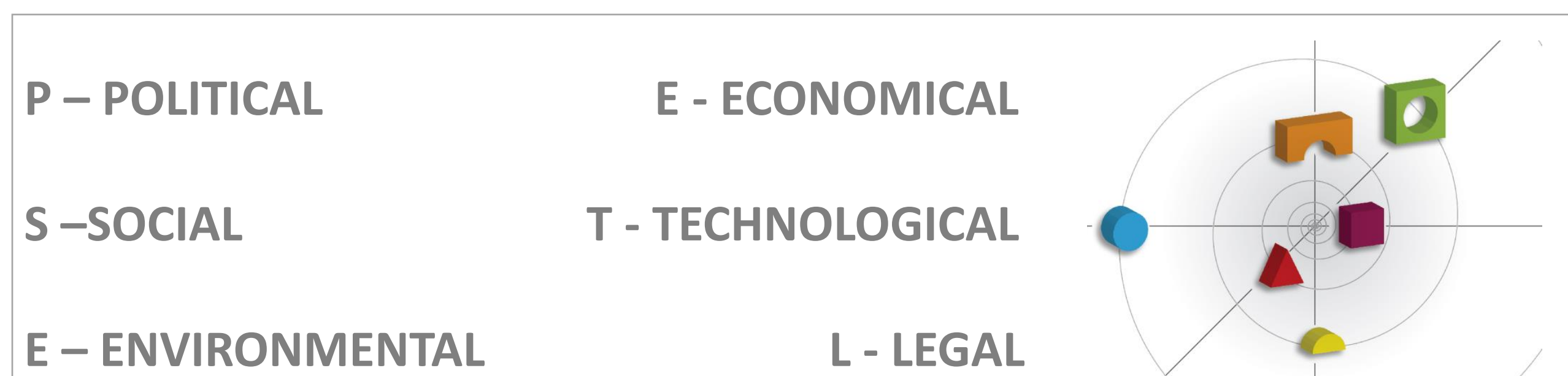


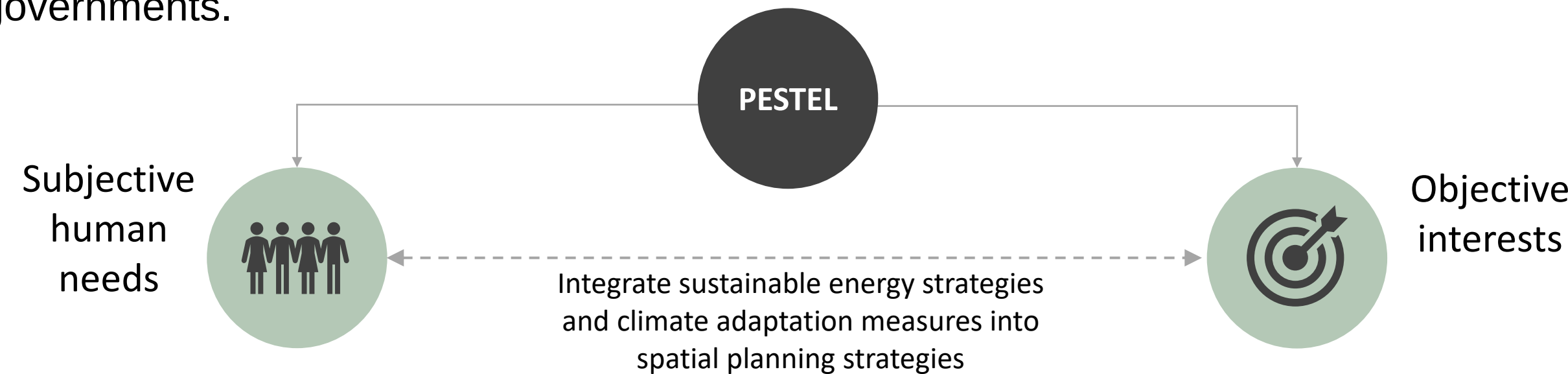
1 INTRODUCTION

Traditional educational approaches often include static disciplinary boundaries that operate in silo's, possibly resulting in substandard learner outcomes and insufficient research outputs. These pedagogies do not prepare students to navigate real-world problems within rapidly evolving landscapes, global pressures, climate change, population growth, geopolitical changes and the need for efficient spatial planning and sustainable development. Higher education requires an innovative and integrative framework to educational practices that not only delivers adequate transdisciplinary education, but also fosters adaptive thinking and critical reflection. In an effort to enhance transdisciplinary education in Bachelor-level projects, Learning Community students, from different educational backgrounds, are required to integrate a PESTEL-based approach into complex research activities. Student projects relate to the NWO-funded Floating Future project, of which the Hanze University of Applied Sciences is a partner.



2 BACKGROUND

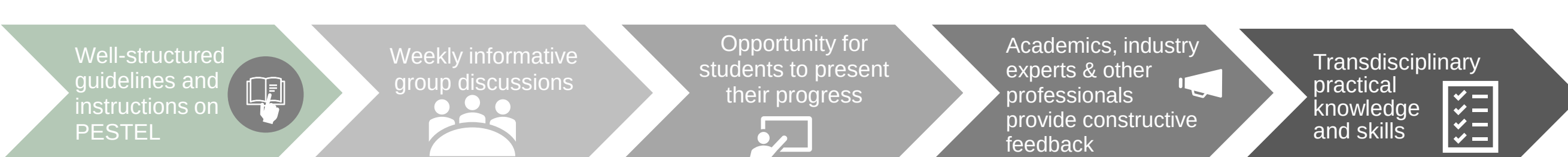
Through an integrated approach, different PESTEL values are considered, and ultimately navigate the complex relationship between subjective human needs and more objective interests. The Learning Community provides the ideal case study to apply this complex integrated approach together with students, researchers, experts, companies, and governments.



- ➔ The **PESTEL** analysis is a strategic framework used to analyze external factors. It provides a comprehensive lens through which we can understand and respond to the macro-environmental forces affecting their sustainable development.
- ➔ The **FLOATING FUTURE** research project aims to provide a better understanding of the advantages and disadvantages of upscaling the implementation of floating cities and infrastructure. Although floating settlements are more resilient to sea level rise, provide more space for development and can easily be relocated, there are still many uncertainties surrounding every developmental aspect. These unknown factors require a multidisciplinary, multi-faceted approach to find solutions.
- ➔ **SPATIAL PLANNING** provides the framework for integrating sustainable energy strategies and climate adaptation measures into the development of resilient urban areas, including floating infrastructure.

3 METHODS

Facilitators at the Learning Community support Bachelor students through the implementation of a step-by-step rebuilding of the current curriculum, towards an actionable knowledge base that contributes to the development of multi- and interdisciplinary processes. Each group, consisting of students from different academic disciplines, were assigned one aspect of the PESTEL analysis and required to develop a research question within the context of the Floating Future research project. Facilitators also provided the following support:



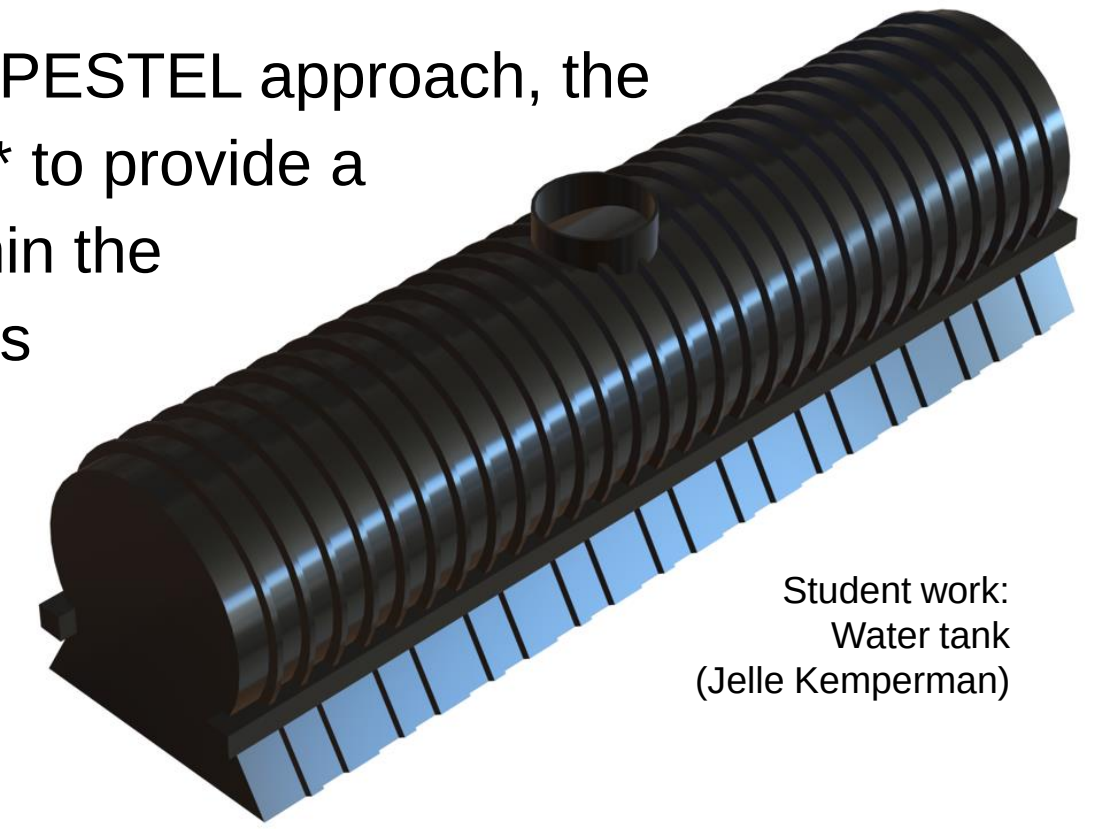
To determine whether the application of the PESTEL approach in student projects contribute to the development of transdisciplinary education, student's work is evaluated based on both quantitative data - through the formal evaluation of Bachelor projects – as well as qualitative data. Qualitative data collected from summative observations are generally supplementary to quantitative results obtained from assessment-based educational supervision. This approach includes an assessment of student awareness through the evaluation of weekly discussions and interactive presentations, as well as a analysis of students' ability to apply adaptive thinking and critical reflection to their research activities.

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4 RESULTS

Since each group was assigned one aspect of the PESTEL approach, the results of individual group projects were combined* to provide a comprehensive overview of research activities within the context of the Floating Future research project. This showed a comprehensive evaluation of variable factors and external forces that impact on the feasibility and development of floating cities and infrastructure. Since project outputs included multi-disciplinary research results, conclusions per PESTEL factor, as well as overall project conclusions, allowed students to interpret the interdisciplinary relationship between different aspects of sustainable development. In addition, this collaborative effort enabled students to develop a roadmap (below) of short-term, mid-term and long-term goals that support the upscaling of floating infrastructure.



2025

Political Influence public opinion & begin vital collaborations	Economic Increment public & private support for R&D regarding floating structures	Social Awareness campaign with workshops & content to educate locals	Technological Solar panels, lithium-ion batteries & smart grids	Environmental Fully functioning system for waste & wastewater	Legal TBC
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2040

Political Create a dedicated regulatory framework & subsidies for floating structures	Economic Plan and implement the findings in targeted areas	Social Structured framework for fostering social bonds	Technological Wind turbines & wave energy converters	Environmental Aquaculture system set up with 90% harmful waste recycled	Legal TBC
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2025

Political Streamline permit application & acquire international leadership	Economic Reduce upfront costs & provide long-term economical benefits	Social Fill cultural & social integration of the floating community	Technological Complete energy independence	Environmental Structures with holes combined with artificial lightning	Legal TBC
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Roadmap from 'Floating Cities: a PESTEL analysis'

5 DISCUSSION/CONCLUSION

From the evaluation of student performance during weekly sessions, presentations and final projects, it is evident that the application of the PESTEL approach in the curriculum, provided an innovative and integrative framework to educational practices. It offered students, from different disciplines, the opportunity to contribute to a collaborative research-based project that aimed to better understand the potential of large scale floating infrastructure and address challenges related to urban resilience, circularity, climate change, energy transition and integration into spatial planning strategies. In addition, it enhanced a transdisciplinary educational approach, enabling students to become more proficient in applying adaptive thinking and critical reflection to their research activities.



Findings indicate that the PESTEL approach facilitates collective and collaborative interactions across different disciplines within the institution, but also provides students access to industry experts and relevant stakeholders. Weekly sessions provided opportunity for feedback, monitoring and enhanced communication between students, academics, and other professionals. It also served as an additional opportunity for a formative assessment of student's progress, which has made a crucial contribution to students developing their approach, and gain an in-depth understanding of real-world problems, which in this case includes the upscaling of floating houses and infrastructure.

Through the PESTEL analysis, students were able to properly define problem statements and develop a strategic response in line with efficient spatial planning strategies and sustainable solutions for floating infrastructure.

This curricular strategy has therefore contributed to achieving high quality research outputs that support transdisciplinary thinking within a dynamic and complex system, and enabled students to appreciate diverse perspectives, thereby fostering a more holistic understanding of complex problems.

6 REFERENCES

- 1.de Vrieze, R. (2019). Understanding Dutch primary school building design complexity: the development of a theoretical framework to balance different stakeholder interests in order to improve . [Thesis fully internal (DIV), University of Groningen]. University of Groningen. <https://doi.org/10.33612/diss.98862175>
- 2.Krol, D, van der Moolen, B., de Vrieze, R. (2025). Naar een integrale (onderwijs)methode voor een toekomst robuuste leefomgeving vanuit intersubjectieve behoeften en intra-objectieve belangen. Hanze University of Applied Science.

*The first round of Bachelor projects relating to the Floating Future project, entitled 'Floating Cities: a PESTEL analysis', has been collated into book-form.