

Developing OCEAN: A Gamified Mobile-Assisted Language Learning Application for English Structure Learning among Maritime Students

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Article Info	Abstract
Article type: Research Article Article history: Received August 30, 2026 Received in revised form September 05, 2026 Accepted September 12, 2026 Published online September 13, 2026 Keywords: Gamified Learning; Mobile-assisted Language Learning; English Structure; Maritime Students; OCEAN Application	This study developed and preliminarily evaluated OCEAN, a gamified mobile-assisted language learning application designed to support English Structure learning among maritime students. Using a modified Four-D research and development model, the Structure component was tested with 12 Ship Machinery Engineering Technology students in three supervised sessions over approximately one week, with about 45 minutes of application use per session. Performance was measured with an English Structure test administered before and after the sessions with identical items. Perceptions were assessed with a 10-item, five-point Likert questionnaire and analyzed descriptively. Mean scores rose from 64.17 to 81.25, an increase of 17.08 points following exposure to OCEAN, $t(11) = 22.99$, $p < .001$, Cohen's $d_z = 6.64$. This effect size is exceptionally large and should be interpreted cautiously: the one-group design had no control group, test items were identical at both time points, and the sample was small and homogeneous. The increase therefore cannot be attributed to OCEAN alone and may partly reflect testing or practice effects. Students reported highly positive perceptions (overall mean = 4.90 out of 5.00), although the questionnaire was not psychometrically validated. These preliminary findings suggest OCEAN may serve as a supplementary tool for English Structure learning, pending confirmation through controlled larger study samples.

Cite this article: Saktiono, M., Prastiwi, A., & Huda, M. (2026). Developing OCEAN: A Gamified Mobile-Assisted Language Learning Application for English Structure Learning among Maritime Student. *Technology Assisted Language Education*, 4(3), 27-53. doi: 10.22126/tale.2026.14576.1202



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DOI: <http://doi.org/10.22126/tale.2026.14576.1202>

Introduction

The integration of digital technologies into language education has substantially expanded how learners access, practice, and receive feedback on language knowledge (Golonka et al., 2014). Among these developments, mobile-assisted language learning (MALL) has emerged as an important approach because mobile devices enable learners to engage with language activities beyond the temporal and spatial boundaries of conventional classrooms (Kukulska-Hulme & Shield, 2008). Recent evidence indicates that MALL can support multiple dimensions of English language development, including vocabulary, grammar, listening, speaking, and writing, while also promoting learner engagement, motivation, and autonomy (Kukulska-Hulme & Shield, 2008; Burston, 2015; Martínez et al., 2025). Beyond mobile applications specifically, other forms of technology-mediated instruction, such as videoconferencing-based English teaching (Asadi, 2022) and augmented reality-enhanced reading tasks (Asadi & Ebadi, 2025), have similarly broadened the range of interactive language practice available to learners.

Grammar, or language structure, remains an important component of English language learning because learners need knowledge of grammatical forms and relationships to construct comprehensible and accurate messages. However, grammar learning can be challenging when instruction relies heavily on decontextualized explanations and mechanical drills that lack meaningful context, interaction, and immediate feedback (Nassaji & Fotos, 2011). Repetition itself is not the problem; purposeful repeated practice embedded in context and accompanied by feedback can support the gradual consolidation of grammatical forms (Hajizadeh et al., 2023). Technology-assisted approaches can address some of these limitations by providing learners with repeated practice, automated feedback, and opportunities to monitor their own performance (Golonka et al., 2014). Feedback appears to be the mechanism most consistently linked to these benefits. Formative assessment and meaningful feedback strongly predict student engagement (Asadi et al., 2017), and more recent research shows that integrating ChatGPT with teacher feedback can improve EFL writing performance (Asadi et al., 2025a). AI-supported peer assessment and AI-assisted teacher instruction in online IELTS writing courses have likewise been examined as ways to support engagement and writing outcomes (Asadi & Taheri, 2024; Asadi et al., 2025b). AI has also been used to help teachers tailor lesson plans to individual learner needs (Mohammadi et al., 2024). However, this AI-supported work mostly concerns writing, reading, and teacher-facing tasks rather than grammar practice in gamified mobile environments.

Gamification provides another promising dimension for technology-assisted language learning. By incorporating game-related elements such as levels, points, rewards, progression, and challenges, gamified environments can make practice more engaging; however, effectiveness still depends on alignment among game mechanics, instructional objectives, and learner needs (Deterding et al., 2011; Hamari et al., 2014). Consequently, a language-learning application should not treat game features as merely decorative; instead, it should integrate gamification with meaningful language practice and feedback.

These considerations are particularly relevant in maritime education, where English proficiency is closely connected to professional communication and safety. The International Maritime Organization (IMO) established the Standard Marine Communication Phrases (SMCP) as a standardized form of maritime English for safety-related communication. The SMCP are intended for ship-to-ship, ship-to-shore, and onboard communication and were developed to reduce language barriers and misunderstandings that may contribute to maritime accidents. The IMO also emphasizes that the SMCP are based on basic knowledge of English and employ standardized linguistic structures to support precise, simple, and unambiguous communication in maritime contexts (International Maritime Organization, 2002). Therefore, English Structure learning for maritime students should not be viewed solely as general grammar instruction; it can also contribute to their preparation for accurate and effective professional communication in maritime environments. For clarity, this paper uses the term English Structure to refer to the grammar course/component within the authors' institutional curriculum, encompassing grammatical sentence construction and accuracy; it is used interchangeably with the more internationally familiar term grammar.

MALL and gamification can reasonably support several language skills and learner engagement (Burston, 2015; Hajizadeh & Weisi, 2025; Sailer & Homner, 2020; Martínez et al., 2025). Evidence for grammar specifically is less settled: a recent meta-analysis found significant benefits of mobile games for vocabulary and pronunciation, whereas the effect for grammar was positive but not significant (Liu et al., 2025). What remains insufficiently investigated is how a gamified MALL application can support English Structure learning in maritime-contextualized instruction, where learners need accurate professional communication and where most existing studies involve general EFL populations (Boeru, 2023). This study addresses that gap by developing and preliminarily evaluating a gamified mobile application for English Structure among maritime students.

The present study builds on the development of the OCEAN platform, an Android-based mobile learning application designed to support English learning among maritime students. Earlier stages of the OCEAN development focused on vocabulary, listening, and reading skills, while the present study extends the platform to English Structure. The application integrates structured learning materials, practice exercises, game-based activities, immediate feedback, scoring, and progression features (Sailer & Homner, 2020). In this study, OCEAN is positioned not simply as an Android application but as a gamified, mobile-assisted language-learning environment designed to provide learners opportunities for repeated, interactive English Structure practice (Shortt et al., 2023).

The development of the Structure component followed the Four-D research and development framework, consisting of Define, Design, Develop, and Disseminate stages (Thiagarajan et al., 1974). The framework organized the development process, but the study's main contribution is implementing a gamified, mobile-assisted approach to English Structure instruction in a maritime context, rather than combining MALL and gamification as such. The target learners were students of the Ship Machinery Engineering Technology program who

were preparing for shipboard training. Their learning needs therefore extend beyond general English proficiency and include the ability to use English accurately in a professional maritime setting (Rochmawati et al., 2025).

To evaluate the application's educational potential, the study used a pre-test/post-test design and collected learners' perceptions after they used OCEAN. The learning assessment examined changes in students' English Structure performance, while the questionnaire assessed their perceptions of the application's usability, interface, navigation, learning materials, exercises, game features, feedback, motivation, perceived learning support, and overall satisfaction. This combination of learning-outcome and learner-perception evidence provides a more comprehensive evaluation of a technology-assisted language learning application than usability assessment alone. Accordingly, this study addressed the following research questions:

How can the Four-D framework be used to develop a gamified mobile-assisted language learning application for English Structure among maritime students?

Does students' English Structure performance change following their use of the OCEAN application?

How do students perceive the usability and learning-related features of OCEAN?

Literature review

Method

Design

This study employed a research and development (R&D) design to develop and preliminarily evaluate OCEAN, a gamified mobile-assisted language learning (MALL) application designed to support English Structure learning among maritime students. The development process adopted the Four-D model proposed by Thiagarajan et al. (1974), which consists of four stages: Define, Design, Develop, and Disseminate. The Four-D model was originally developed as a systematic framework for instructional development and provides a structured process for defining learning requirements, designing instructional materials, developing the product, and disseminating the resulting product (Thiagarajan et al., 1974).

In the present study, the Four-D model was modified in three respects, all of which follow from the fact that the underlying OCEAN platform, including its Vocabulary, Listening, and Reading components, had already been developed in earlier stages of the broader OCEAN project. First, the Define, Design, and Develop stages were applied only to a new English Structure component rather than to an entirely new application. Second, in the Develop stage, the expert validation and the individual, small-group, and large-group trials described in the original model were replaced by an internal review of the application (Section 2.2.3) followed by a single user trial with 12 students; formal expert validation was not conducted. Third, the Disseminate stage was limited to an initial release of the updated application to the target users.

These modifications were made because the platform's interface, navigation, scoring, and progression architecture already existed, and because the study aimed to evaluate the new component preliminarily rather than complete a full validation cycle. The Define stage involved collecting data to identify learning requirements and target users. The Design stage comprised the preparation of Structure materials, layout design, and visual design. The Develop stage involved integrating the Structure component into the OCEAN application, revising it, and conducting user testing. The Disseminate stage involved the initial release of the updated OCEAN application to the target users, rather than large-scale deployment across institutions. It should be noted that the Four-D framework describes the product-development process, whereas the pre-test-post-test evaluation described in Sections 2.3-2.6 constitutes a separate empirical evaluation layered onto the Disseminate stage to examine preliminary changes in performance and perceptions following use of the resulting product; the two should not be conflated as a single research design. The development process explains how OCEAN was built, whereas the evaluation examines whether scores changed after exposure to it and, as a one-group design, cannot establish effectiveness.

The study also included a preliminary evaluation of learning outcomes and learner perceptions. The study examined students' English Structure performance using a pre-test and post-test and assessed their perceptions of the application with a 10-item questionnaire. This evaluation is particularly relevant to MALL research because previous research has emphasized the importance of examining measurable language-learning outcomes rather than relying solely on learners' subjective evaluations of mobile applications (Golonka et al., 2014; Shortt et al., 2023).

Development Procedure

The development of the Structure component followed four stages: Define, Design, Develop, and Disseminate. Table 1 summarizes the main activities, outputs, and decision basis for each stage to improve the transparency of the development procedure.

Table 1

Modified Four-D Procedure used to develop the OCEAN Structure component

Stage	Main activities	Outputs	Decision basis and criteria
Define	Direct observation and interviews with 12 prospective target learners (fourth-semester students preparing for the sea practicum) to identify the learning context and Structure-material needs.	Identified needs: difficulty with Structure (grammar); expectation of an interactive, visually engaging, gamified medium; need for self-paced practice with objective monitoring.	Learners' stated difficulties and expectations; the need to prepare for shipboard communication.
Design	Preparation of Structure materials and items from the SMCP course syllabus, set in nautical and ship-machinery contexts; layout design (wireframes and mockups in Figma); visual design; design of game mechanics and feedback.	Blueprint of five progressive levels with two item types (word-tile sentence construction; multiple-choice fill-in-the-blank); interface mockups.	Alignment with SMCP-based content and maritime contexts; difficulty increased across levels by grammatical complexity, item type, vocabulary, sentence length, and cognitive demand.
Develop	Implementation of the Structure Games in the existing Android application (Flutter and Dart); integration of materials, exercises, navigation, scoring, progression, and feedback; internal review and revision; user trial with 12 students.	Working Structure Games component within OCEAN; version revised after internal review.	Eight internal review criteria: suitability of material to objectives; clarity of instructions; grammatical accuracy and answer keys; item difficulty per level; suitability of context to English for Maritime Purposes; consistency of interface and navigation; functioning of buttons, page transitions, and level system; readability and ease of use. No formal expert validation.
Disseminate	Initial release of the updated application to the target users (installation on students' Android smartphones) for the trial.	Application used by 12 students in three supervised sessions.	Limited to an initial release because the study was a preliminary, single-institution evaluation; no multi-institution implementation.

Source: Authors' own development.

Define

The Define stage was conducted to identify the learning requirements and information needed to develop the English Structure component of OCEAN. At this stage, data were collected through direct observation and interviews with 12 prospective target learners, fourth-semester students preparing for a one-year sea practicum, to identify their learning context and Structure-material requirements. The interviews indicated that students still experienced difficulties learning English, particularly in the Structure (grammar) aspect, and that they expected a more interactive and visually engaging learning medium, such as a gamification-based application, to increase their learning interest and motivation. Three principal needs therefore emerged: support for learning grammar (Structure); an interactive and visually engaging medium that could sustain interest and motivation; and self-paced, challenge-based practice with objective and ongoing monitoring of Structure performance. These needs informed the decision to design Structure practice around self-paced, challenge-based exercises with immediate feedback and visible progress indicators, so that students could practice independently and monitor their own performance. The target learners were students in the Ship Machinery Engineering Technology program at the Faculty of Vocational Shipping. The students were preparing for shipboard training and therefore required English learning activities relevant to their future professional context. The information obtained during this stage was used to determine the Structure content, learning activities, and functional requirements of the application. The development was directed toward providing mobile-based opportunities for students to practice English Structure through an interactive and game-oriented learning environment. The use of mobile technology in this context is consistent with the broader concept of MALL, in which mobile devices are used to facilitate language learning beyond conventional classroom settings and can support flexible and learner-centred language practice (Li et al., 2023).

Design

The Design stage translated the learning requirements identified during the Define stage into the instructional and visual structure of the OCEAN application. Three main activities were conducted:

1. preparation of English Structure materials
2. layout design
3. visual design.

The Structure materials were organized into learning activities that could be accessed through a mobile device. The application was designed to provide opportunities for purposeful repeated practice, in which items were embedded in maritime contexts and each response was followed by immediate feedback, rather than for mechanical drilling of decontextualized sentences. The game-based design incorporated several features, including levels, scores, stars, voyage points, accuracy, and best streaks. These features were integrated into the learning activities to create a progression-oriented learning environment (Sailer & Homner, 2020). Immediate feedback was also incorporated to enable students to recognize whether their

responses were correct and to identify errors during practice. These features moved the Structure component beyond a static digital repository, embedding practice within a game-based progression system.

Content basis and progression. The Structure materials were derived from the syllabus of the Standard Marine Communication Phrases (SMCP) course, rather than from a general grammar textbook or an external proficiency framework, and the items were contextualized around nautical and ship-machinery topics so that grammar practice would relate to the students' future professional communication. The five levels were arranged in ascending order of difficulty, which was increased gradually through the complexity of the grammatical structures, the type of item, the vocabulary used, sentence length, and cognitive demand. Each level was unlocked only after the previous level had been completed.

Alignment of game mechanics with learning objectives. The game mechanics were chosen to serve specific learning functions rather than as decoration: sequential levels support ordered progression from simpler to more complex structures; word-tile sentence construction requires learners to produce correct word order; multiple-choice fill-in-the-blank items focus attention on the selection of specific grammatical forms; immediate feedback allows learners to recognize and correct errors during practice; and stars, voyage points, accuracy, and best-streak indicators provide visible information on performance. These intended functions are summarized in Table 3 (Section 3.2).

Develop

The Develop stage involved the implementation of the English Structure component within the existing OCEAN Android application. At this stage, the Structure materials, exercises, layout, visual elements, navigation, scoring system, progression features, and feedback mechanisms were integrated into the application. Before the user trial, the application underwent an internal review by the development team, which consisted of the researchers, a supervising lecturer, and colleague lecturers or researchers with relevant competence in English language teaching and instructional media development. The review checked eight aspects: (1) the suitability of the Structure materials to the learning objectives; (2) the accuracy and clarity of instructions; (3) grammatical accuracy and answer keys; (4) the difficulty of items at each level; (5) the suitability of item contexts to English for Maritime Purposes; (6) the consistency of navigation and interface; (7) the functioning of buttons, page transitions, and the level system; and (8) readability and ease of use. Formal expert validation was not conducted in this study. Therefore, no expert-validation scores or expert-based feasibility categories were used as evidence of product validity. The internal review was a quality check by the development team and should not be read as validation by independent experts. The absence of expert validation limits the strength of the development claims made in this paper, and formal validation of the application content and of the test is a priority for future work.

After the application had been developed and revised, it was tested with the target learners. The user trial involved 12 maritime students; its procedure, instruments, and analyses are described in Sections 2.3 to 2.6.

Disseminate (Initial Release)

The Disseminate stage, in this study, refers specifically to the initial trial release of the updated OCEAN application containing the English Structure component to a single group of target users, rather than a systematic or institution-wide dissemination process. The only dissemination activity that took place was the installation and use of the updated application on the Android smartphones of the 12 participating students during the trial; no multi-institution implementation or wider release was carried out within this study. The trial involved 12 students of the Ship Machinery Engineering Technology program as respondents and aimed to examine their responses to using the Android-based, gamified English learning application, particularly with respect to their learning experience in Structure. For this reason, the stage is more precisely described as an initial release than as systematic dissemination. The application was developed for Android smartphones and was primarily intended for students in the Faculty of Vocational Shipping. The application may also be used by other learners with English-learning needs related to maritime and port environments. However, the dissemination undertaken in this study represents the initial release of the developed application, rather than a large-scale implementation across multiple educational institutions. Therefore, the present study focuses on the development and preliminary evaluation of the application rather than on establishing its generalizability across different populations or educational settings.

Participants

The participants were 12 students enrolled in the Ship Machinery Engineering Technology program at the Faculty of Vocational Shipping. They represented the target users for whom the English Structure component of OCEAN was developed. The participants were involved in all stages of the preliminary user evaluation. They completed the English Structure pre-test before using OCEAN, participated in the application-based learning activities, completed the post-test following the intervention, and subsequently responded to the learner-perception questionnaire. The participants were selected using purposive sampling based on the match between their characteristics and the aim of developing and testing the Structure component. The inclusion criteria were: (1) being an active student of the Ship Machinery Engineering Technology program; (2) being in the target semester (the fourth semester); (3) having received basic English instruction relevant to the Structure material; (4) owning an Android smartphone able to run OCEAN; and (5) being willing to take part in the pre-test, all application sessions, and the post-test.

We collected no data on participants' English proficiency level or their previous experience with other mobile-assisted or gamified learning applications. All participants were male fourth-semester students aged 20 to 21 years. None of the participants had used OCEAN, in any of its

components, before this trial, so the Structure component was their first exposure to the platform. The small sample of 12 male students from a single program at one institution substantially limits the external validity of the findings, and the results cannot be generalized to other students, programs, or institutions. The study did not obtain formal ethical approval from an institutional review committee or written informed consent; participants gave verbal consent. The absence of formal approval and written consent is acknowledged as a limitation of the study.

Instruments

Two main instruments were used to evaluate the developed OCEAN application. The researchers developed both instruments; their development, content basis, and the evidence for their validity and reliability are described below.

English Structure Test

The researchers administered an English Structure test as a pre-test and post-test. The pre-test and post-test used identical items, and no parallel or equivalent form was used. Observed scores ranged from 55 to 75 in the pre-test and from 75 to 90 in the post-test. The pre-test was conducted before students used the OCEAN Structure component, while the post-test was administered after the learning intervention. The test scores were used to examine changes in students' English Structure performance following their use of the application. Because the same items were repeated after about one week, post-test scores may partly reflect testing effects (familiarity with the items) and practice effects rather than learning of the target structures alone; this possibility is discussed in Section 4.2. The test did not undergo formal expert validation, and its validity and reliability were not established. The scores are therefore treated as an indicator of change in performance on this particular test rather than as a validated measure of grammatical proficiency.

Learner-Perception Questionnaire

Learners' perceptions of the OCEAN application were assessed using a 10-item questionnaire administered after the learning activity. The questionnaire addressed ease of use, interface attractiveness, navigation, content comprehensibility, exercise--content alignment, gamification, immediate feedback, learning motivation, perceived learning support, and overall satisfaction. The questionnaire was developed by the researchers and was informed by, but not adapted from, previous research on MALL, gamification, learner perceptions, usability, motivation, and feedback (see the note to Table 1); it is not an established or validated instrument, and its content validity was not formally evaluated. Because the ten items address several distinct aspects rather than a single construct, they were not treated as a unidimensional scale, and results are reported separately for each aspect. These dimensions, particularly those concerning feedback, motivation, and engagement, draw conceptually on prior research demonstrating that formative assessment and meaningful feedback are strong predictors of

student engagement (Asadi et al., 2017) and that structured feedback combined with active learner participation enhances engagement in technology-mediated language instruction (Asadi & Taheri, 2024). Each statement was rated using a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). The questionnaire was completed by all 12 participating students. The items used in the questionnaire are presented in Table 2.

Table 2

Learner Perception Questionnaire for the OCEAN English Structure Application

No.	Statement	Measurement Aspect
1	The OCEAN application is easy to use for learning English Structure.	Ease of use
2	The interface of the OCEAN application is attractive and comfortable to use.	Interface attractiveness
3	The menus and navigation of the OCEAN application are easy to understand.	Navigation
4	The English Structure materials presented in the OCEAN application are easy to understand.	Content comprehensibility
5	The exercises provided in the OCEAN application are relevant to the English Structure materials.	Exercise–content alignment
6	The game features in the OCEAN application make learning English Structure more interesting.	Gamification and engagement
7	The feedback provided by the application helps me identify errors when completing the exercises.	Immediate feedback
8	The OCEAN application increases my motivation to learn English Structure.	Learning motivation
9	The OCEAN application helps me understand and improve my English Structure ability.	Perceived learning support
10	Overall, I am satisfied with using the OCEAN application as a medium for learning English Structure.	Overall satisfaction

Source: Researcher-developed items informed by (not adapted from) previous research on MALL, gamification, learner perceptions, usability, motivation, and feedback (Aliakbari & Mardani, 2022; Karakaya & Bozkurt, 2022; Liu & Hwang, 2024; Zhang & Crawford, 2024).

For descriptive analysis, the mean and standard deviation were calculated for each item. Because the items address distinct aspects rather than a single construct, the item means are the primary results, and an overall mean across the ten items is reported only as a descriptive summary, not as a psychometrically meaningful scale score. The results were interpreted descriptively to represent learners' perceptions of the OCEAN learning experience. No reliability coefficient was used to combine the ten items into a single scale because the items represent distinct aspects of the learning experience and the study was not designed to validate a unidimensional questionnaire.

Procedure

Data collection followed a sequential procedure: Pre-test → OCEAN-based learning → Post-test → Learner-perception questionnaire, carried out in three supervised sessions over approximately one week. First, in the first session (day 1), the researchers introduced the OCEAN application and its usage procedure, and the 12 participants completed the English Structure pre-test. Second, they used the English Structure component of the OCEAN Android application across the three sessions (day 1, day 3 or 4, and day 7), with approximately 45 minutes of OCEAN use per session (approximately 2 hours 15 minutes in total), while each session lasted approximately 1 to 1.5 hours including briefing and testing. During the learning activities, students accessed Structure materials and completed game-based exercises supported by scoring, progression, and immediate feedback. In the third session, students completed review and practice activities before the post-test. After completing the OCEAN-based learning activities, the participants completed the post-test. The post-test scores were then compared with the pre-test scores to examine changes in English Structure performance. Finally, the participants completed the 10-item questionnaire to report their perceptions of the OCEAN application. This procedure generated two complementary forms of evidence: learning-outcome evidence from the pre-test and post-test and learner-experience evidence from the questionnaire.

Access to the Structure component was provided only during scheduled sessions and was not available for free use at other times, so all participants received the same treatment and changes in post-test scores would not be affected by uncontrolled additional practice. All 12 participants worked through all five Structure Games levels in sequence; the next level unlocked only after the previous one was completed, and every participant received the same materials, the same number of levels, and the same opportunities to play, so exposure was intended to be equivalent across participants. Participants worked independently on the application under the researchers' supervision. At the start of each session, the researchers explained the usage procedure, and during the sessions they observed participants directly to ensure the procedure was followed, usage time was equal, and the planned stages were completed. The researchers provided no help with answers, only technical assistance when a problem with the application occurred. They recorded attendance, duration of use, and the levels completed by each participant. The application has no automatic usage log, so monitoring relied on direct observation and the researchers' records.

Data Analysis

The pre-test and post-test scores were analyzed using descriptive and inferential statistics. The mean, standard deviation, minimum, maximum, and mean score gain were calculated for both assessments. Because the same 12 participants completed both the pre-test and post-test, a paired-samples t-test was used to determine whether the difference between the two sets of scores was statistically significant. The analysis was conducted at the conventional significance level of $\alpha = .05$. Because of the very small sample, we examined the normality of the difference

scores with the Shapiro-Wilk test and also conducted a Wilcoxon signed-rank test, which does not assume normality (results in Section 3.3). The 95% confidence interval of the mean difference and Cohen's d_z (the mean difference divided by the standard deviation of the difference scores) were reported. Statistical significance was distinguished from practical significance, and because d_z becomes very large when individual gains are nearly uniform, it was interpreted cautiously; for reference, Cohen's d based on the average of the pre-test and post-test standard deviations (d_{av}) was also calculated. The questionnaire data were analyzed descriptively. We calculated the mean and standard deviation for each item on the five-point Likert scale, and reported an overall mean across items only as a descriptive summary. Because the study used a one-group pre-test–post-test design without a control group and involved only 12 participants, the results were interpreted as preliminary evidence of changes in English Structure performance following the OCEAN-based learning intervention. The findings were not interpreted as definitive evidence of causal effectiveness.

Findings

Development of the OCEAN English Structure Component

The development resulted in an English Structure component, the Structure Games, integrated into the existing OCEAN Android application. Its main outputs were: (a) five progressive levels of Structure practice; (b) two activity types, namely sentence construction by arranging word tiles and multiple-choice fill-in-the-blank items, both set in maritime scenarios such as captain's orders, deck reports, and voyage notes; (c) immediate feedback after each response; and (d) game-based progression and performance indicators (stars, voyage points, accuracy, and best streak). Table 1 lists the concrete outputs of each Four-D stage. The component was built with the Flutter framework and the Dart programming language, and the interface was designed in Figma.

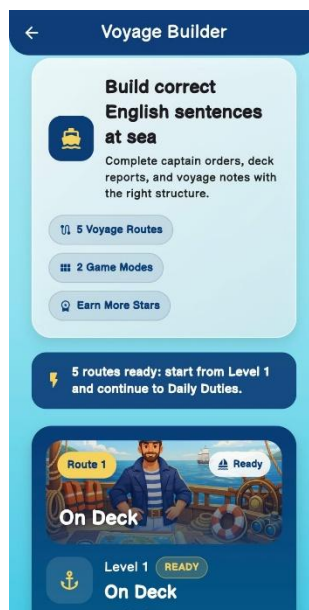


Figure 1. Main menu of the OCEAN mobile-assisted language learning application

Source: Authors' own development.

Figure 1 presents the main menu of the OCEAN application, which provides access to several language-learning components, including Vocabulary, Listening, Reading, and Structure Games. The integration of these components allows learners to access different areas of English learning within a single mobile application. The Structure Games component was added in this development to provide interactive practice in English Structure.

The Structure Games were organized into five progressive levels and presented through a voyage-based game structure. The interface incorporated game elements, including voyage routes, game modes, and star rewards, to organize learner progression.

**Figure 2.** Structure Games interface of the OCEAN application

Source: Authors' own development.

Figure 2 illustrates the Structure Games interface, which presents English sentence construction within a maritime-themed game environment. The activities are contextualized around maritime situations, including captain orders, deck reports, and voyage notes, connecting English Structure practice to students' professional learning context.

At the activity level, learners are required to construct grammatically appropriate English sentences by arranging the available word tiles. Figure 3 presents the Level 1 "On Deck" activity, which uses a "Captain's Order" scenario. Learners select and arrange the provided words to complete the target sentence before submitting their answer for checking.

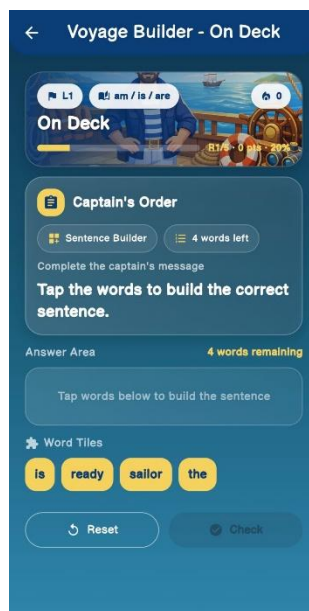


Figure 3. Level 1 Structure Game: On Deck

Source: Authors' own development.

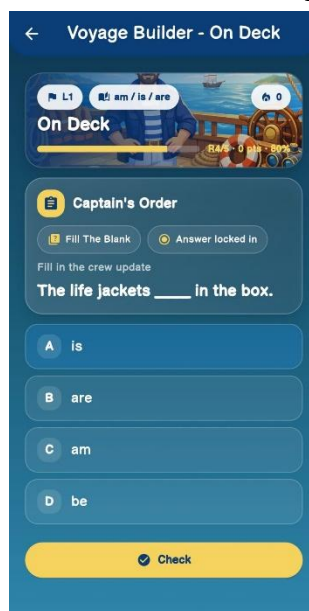


Figure 4. Level 1 Structure Game: Fill-the-Blank Activity

Source: Authors' own development.

In addition to sentence-building activities, OCEAN provides fill-in-the-blank tasks to practice specific grammatical structures. Figure 4 presents a Level 1 activity in which learners complete a sentence by selecting the appropriate grammatical form from the available options. In this example, learners are required to identify the appropriate form of the verb “be” to complete the sentence. The multiple-choice format provides an alternative form of Structure practice within the same maritime-themed learning environment.

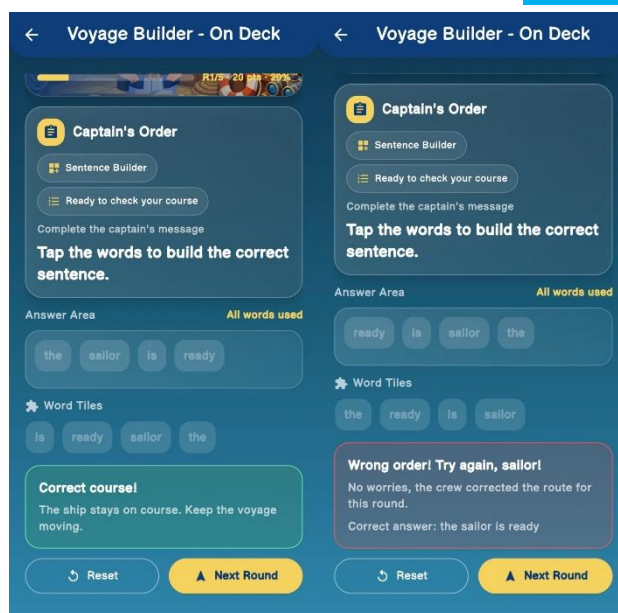


Figure 5. Immediate feedback in the Level 1 Structure Game: (a) correct response and (b) incorrect response

Source: Authors' own development.

The application provides immediate feedback after each response. A correct response generates positive feedback and allows learners to proceed to the next round, whereas an incorrect response provides corrective information and displays the correct answer. This feature enables learners to identify errors immediately during Structure practice rather than waiting for instructor feedback.

Gamified Features of OCEAN for English Structure Learning

The Structure component was designed as a gamified, mobile-assisted language-learning environment in which language practice was integrated with game-based progression and performance feedback, rather than presented only through conventional text-based exercises. Table 3 links each game mechanic to its intended instructional function.

Table 3

Game mechanics and their intended instructional functions

Game mechanic	Implementation in OCEAN	Intended instructional function
Progressive levels	Five levels of increasing difficulty; a level is unlocked after the previous one is completed.	Sequences practice from simpler to more complex structures and ensures that all learners follow the same order.
Word-tile sentence construction	Learners arrange scrambled words in an answer area to form a sentence and then check it.	Requires active production of correct word order and sentence structure.

Game mechanic	Implementation in OCEAN	Intended instructional function
Multiple-choice fill-in-the-blank	Learners choose the appropriate grammatical form to complete a sentence (e.g., a form of the verb “be”).	Directs attention to the selection of specific grammatical forms.
Maritime scenarios	Items are set in situations such as captain’s orders, deck reports, and voyage notes.	Connects grammar practice to learners’ future professional communication.
Immediate feedback	A correct or incorrect message after each response, with the correct answer displayed when the response is wrong.	Supports error recognition and correction during practice without waiting for an instructor.
Stars, voyage points, accuracy, and best streak	Performance summary shown at the end of each level: stars (up to three), voyage points, accuracy, and best streak, with a short message on the result (e.g., “Keep Training, Sailor!”).	Gives visible indicators of progress and performance to support self-monitoring.
Replay option (“Sail Again”)	Learners can repeat a level.	Allows purposeful repeated practice of the same structures.

Source: Authors’ own design rationale. The functions listed are intended functions and were not tested experimentally.

These features are design intentions. Because the study did not experimentally isolate any single feature, the results reported below do not allow conclusions about the contribution of levels, stars, voyage points, streaks, or feedback to the observed scores.

Students’ English Structure Performance Before and After Using OCEAN

To examine changes in students’ English Structure performance, the 12 participants completed a pre-test before using the OCEAN Structure component and a post-test after the learning intervention. As shown in Table 4, the mean score increased from 64.17 (SD = 5.97) in the pre-test to 81.25 (SD = 4.83) in the post-test. The mean score gain was 17.08 points, corresponding to a 26.62% increase relative to the pre-test mean.

Table 4

Descriptive statistics of English Structure test scores

Assessment	N	Mean	SD	Minimum	Maximum
t	n	m	m	m	m
Pre-test	1	64.17	5.9	55	75
	2		7		
Post-test	1	81.25	4.8	75	90
	2		3		

Mean gain	1	17.08	2.5	15	20
	2		7		

Source: Authors' own analysis based on the study data.

Individual change scores are summarized in Table 5. All 12 students obtained a higher score in the post-test than in the pre-test: seven students gained 15 points and five students gained 20 points, and no student's score decreased or remained unchanged. Individual pre-test and post-test scores are presented in Supplementary Table S1. Because the pre-test and post-test scores were obtained from the same participants, a paired-samples t-test was conducted. The analysis indicated a statistically significant difference between the pre-test and post-test scores, $t(11) = 22.99$, $p < .001$. The mean difference was 17.08 points, with a 95% confidence interval of [15.45, 18.72]. The standardized paired effect size was Cohen's $d_z = 6.64$. The difference scores departed from normality (Shapiro-Wilk $W = .64$, $p < .001$), which reflects that they took only two values (15 and 20 points). A Wilcoxon signed-rank test, which does not assume normality, led to the same conclusion: all 12 differences were positive ($T = 0$, exact $p < .001$, rank-biserial $r = 1.00$).

Table 5

Distribution of individual change scores

Change in score (post-test minus pre-test)	Number of students	Percentage of students
Gain of 15 points	7	58.3%
Gain of 20 points	5	41.7%
No change or decrease	0	0.0%
Total	12	100.0%

Source: Authors' own analysis based on the study data.

Cohen's d_z is the mean difference divided by the standard deviation of the difference scores. Here the difference scores took only two values (15 and 20 points; $SD = 2.57$), so the standardized effect is very large even though the mean gain is 17.08 points. When the average of the pre-test and post-test standard deviations (about 5.43) is used instead, the standardized difference is $d_{av} \approx 3.15$, which is still large. Given the near-uniform gains, the identical test items, and the small sample, these values should not be taken as an estimate of the application's typical effect size. The observed change reflects an increase in scores following the OCEAN-based learning activity; the one-group design does not allow attribution to the application alone (see Section 4.2).

Learners' Perceptions of the OCEAN Application

Following the learning activity, the 12 participants completed a 10-item questionnaire using a five-point Likert scale. The questionnaire assessed students' perceptions of the application's ease of use, interface, navigation, structured materials, exercises, game features, feedback, motivation, perceived learning support, and overall satisfaction. Item means ranged from 4.75 to 5.00 (Table 6), indicating highly favorable perceptions among this particular sample. Because

responses were near the ceiling, they reflect favorable perceptions rather than evidence of the application's effectiveness.

Table 6

Learners' perceptions of the OCEAN application

No.	Evaluation aspect	Mean	SD
1	Ease of use	4.92	0.29
2	Interface	4.75	0.45
3	Navigation	4.92	0.29
4	Structure materials	4.83	0.39
5	Exercises	4.92	0.29
6	Game features	4.92	0.29
7	Immediate feedback	4.92	0.29
8	Motivation	4.92	0.29
9	Perceived Structure learning support	4.92	0.29
10	Overall satisfaction	5.00	0.00
Overall mean (descriptive summary only)		4.90	–

Source: Authors' own analysis based on learner questionnaire data. SDs were calculated from raw, item-level responses from the 12 participants.

Overall satisfaction received the highest rating ($M = 5.00$, $SD = 0.00$). Ease of use, navigation, exercises, game features, immediate feedback, motivation, and perceived Structure learning support each received a mean score of 4.92 ($SD = 0.29$). The Structure materials received a mean of 4.83 ($SD = 0.39$), while the interface received the lowest mean score of 4.75 ($SD = 0.45$). The participants' ratings were favorable across usability, instructional, game-based, and feedback-related aspects. However, near-ceiling ratings and limited variability limit interpretation, and the overall mean of 4.90 is a descriptive summary only (see Section 2.4.2).

In suhe development produced a Structure Games component with five progressive levels, two activity types, immediate feedback, and performance indicators within the existing OCEAN platform. In the trial with 12 students, post-test scores were higher than pre-test scores for every participant (means of 64.17 and 81.25, respectively), and ratings of the application were favorable on all questionnaire aspects (item means from 4.75 to 5.00). Because the score data and perception data came from the same small, uncontrolled sample, these results are preliminary and not treated as independent confirmation of the application's effectiveness.

Discussions

This section distinguishes between what the data demonstrate, what they suggest, and what remains uncertain. The data demonstrate that all 12 participants scored higher in the post-test than in the pre-test and that they rated OCEAN favorably. They suggest that using the OCEAN Structure component was associated with an increase in test scores and that the application was

acceptable to this group of learners. They do not establish that OCEAN caused the increase, how large its effect would be in a broader population, or whether any gains transfer to authentic maritime communication.

This study developed OCEAN as a gamified mobile-assisted language learning (MALL) application for English Structure learning among maritime students. The application integrates mobile access, progressive Structure activities, game-based progression, immediate feedback, and performance indicators. This design aligns with the broader development of MALL, which has increasingly moved beyond simple mobile content delivery toward interactive, learner-centered language learning environments (Kukulska-Hulme & Shield, 2008). More recent evidence from higher education further indicates that MALL can support several dimensions of English learning, including grammatical development (Martínez et al., 2025). Studies of technology-mediated instruction in other language domains point to the same design principle: digital tools are adapted to particular skills, as in augmented-reality-supported reading (Asadi & Ebadi, 2025), and feedback and engagement are treated as central mechanisms, as in AI-supported feedback and peer assessment in writing (Asadi et al., 2025a; Asadi & Taheri, 2024).

This study extends these findings by applying MALL to a specific disciplinary context: maritime education. The combination of MALL and gamification is not new; the more distinctive contribution is implementing it for English Structure practice in maritime education, using content derived from the SMCP course and set in maritime scenarios. Rather than developing a generic English-learning application, OCEAN was designed for maritime students and incorporated Structure activities relevant to their learning context. This contextualization matters because the effectiveness of technology-assisted language learning depends not only on technology availability but also on alignment among technological features, pedagogical objectives, and learner needs.

As a design feature, OCEAN integrates gamification with language practice rather than using game elements as an independent component. Learners progress through Structure levels while receiving scores, stars, voyage points, accuracy information, and best-streak indicators. This design reflects the concept of gamification as the incorporation of game-design elements into non-game learning contexts (Deterding et al., 2011). Previous meta-analytic evidence reports positive effects of gamification on cognitive, motivational, and behavioral learning outcomes, although the magnitude of these effects varies by instructional and contextual conditions (Sailer & Homner, 2020).

Thus, the present study is consistent with previous research but adds a discipline-specific MALL implementation for maritime English learning. This is particularly relevant because recent reviews have identified a need for further empirical research on how mobile technologies can be adapted to specific learning contexts, rather than assuming the same technology will produce equivalent outcomes across learners and settings (Martínez et al., 2025).

A central finding of this study was the increase in students' English Structure scores after using OCEAN: all 12 participants scored higher on the post-test than on the pre-test, and both

the paired-samples t-test and the Wilcoxon signed-rank test showed a statistically significant difference (Section 3.3). This finding demonstrates a score increase on this test; it does not by itself demonstrate that OCEAN caused the increase.

This result is broadly consistent with research indicating that MALL can produce positive language-learning outcomes. Burston (2015), through a meta-analysis of MALL projects, reported generally positive learning outcomes across mobile language-learning interventions. More recently, Martínez et al. (2025) synthesized evidence from higher education and reported that MALL has considerable potential to improve grammatical ability alongside other English-language competencies.

The evidence for grammar outcomes in mobile learning is less conclusive than for other outcomes. Recent meta-analytic evidence indicates that mobile games can have a large overall effect on language learning (Liu et al., 2025). However, the effects varied across learning outcomes, with significant benefits observed particularly for vocabulary and pronunciation, whereas the effect for grammar, although positive, was not statistically significant. The present result should therefore be treated as preliminary and in need of replication with controlled designs, rather than as confirmation of the existing literature on grammar.

Several alternative explanations for the score increase must be considered. Because the same items were used in the pre-test and post-test about one week apart, participants may have become familiar with the items (a testing effect), and repeated exposure to similar material during the sessions may have raised scores through practice alone. Maturation and other events between the two measurements cannot be excluded, although the short interval makes substantial maturation less likely. Regression to the mean is also possible, although participants were not selected on the basis of extreme pre-test scores. Finally, familiarity with the assessment, the supervised setting, and the absence of a comparison condition mean that the design cannot separate the contribution of OCEAN from these influences. The uniform gains (15 or 20 points for every participant) are consistent with both a genuine learning effect and a general practice or familiarity effect.

Studies of technology-supported interventions in other language domains, such as augmented-reality-supported reading (Asadi & Ebadi, 2025) and AI-integrated feedback in writing instruction (Asadi et al., 2025a, 2025b), also examine whether technology can influence language-learning outcomes. Such comparisons require care, because those studies address different skills, learner populations, and designs. The present one-group design cannot establish effectiveness in the way that designs with comparison conditions can, so these studies are cited to situate the present result within the wider literature and to underline the importance of appropriate research designs, not as evidence that the present increase is an effect of OCEAN.

The result is also consistent with research on gamification, which has generally reported positive but heterogeneous effects on cognitive and motivational outcomes, depending on contextual and methodological characteristics (Sailer & Homner, 2020; Zhang & Yu, 2022). However, this evidence remains suggestive rather than conclusive because the effects of

gamification on learning outcomes have not been consistently established across educational contexts (Bai et al., 2020). Therefore, the increase observed in the present study is best understood as a change following the overall OCEAN intervention rather than as a causal effect of gamification.

The increase observed in the present study may therefore reflect the combined influence of several instructional features, including repeated Structure practice, immediate feedback, progressive levels, mobile accessibility, and gamified performance indicators. The present research design cannot isolate either the individual contribution of these features or the alternative feedback as helpful for identifying errors. OCEAN provides feedback directly after learners submit their answers, allowing them to identify incorrect responses and observe the appropriate answer. This creates an opportunity for learners to practice repeatedly while receiving information about their performance.

Learners' high rating of immediate feedback ($M = 4.92$) aligns with what MALL research generally reports about repeated and flexible practice (Kukulska-Hulme & Shield, 2008; Martínez et al., 2025). However, this finding reflects learners' perception of the feature rather than evidence that feedback alone drove the score gains, since the study did not experimentally compare immediate feedback with delayed or no feedback. The present data therefore do not allow the score gains to be attributed to immediate feedback.

Research on formative assessment and feedback offers a useful frame for interpreting these favorable ratings. Formative assessment and meaningful feedback have been identified as strong predictors of student engagement (Asadi et al., 2017), and recent work on technology-mediated feedback, including ChatGPT combined with teacher feedback in EFL writing (Asadi et al., 2025a) and AI-supported peer assessment in online IELTS writing (Asadi & Taheri, 2024), also links feedback to learner engagement and performance. Feedback in OCEAN is automated and immediate, so it differs from the teacher-mediated and AI-generated feedback examined in those studies, and we could not assess its independent contribution to learning here.

The present findings are consistent with this argument for English Structure learning, in that learners responded positively to an environment in which grammatical exercises could be repeated with immediate information about their performance, a combination that may be particularly useful for Structure learning given that grammatical accuracy often requires repeated exposure and practice rather than a single explanation of a rule. Whether such purposeful, contextualized repetition actually supports learning of the target structures is a hypothesis for controlled studies rather than a conclusion of the present study.

The questionnaire results showed highly positive perceptions of the OCEAN game features ($M = 4.92$) and motivation-related items ($M = 4.92$). These findings are consistent with previous literature indicating that gamification can support learner motivation and engagement. Zhang & Yu (2022) reported a positive motivational effect ($d = 0.77$) alongside gains in learning achievement, and Sailer and Homner (2020) similarly found significant motivational and

cognitive effects, though varying across contexts and designs. This supports the interpretation that game-based elements contributed to a positive learning experience here, though enjoying an application or reporting high motivation does not by itself guarantee higher language proficiency. Dehghanzadeh et al. (2021) found the gamification literature in second-language acquisition offers stronger evidence for motivation and engagement than for direct cognitive learning outcomes. Research on engagement in technology-supported language instruction, including AI-supported peer assessment and feedback in online IELTS writing (Asadi & Taheri, 2024), likewise treats learner engagement, feedback, and the learning experience as interrelated, which helps to contextualize the favorable ratings reported here. Because the study used no comparison condition, however, it cannot conclude that gamification produced the learning gains.

The questionnaire findings should be read as descriptive, tentative indications of highly positive learner perceptions rather than as a psychometrically validated measure, given the near-ceiling ratings, restricted variability, and absence of formal instrument validation. In the present study, students reported highly positive perceptions and their Structure scores also increased, but the two observations do not confirm each other: both were collected from the same small, uncontrolled sample, and favorable perceptions do not establish learning. The findings should therefore be regarded as preliminary evidence rather than proof of effectiveness. This caution is consistent with broader evidence in the MALL literature, where studies without control groups tend to report inflated effect sizes and carry a higher risk of bias (Mihaylova et al., 2022).

The maritime context provides an additional dimension to the findings. OCEAN was developed for students preparing for shipboard training, and the Structure activities were connected to their maritime learning environment. This contextualization distinguishes the application from generic English-learning applications.

The relevance of English Structure in maritime education is supported by the International Maritime Organization (IMO). The IMO Standard Marine Communication Phrases (SMCP) were developed as a standardized safety language for maritime communication, with the explicit aim of overcoming language barriers and avoiding misunderstandings that can contribute to accidents. The SMCP covers ship-to-ship, ship-to-shore, and onboard communication and is based on simplified maritime English (International Maritime Organization, 2002).

In this context, the use of Structure-focused mobile learning can be understood as part of students' broader preparation for professional maritime communication. However, the present study did not directly assess SMCP proficiency or authentic shipboard communication. Therefore, it would be inappropriate to claim that the increase in Structure scores automatically translates into improved maritime communication or enhanced safety. The more defensible interpretation is that OCEAN provides a technology-assisted environment for strengthening one linguistic component that may contribute to students' broader maritime English preparation.

Whether gains on Structure tests transfer to authentic maritime communication or to standardized maritime English competencies remains to be investigated.

The findings contribute to the technology-assisted language education literature in a modest and preliminary way. The principal contribution is the development and preliminary evaluation of a maritime-contextualized, gamified MALL component for English Structure. The combination of mobile delivery, game-based progression, and feedback is not in itself new, and previous research has documented positive effects of MALL and gamification (Burstion, 2015; Sailer & Homner, 2020); what the present study adds is an implementation for English Structure practice in a maritime setting, described in sufficient detail to be examined and tested in further studies.

Placed within the wider evolution of technology-assisted language education, OCEAN reflects several strands of recent work. First, digital tools increasingly extend access to interactive practice beyond the classroom, as in videoconferencing-based teaching (Asadi, 2022) and augmented-reality-supported reading (Asadi & Ebadi, 2025). Second, feedback and engagement are treated as central mechanisms, whether through formative assessment (Asadi et al., 2017), teacher feedback combined with ChatGPT (Asadi et al., 2025a), or AI-supported peer assessment and AI-assisted teacher instruction (Asadi & Taheri, 2024; Asadi et al., 2025b). Third, AI tools are applied to both learner-facing tasks such as writing feedback (Asadi et al., 2025a) and teacher-facing tasks such as lesson planning (Mohammadi et al., 2024). OCEAN currently belongs to the first two strands: it extends mobile access to interactive practice and provides automated, immediate feedback, but it does not yet use AI-generated or teacher-mediated feedback. Adding such feedback could be a direction for future development, provided that it is evaluated with controlled designs.

The study also provides preliminary evidence on grammar/Structure learning, an area for which the evidence base for mobile games is less conclusive than for vocabulary and pronunciation. The score increase observed here is a useful preliminary observation rather than evidence of effectiveness, and it highlights the need for larger controlled studies of mobile-assisted grammar learning.

Conclusion

The development of OCEAN produced a gamified mobile-assisted language learning component for English Structure, comprising five progressive Structure levels, two activity types, immediate feedback, and game-based performance indicators, and the component proved feasible to use in a small supervised trial with 12 maritime students. Students' mean test scores increased after exposure to OCEAN (64.17 on the pre-test and 81.25 on the post-test; $t(11) = 22.99$, $p < .001$), and students rated the application favorably (item means from 4.75 to 5.00 on a five-point scale). These findings are preliminary. Because the study had no control group, used identical test items at both time points, and involved only 12 participants, these findings indicate performance gains following exposure to OCEAN and favorable learner perceptions, but they do not establish that OCEAN improves English Structure or caused the observed gains.

OCEAN may therefore be regarded as a promising supplementary tool that warrants further, controlled evaluation.

This study has several limitations that should be acknowledged. First, the evaluation involved a small, purposively selected sample of 12 male students from a single program at one institution, which limits the generalizability of the findings; no data on participants' English proficiency or prior experience with mobile learning were collected. Second, the study employed a one-group pretest–posttest design without a control group and used identical items in the pre-test and post-test; therefore, the observed increase cannot be attributed solely to the OCEAN application, as alternative explanations such as testing and practice effects, maturation, and regression to the mean cannot be ruled out. Third, the authors did not conduct formal expert validation of the application or the English Structure test, nor did they estimate test reliability; therefore, the instruments' validity relies on the researchers' instructional judgment rather than independent expert review. Fourth, the questionnaire was researcher-developed and not formally validated, and its near-uniformly high responses and small sample limit the extent to which its descriptive results can be interpreted psychometrically. Fifth, the observed effect size (Cohen's $d_z = 6.64$) is considerably larger than typically reported in comparable studies, which may reflect near-uniform gains, the small and homogeneous sample, and the repetition of identical items rather than a true population effect; larger, controlled studies should verify this. Sixth, this preliminary trial did not obtain formal ethical approval or written informed consent (only verbal consent was given), and participants used the application under researcher supervision, which may have influenced their performance and responses.

Future research should use larger, more diverse samples; include comparison or control groups (for example, quasi-experimental designs); use longer intervention periods; use formally validated assessment instruments; and preferably use parallel pre-test and post-test forms. The application and its test should also undergo formal expert validation. It would also be valuable to investigate whether gains on Structure tests transfer to authentic maritime communication and to standardized maritime English competencies.

Bio-data

First Author: Maxima Ari Saktiono: conceived and designed the study, developed the application, and wrote the first draft of the manuscript.

Second Author: Afita Dewi Prastiwi: collected and analyzed the data, and contributed to the revision of the manuscript.

Third Author: Mohammad Adam Ramadhan Putra Huda: supervised the research process, reviewed the manuscript, and approved the final version for submission.

Funding: This research was supported by Institute for Research and Community Service (LPPM), Universitas Hang Tuah.

Declaration of Competing Interest: The authors declare that they have no competing interests.

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