this study found that integrated learning, project-based learning, and storytelling principles can effectively simplify scientific concepts. Drawing on the derived teaching aid design principles, and with reference to the preliminary design of marine conservation education teaching aids proposed by Cheng and Wang (2025), this study further designed and produced a series of teaching aids for marine conservation education, as shown in Tables 4 to 8. These five tables include the first version of the self-made interactive marine conservation teaching aid design process (Table 4), the second version of the self-made interactive marine teaching aid design process (Table 5), the planar drawings and completed physical works of the self-made interactive marine conservation teaching aid design (Table 6), the handheld whale design process of the self-made interactive marine conservation teaching aid (Table 7), and the interactive device design process of the self-made interactive marine conservation teaching aid (Table 8). All of these self-made interactive teaching aids for marine conservation education will serve as the basis for subsequent field testing in schools and for the inclusion of social benefit evaluation, with the aim of expanding gamified educational spaces and enhancing students' interest in learning marine knowledge.

Table 4: First Version of the Design Process Diagram for the Self-Made Interactive Marine Conservation Teaching Aid

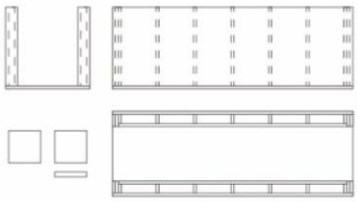
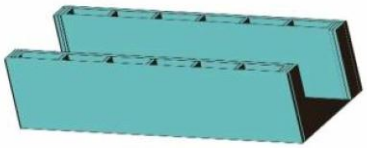
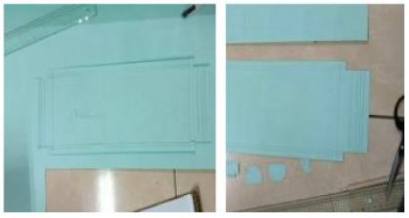


(Source: Adapted from Cheng and Wang, 2025; this study further added the production process and photographs of the physical interactive marine conservation teaching aid, 2026)

During the development process of the interactive marine conservation teaching aid, this study first designed the structural prototype of the first version of the simulation box,

using structural drawings and simulation diagrams as the basis for preliminary planning and evaluation. The first version of the interactive marine conservation teaching aid was designed with portability and lightness as its main concept (see Table 4), adopting a foldable structure and using 270 lb. cardstock as the material to facilitate production and carrying. However, the design evaluation revealed that although this version offered the advantages of convenient storage and simple production, it still had several limitations in actual teaching contexts. Since the target users were second-grade elementary school students, whose operations tend to be direct and involve relatively large movements, 270 lb. cardstock was insufficient in terms of pressure resistance, stability, and durability, making it difficult to meet the demands of repeated classroom use and frequent manipulation. Although the foldable structure improved portability, portability was not the primary concern of this study; instead, it reduced the overall structural stability and service life of the teaching aid. Based on these considerations, the simulation box in the first version of the interactive marine conservation teaching aid did not meet the expected goals in terms of material suitability, structural strength, and reusability. Therefore, it was not adopted and instead served as an important basis for subsequent design revisions and improvements.

Table 5: Second Version of the Design Process Diagram for the Self-Made Marine Interactive Teaching Aid

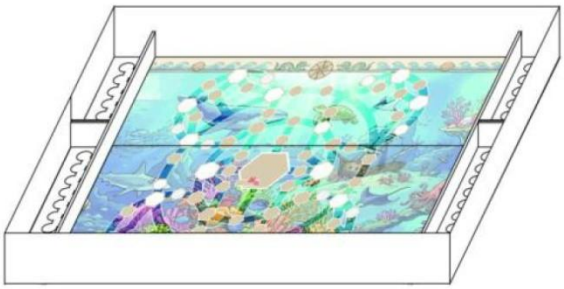
Second Version	Structural Diagram of the Marine Interactive Teaching Aid Design 	Simulation Diagram of the Marine Interactive Teaching Aid Design 
	Photographs of the Handmade Production of the Marine Interactive Teaching Aid 	

(Source: Adapted from Cheng and Wang, 2025; this study further added the production process and photographs of the physical interactive marine conservation teaching aid, 2026)

After evaluating the structural design of the first version of the interactive marine conservation teaching aid simulation box, this study further developed the second version of the marine interactive teaching aid simulation box, using structural drawings and simulation diagrams as the basis for design review. The second version of the interactive

marine conservation teaching aid adopted white corrugated board, cloud paper, and diluted 3670 white glue as materials for assembly (see Table 5).

Table 6: Series of Planar Drawings and Completed Physical Works of the Self-Made Interactive Marine Conservation Teaching Aid Design

Third Version	Planar Drawing of the Marine Interactive Teaching Aid Design 
	Simulation Diagram of the Marine Interactive Teaching Aid Design 
	Completed Photograph of the Marine Interactive Teaching Aid Design 

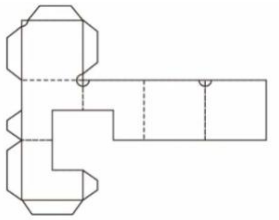
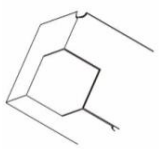
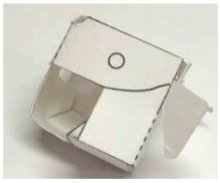
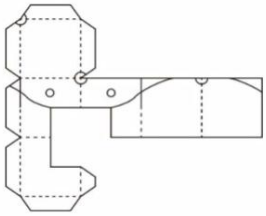
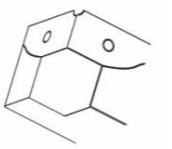
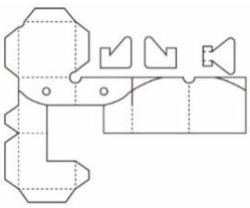
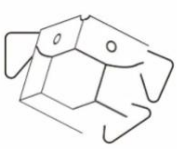
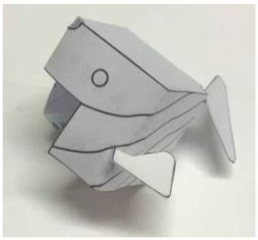
(Source: Drawings and physical production of the interactive marine conservation teaching aid by this study, 2026)

The box was mainly constructed by wrapping corrugated board with cloud paper, and the structure was repeatedly reinforced and bonded with diluted white glue to enhance overall strength and stability. Compared with the first version, which used 270 lb. cardstock, the second version showed clear improvement in the material and support of the box walls. Not only were the walls stronger, but with the addition of load-bearing structures, the box also demonstrated better uprightness and stability, making it more suitable for students'

classroom interaction and repeated use. However, during actual testing and evaluation, it was found that the increased thickness of the box walls, while beneficial for structural strength, also reduced the effectiveness of the magnetic components, causing the interactive function to fall short of expectations. Therefore, although the second version showed improvement in material reinforcement and structural support, it was ultimately not adopted due to unsatisfactory magnetic performance, and instead served as an important reference for subsequent revisions and integration.

After the first two versions of the interactive marine conservation teaching aid simulation box had undergone evaluation in terms of materials, structure, and functionality, this study further developed the third version of the interactive marine conservation teaching aid design, presented through planar drawings and photographs of the completed physical work. The third version adopted 3 mm white dense board, 3 mm mirror acrylic, and 2 mm transparent acrylic as materials to enhance the durability, display effect, and operational stability of the teaching aid (see Table 6). Considering that the teaching aid in this study was intended not only for classroom use but also for in-class demonstrations and promotional activities, portability was reintroduced as a design consideration in this version. Accordingly, the teaching aid was expanded into a tabletop game prop with an unfolded size of approximately 75 cm × 90 cm.

Table 7: Series of Design Process Diagrams for the Handheld Whale of the Self-Made Interactive Marine Conservation Teaching Aid

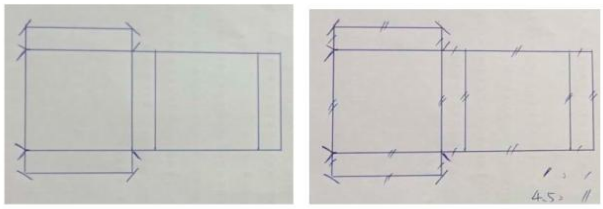
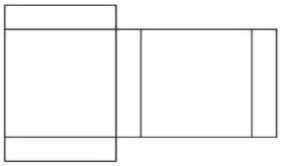
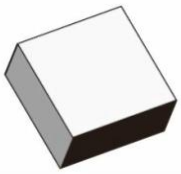
Handheld Whale Design	Structural Diagram of the Handheld Whale in the Interactive Marine Conservation Teaching Aid	Simulation Diagram of the Handheld Whale in the Interactive Marine Conservation Teaching Aid	Photographs of the Handmade Production of the Handheld Whale in the Interactive Marine
First Version			
Second Version			
Third Version			

(Source: Adapted from Cheng and Wang, 2025; this study further added the production process and photographs of the physical interactive marine conservation teaching aid, 2026)

To increase students' willingness to participate in interaction and improve their level of understanding, the third version adopted a board-game format that was more engaging and easier to follow. This allowed students to connect marine conservation knowledge and learning content with task-based situations during gameplay. The number of participants for this version was set at two to four, which better suited classroom group operation and interactive learning needs. Compared with the earlier stages, which mainly focused on structural testing and material adjustment, the third version further developed into a teaching aid form that integrated displayability, interactivity, educational value, and operational feasibility, making it more consistent with the objectives of this study in the design and instructional application of interactive marine conservation teaching aids.

During the design process of the interactive marine conservation teaching aid, the handheld whale teaching aid also underwent several revisions and improvements (see Table 7) in order to enhance its structural completeness and instructional functionality.

Table 8: Design Process Diagram of the Self-Made Interactive Marine Conservation Device

Marine Conservation Interactive Device Design	Pencil Sketch of the Interactive Marine Conservation Device Design 
Magnetic Corrugated Component	Structural Diagram of the Interactive Marine Conservation Device Design  Simulation Diagram of the Interactive Marine Conservation Device Design  Photographs of the Physical Production of the Interactive Device Design 

(Source: Adapted from Cheng and Wang, 2025; this study further added the production process and photographs of the physical interactive marine conservation teaching aid, 2026)

In the first version, 270 lb. cardstock was used as the main material, with the primary purpose of confirming the overall outline and basic structure of the handheld whale, serving as the preliminary basis for subsequent form development and physical production. At this stage, the focus was placed on establishing the overall proportion and formability of the

shape in order to examine the feasibility of the design concept. In the second version, the positions of the eyes and mouth were further clarified based on the first version, making the whale image more recognizable and strengthening students' understanding of positional relationships in the form, thereby enhancing the intuitiveness and visual communication effect of the teaching aid. In the third version, the cutting lines and bonding positions were revised to improve the accuracy of assembly and structural stability. At the same time, fins and a tail were added to further strengthen the whale's visual characteristics, making the teaching aid more appropriate to the theme of marine life. The design process of the handheld whale teaching aid thus demonstrates a gradual development from the establishment of a basic structure to the refinement of detailed form, which not only improved the completeness of the teaching aid but also made it more suitable for teaching the theme of marine conservation.

In the design of the interactive marine conservation teaching aid, this study also planned an interactive device as an important medium for enhancing students' sense of participation and exploratory ability. This interactive device mainly adopted a magnetic corrugated structure, in which magnets were placed between two pieces of corrugated board and then covered with blue cloud paper on the surface. This treatment allowed the device to visually correspond to the overall marine-themed context of the teaching aid while also providing concealment and operational safety. In practical application, the device was placed inside the simulation box and embedded into the gaps on both sides of the box as part of the interactive detection mechanism. Young students could explore by using the handheld whale teaching aid. When magnetic attraction occurred, the teacher could further guide them to infer the possible meaning of the hidden object, such as food, a fishhook, or other items related to the marine environment; when no magnetic attraction occurred, it could also serve as a basis for reverse judgment and discussion. This design not only increased the fun and interactivity of operating the teaching aid, but also guided students, through processes of perception and reasoning, to connect the gaming experience with the understanding of marine organisms' feeding behavior, survival risks, and marine conservation issues. Overall, the design of the interactive device integrates operability, contextualization, and educational value, helping to enhance students' active participation and learning interest during the experience, and thereby improving the effectiveness of marine conservation teaching.

Practical Implementation of Interactive Teaching Aids in Marine Conservation Education and Teaching Practice Research

After completing the above series of marine teaching aid implementations, this study found that the design of marine teaching aids is not merely the production of instructional materials, but also one of the important processes in teaching practice research. Based on this implementation process, seven major findings were summarized, which are presented in the related diagram of the practical implementation results of interactive marine conservation teaching aids and teaching practice research (see Figure 2): (1) teaching aid design centered on students' learning needs; (2) the promotion of marine conservation knowledge and its application in teaching practice; (3) the enhancement of learning effectiveness through interactive participation in marine conservation activities; (4) teaching practice concerning the materials and operational safety of interactive marine

conservation teaching aids; (5) the coordination between the structural design of interactive marine conservation teaching aids and classroom teaching implementation; (6) the integration of contextualization and gamification of interactive marine conservation teaching aids into teaching practice; and (7) the alignment among interactive marine conservation teaching aids, lesson plans, and learning objectives.

Using the CIPP evaluation model as the analytical framework, this study explored the design characteristics of teaching aids and lesson plans in marine conservation education, as well as their implications for instructional application, and further developed self-made interactive marine conservation teaching aids accordingly. The findings indicate that, for marine conservation education aimed at students, the design of teaching aids and lesson plans should fully consider students' cognitive developmental characteristics, transforming abstract concepts of marine conservation into concrete, perceptible, and easy-to-operate learning content. In addition, strategies such as gamification, storytelling, and situational exploration can enhance students' learning motivation, participation, and comprehension. When teaching aids and lesson plans in marine conservation education are combined with interactive media, clear instructional procedures, and diversified assessment designs, they can help students construct ocean literacy through operational and observational processes, while also promoting the development of problem-solving ability and interdisciplinary integration skills.

Figure 2: Relationship Diagram of the Practical Implementation Results of Interactive Marine Conservation Teaching Aids and Teaching Practice Research

(Source: This study, 2026)

CONCLUSION

This study, grounded in teaching practice research and combined with the CIPP evaluation model, explored the design characteristics of teaching aids and lesson plans in marine conservation education, as well as their instructional implications and applications in teaching settings. The findings show that marine conservation education can meet students' learning needs when the design of teaching aids and lesson plans fully takes students'

cognitive characteristics into account and provides learning content that is easy to operate. In addition, through gamification and contextualization, students' learning motivation, interactive participation, and understanding of marine conservation knowledge can be enhanced. Through the CIPP analysis of three cases of marine conservation education, this study found that the integration of interactive instructional media into teaching aids and lesson plans helps students enhance their ocean literacy through processes of operation, observation, reasoning, and reflection. By integrating teaching aids with instructional activities, marine conservation education can guide students from understanding marine issues to further developing concern for and participation in marine conservation.

From the perspective of teaching practice research, this study, through the actual design, production, revision, and reflection of interactive marine conservation teaching aids, specifically demonstrates how teachers can continuously adjust teaching aid materials, structures, interaction methods, and instructional applications based on the needs of real teaching settings. The research process shows that the design of interactive marine conservation teaching aids, through the progressive revisions of the first, second, and third versions of the simulation box, as well as the handheld whale teaching aid and the magnetic interactive device, led to the identification of seven key points in the practical implementation of interactive marine conservation teaching aids and teaching practice research. These include teaching aid design centered on students' learning needs, the promotion and practical application of marine conservation knowledge, the enhancement of learning effectiveness through interactive participation, considerations of materials and operational safety, and the coordination between teaching aid structure and classroom implementation.

These results indicate that teaching aid design and teaching practice are highly interrelated, and that only through continuous reflection and revision can truly applicable interactive instructional materials for teaching settings be developed. From the perspective of teaching practice research, the process of revising teaching aids further verifies the importance of marine conservation instructional materials. The self-made interactive marine conservation teaching aids developed in this study integrate displayability, interactivity, and educational value, and can serve as important teaching aids for future classroom implementation, thereby further enhancing the teaching quality and promotion of marine conservation education.

ACKNOWLEDGEMENTS

The authors would like to express sincere gratitude for the research funding support provided by the Ocean Conservation Administration of the Ocean Affairs Council in Taiwan through two projects, namely the 2025 Marine Conservation Education Innovation and Promotion Project and the 2026 Marine Conservation Education Innovation and Promotion Project. The project numbers are【114 OCA -0615- C-S -08】 and 【115-OCA-0601-C-S-01】, respectively. This study constitutes part of the final report of these projects. The authors would also like to thank the project assistant Wei-Hsin Cheng for her assistance in the production of the marine teaching aids, as well as all project assistants for their support in handling project-related affairs. Their contributions are gratefully acknowledged.

REFERENCES

Brenes-Cuevas, C., Ruiz, L., & Garrido-Pérez, C. (2025). Integrating ocean literacy through a locally contextualized Dobble-like card game: An exploratory classroom implementation. Sustainability, 17(23), 10840. https://doi.org/10.3390/su172310840

Chen, C. H. (2012). An action research on integrating adventure education into the integrated activities curriculum in elementary schools (Master's thesis). In-Service Master's Program, Department of Civic Education and Leadership, National Taiwan Normal University.

Chen, H. J. (2020). The design of physical teaching aids based on interactive learning (Doctoral dissertation). Doctoral Program, Department of Electrical Engineering, Tamkang University.

Chen, W. H., & Chang, C. C. (2025). A study on integrating marine education into water sports to enhance university students' ocean citizenship. Sports Research, 34(2), 175–187.

Cheng, W. H., & Wang, L. T. (2025). Enhancing children's marine conservation through experiments with interactive teaching aids incorporating three-dimensional structures. Annual of Chinese Printing Technology, 281–291.

Du, M. R. (2025). Implementing Dewey's philosophy in elementary school project-based learning courses: A case of marine education integrating technology and art. Quarterly of Technology and Human Resource Education, 11(3), 63–79.

Hsiao, C. L. (2016). Enhancing young children's computational thinking through a game-based tangible interactive interface (Master's thesis). Department of Information Management, Chung Yuan Christian University.

Hsueh, C. C., & Li, C. F. (2018). Exploring teaching aid needs for technology learning among school-age children. In Proceedings of the LSHI 2018 International Conference on Linkage and Symbiosis: Cultural Heritage and Design Innovation (pp. 381–392).

Jhang, J.-N., Lin, Y.-C., & Lin, Y.-T. (2025). A study on the effectiveness of a hybrid digital-physical board game incorporating the sustainable development goals in elementary school sustainability education. Sustainability, 17(15), 6775. https://doi.org/10.3390/su17156775

Kuo, C. Y. (2015). A study on the editing and illustration design of Natural Science and Life Technology textbooks for middle-grade elementary school students (Master's thesis). In-Service Master's Program, Department of Visual Communication Design, Tainan University of Technology.

Kuo, F. C. (2023). A study on the design of teaching aids for Chinese learning assisted by oracle bone script imagery (Master's thesis). Master's Program, Department of Creative Product Design, Ling Tung University.

Leitão, R., Yao, S., & Guimarães, L. (2025). An augmented reality board game to work ocean literacy dimensions. Education and Information Technologies, 30, 19245–19268. https://doi.org/10.1007/s10639-025-13519-3

Li, J. L. (2023). Evaluating the Taipei street cat friendly care action program using the CIPP model (Master's thesis). Graduate Institute of Public Affairs, National Taiwan University.

Li, P. Y., & Yang, Y. C. (2018). Reflections on the collaborative lesson preparation model promoted by professional learning communities for Chinese language courses among middle-grade elementary school teachers. Taiwan Educational Review Monthly, 7(4), 108–111.

Lin, C. H. (2025). Exploring interdisciplinary learning practices in technology education through a paper circuit lesson plan: A teaching model integrating marine biological characteristics and hands-on ability. Quarterly of Technology and Human Resource Education, 11(3), 53–62.

Lin, H. C. (2022). Evaluating interdisciplinary teaching in aesthetic education using the CIPP model: A case study of the "Art and Mathematics Encounter" curriculum in M Junior High School in Taipei City. Taiwan Educational Review Monthly, 11(4), 156–161.

Liu, Y. C. (2025). A study of cooperative board games on junior high school students' marine knowledge ocean literacy personality traits collaborative problem solving and flow (Master's thesis). In-Service Master's Program in Digital Learning, Department of Educational Technology, Tamkang University.

Lu, S. J., Chu, C. H., & Lu, F. H. (2013). Development and design of an innovative digital tabletop game-based learning model: A case of marine conservation education for middle-grade elementary school students. National Education, 53(4), 45–55.

Pazoto, C. E., Duarte, M. R., & Silva, E. P. (2024). Challenges and prospects for teaching ocean literacy in Brazilian schools. Marine Policy, 166, 106220. https://doi.org/10.1016/j.marpol.2024.106220

Schio, C., & Reis, P. (2024). Design of a pedagogical model to foster ocean citizenship in basic education. Sustainability, 16(3), 967. https://doi.org/10.3390/su16030967

Wu, J. G. (2025). Opportunities challenges and curriculum localization strategies for marine conservation promoted through the four-year plan of the Ocean Affairs Council. Taiwan Educational Review Monthly, 14(10), 45–50.