

Integrating Green Technologies into Maritime Education: Competencies, Learning Environments and Strategic Capacity Development

PhD Student: Johannes Kolind
University Supervisor: Marie Lützen
Company Supervisors: Henriette Falbe-Hansen
Duration: 01-08-2026 – 01-08-2029



Background

The maritime sector is at the onset of a sustainability transition where new fuels, hybrid and battery propulsion, and improved technological solutions will replace many long-standing staples of maritime operations. Simultaneously, international regulations such as FuelEU, EEXI, and CII, pose increased demands for energy efficient operations.

The maritime colleges have a pivotal role in equipping future seafarers with the needed competencies to handle new fuels and technologies in a safe and efficient manner.

A preliminary survey conducted across members of the International Association of Maritime Universities (IAMU) in the spring of 2026 indicates that efforts to teach subjects related to sustainability transitions of the maritime sector are scattered and unfocused; there is no consensus regarding neither methods, content, nor obstacles.

Seafaring in general, and marine engineering in particular, comprise hands-on professions, where access to physical equipment during education and training is crucial to acquiring the needed competencies to ensure operation of critical equipment under all conditions in an independent manner. Special effort is needed then, to establish flexible learning environments where broad understanding of central topics can be easily supplemented by the specialized skills and knowledge stipulated by specific technologies and regulations.

Objectives

This project investigates which skills and competencies, related to green technology, seafaring professionals will need, and how the acquiring of these should be facilitated through investments in laboratory equipment and flexible learning environments.

- RQ1: Which fuels and technologies will be most important in the next 5 years, which competencies will these require from marine engineers, and how can maritime colleges ensure that curricula reflect the competency need going forward?
- RQ2: How and to what extent can experimental learning environments, such as virtual reality, laboratories, and problem-based learning support flexible integration of new technology, and how should maritime academies and universities decide which equipment / learning environments to invest in?
- RQ3: How can the development of flexible learning environments, coupled with improved cooperation across education, industry and regulatory actors, support a strategic capacity development in the sector?

Methodology

Three partially consecutive stages will form the methodological and chronological backbone of the project.

In the first stage, mapping of the expected dominating technologies and resulting competency need will be explored through literature review, survey and a modified Delphi-study. Document analysis of curricula will help identify the competency gap. The Delphi panel will include teachers and researchers, industry actors, regulatory bodies, and seafarers.



Foto: Sea water cooling rig at SIMAC

In the second stage, experiments will be carried out to determine effectiveness of different learning environments in enabling students to acquire the identified competencies. Experiments will be carried out as intervention studies with marine engineering students at SIMAC. Findings from these experiments will be tested on other maritime colleges, to further qualify the results and support broader adaptation. MARIKO will be involved in this process, supporting broad knowledge dissemination.

In the final stage the findings are synthesized and contextualized to the demands of the sector and the capabilities of educational institutions and industry actors. To some extent, the three project stages will be carried out concurrently, in an iterative approach.



Foto: Generating set and HV insulator at SIMAC

Company, Collaboration and Funding

The Private PhD student will be employed at SIMAC, a leading maritime education centre offering bachelor programmes and simulator training for future officers and engineers. This PhD project is a collaboration between SIMAC and the University of Southern Denmark. The project has received funding from Orient's Fund



A/S D/S Orient's Fond