

Research and education project report

The impact of VR simulation on the effectiveness of sailing training.

Author: Marcin Kotowicz

Implementation period: December 2025 – May 2026

Venue: Laboratory phase (school), Empirical phase (open water)

Research group: Primary school students

- **VR experimental group:** N = 10 students
- **Non-VR control group:** N = 10 students

Abstract

This article presents the results of an educational and research project evaluating the effectiveness of the transfer of sailing competences from the virtual reality (VR) environment to natural conditions. The study, carried out in a two-phase system (e-sailing training and a verification sailing camp), showed significant differences in the dynamics of adaptation of the participants.

Students trained with the MarineVerse VR platform demonstrated the ability to immediately assume the role of helmsman and operate at dynamic wind angles, while the control group based navigation solely on fixed landmarks. The results **strongly suggest** the high didactic potential of immersive technologies in maritime education.

1. Introduction and purpose of the study

Traditional sailing training has been facing the barrier of a high entry threshold for years. The first contact with a vessel in natural conditions is associated with a high level of stress for beginners (the so-called adaptation shock), which significantly limits the effectiveness of acquiring practical knowledge.

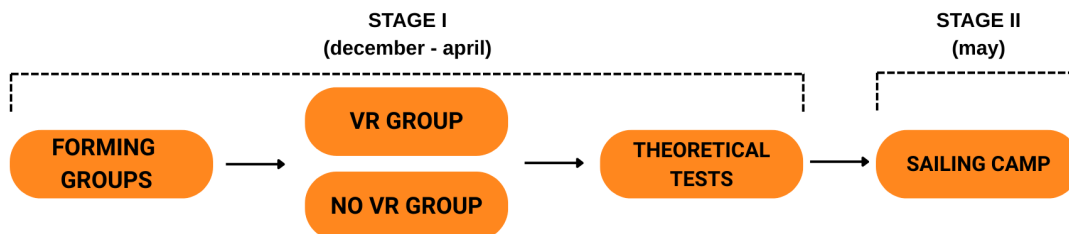
The main objective of this project was to investigate and verify the hypothesis according to which systematic training in a simulated environment (e-sailing VR) allows for the development of permanent motor habits and spatial orientation, which will be transferred during real practice on the water.

2. Project methodology and structure

The study was organised in a two-stage structure, lasting a total of six months:

- **Stage I (December – April) - Laboratory phase:** An experimental group (students following a systematic program of exercises in VR goggles on the MarineVerse platform) and a control group (students undergoing a classic, theoretical sailing lecture) were selected.
 - VR training included the operation of steering devices, trimming the sails, and reactions to dynamic weather changes.
 - The traditional preparation focused on the same issues, but the implementation was carried out only in the theoretical version and with the use of magnetic models of sailboats.
- **Stage II (May) - Empirical phase:** Both groups were transported to natural conditions to an organized school sailing camp. The practice was carried out on identical, 5-person training sailboats under the supervision of instructors conducting continuous control observation.

PROJECT STRUCTURE



3. Results and comparative analysis

During the field verification in May, the instructors noted diametrical differences in the behavior of the two research groups in three key areas: psychophysical adaptation, course geometry, and decision autonomy.

Table 1: Summary of performance indicators after going out into open water

Area of competence	Control Group (Traditional)	Experimental Group (MarineVerse VR)
Adaptation to the role of helmsman	Required a long time to get used to the sailboat; high reserve and fear of taking the helm.	Taking up the role immediately; lack of psychological barriers; intuitive motor coordination.
Reference system in space	Terrestrial navigation – orientation only on the basis of fixed points on the shore (trees, buildings).	Wind navigation – treating the wind direction as the main axis of the course coordinates.
Execution of dynamic maneuvers	Turns through the mast (tack) and stern (gybe) are made only on the instructor's unambiguous command, with the need to correct after entering a new course.	Turns made autonomously, with full awareness of the passage of the wind line and the operation of the sails.

Overview of results

The most key and measurable indicator of the advantage of the e-sailing group was the ability to operate on the so-called courses in relation to the wind.

Students trained traditionally, unable to sense the direction of the wind with their sails, navigated only linearly – from a landmark on the shore to the next. When the wind changed direction, they lost their orientation and the ability to trim correctly.

At the same time, graduates of the December-April VR training demonstrated a deep understanding of the theory of aerodynamics. They used the direction of the wind as a fixed point of reference. This allowed them to independently and smoothly correct the course (coming up / hardening up or bearing away), which in the traditional training model is usually achieved only after many sessions of regular classes on the water.

4. Pedagogical conclusions and recommendations

Breaking down barriers in sports education through the marriage of modern technologies with the traditional form of movement has brought promising educational results:

- **Validation of competence transfer:** The VR environment instills correct decision-making and motor habits, reducing the time needed to adapt in the real world to almost zero.
- **Optimization of training time:** By eliminating initial anxiety and navigational errors in VR students, instructors were able to skip the elementary basics and go directly to advanced sailing tactics and safety procedures.
- **Application conclusion:** The results of the research suggest the legitimacy of redefining the existing training programs by extending them to include sessions using VR technology.

A training cycle based on the following model should be introduced as a permanent standard in modern maritime education:

1. **Winter in VR (December–April)** – preparation for classes on the water.
2. **Spring on the water (May–June)** – activities in the aquatic environment.

5. Scope of the pilot and future development

This project should be treated as a school-based pilot educational study. It involved 10 students in the MarineVerse VR group and 10 students in the control group. The on-water assessment was carried out in real sailing conditions during the spring camp, mainly through instructor observation.

The results suggest a promising transfer of selected sailing competences from the VR environment to practical sailing, especially in the areas of helm confidence, wind-relative orientation, and basic maneuver awareness. At the same time, future editions of the project would make it possible to verify whether similar results can be observed with larger groups of students and in different sailing contexts.

In the next stage, the project may be expanded in cooperation with a local yacht club. The planned continuation would prepare students aged 10–14 using VR classes before transitioning to real-world Optimist sailing during the spring camp. This would create an opportunity to compare results again and measure progress using more detailed indicators, such as time to take the helm, number of instructor interventions, ability to identify wind direction, tack and gybe independence, and confidence before sailing.

Future editions could also benefit from simple predefined assessment sheets, a larger participant group, and possible support from educational, sailing, academic, or grant-funded partners. This would help develop the project from a successful school pilot into a repeatable model that could be shared, compared, and tested by other schools, clubs, or sailing education programmes.

6. Acknowledgements

The implementation of the preparatory phase of this project would not have been possible without the technological support of the software developers. We express our

sincere gratitude to the creators of the MarineVerse platform for generously supporting our educational initiative and providing complimentary installation keys for the VR simulator application.

The provided software infrastructure became the foundation of our digital sailing laboratory, allowing our youth to safely and realistically enter the world of maritime theory and practice. Through this collaboration, we have proven that VR technology serves as a genuine bridge in sports education.

Marcin Kotowicz

School Project Coordinator