

Operationalising Peace Engineering and Social Justice through a Problem-Based School Module

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Research Overview:

This study operationalises peace engineering within a Finnish secondary school curriculum through a problem-based module. Drawing on a two-phase intervention, it examines how education can embed peacebuilding and social justice. Findings reveal enhanced student agency, ethical awareness, and application of engineering for equitable and sustainable societal transformation.

Purpose of Study:

Engineering education is increasingly expected to address complex global challenges such as climate change, inequality, and conflict. Contemporary scholarship highlights that engineering is no longer a purely technical discipline but one deeply intertwined with ethical responsibility, sustainability, and social justice. Within this evolving context, peace engineering has emerged as an approach that integrates technical knowledge with the intentional design of systems that reduce structural inequalities and promote sustainable peace.

Despite this conceptual shift, peace-oriented approaches remain insufficiently embedded in formal curricula. Traditional models often isolate technical content from societal contexts, resulting in students who are technically proficient but uncertain in applying their knowledge to real-world challenges. Prior evidence suggests students recognise engineering's societal relevance yet lack frameworks to act as agents of change. This disconnect highlights a persistent gap between technical competence and social application.

This study addresses this gap through an iterative curriculum intervention in Tampere Schools, Finland, centred on a 2 ECTS optional module titled “Social Justice and Sustainability in Engineering”. Developed following an exploratory conversation series, the module employs a problem-based learning (PBL) approach guided by four aims: introducing social justice and sustainability concepts; critically examining case studies; fostering ethical awareness; and strengthening understanding of global and local sustainability challenges.

Research Methods:

The study adopts a qualitative approach, drawing on two interconnected phases: a conversation series and a curriculum intervention. The research involved students aged 16–18 from both the International Baccalaureate and Finnish national curriculum.

In the first phase, a structured conversation series engaged 72 students with expert narratives from engineering, academia, and social innovation contexts. Students participated in discussions and reflections exploring sustainability, social justice, and the societal role of engineering. Analysis of these responses identified key curricular gaps, particularly the separation of technical knowledge from its social application and students' uncertainty in acting on their aspirations. These findings informed the development of the second phase: a 2 ECTS optional module grounded in peace engineering principles. The module combined problem-based and challenge-based learning, enabling students to engage with real-world issues and design contextually relevant solutions. The module was delivered to a cohort of 11 students from across Tampere, Finland, who undertook collaborative projects and reflective tasks. Data were collected from conversation series responses, group discussions, project outputs, and individual reflections.

Thematic analysis was employed to identify patterns related to student agency, ethical reasoning, and conceptualisations of engineering as a peacebuilding practice. Combining both phases enabled a longitudinal understanding of how peace engineering thinking evolves from awareness to application.

Results and Discussion:

The findings reveal a significant shift in how students conceptualised engineering. Initially, engineering was largely understood in technical or infrastructural terms; however, engagement with the conversation series and module reframed it as a socially embedded discipline capable of addressing issues such as sustainability, healthcare, and inequality. Students increasingly demonstrated what can be described as peace engineering thinking, considering how engineering solutions affect equity, access, and social stability. This was evident in their emphasis on inclusive design, environmental responsibility, and equitable resource distribution. The intervention also strengthened students' awareness of the ethical dimensions of engineering, encouraging them to critically reflect on the societal consequences of technological decisions.

A key contribution of the module was its role in bridging the gap between awareness and action. While students initially recognised global challenges, they often lacked clarity on how to respond. The problem-based and challenge-based learning framework enabled students to translate conceptual understanding into practical proposals, fostering a sense of agency. Many began to identify themselves as contributors to societal change, although some uncertainty persisted regarding implementation. Emotional engagement

also emerged, with students expressing both optimism and concern about global futures, reinforcing the value of integrating reflective and ethical dimensions into engineering education. These findings suggest that peace engineering approaches can help align technical competence with social responsibility, though sustained curricular support is required to consolidate these outcomes.

Conclusion:

This study demonstrates that peace engineering can be effectively operationalised within school curricula through targeted, problem-based interventions. By linking technical learning with societal challenges, the module enabled students to develop ethical awareness, a sense of agency, and the ability to connect engineering practice with peacebuilding and social justice outcomes. The iterative design from conversation series to module implementation highlights the importance of responsive curriculum development grounded in student perspectives. The study is limited by its focus on a single school context and a relatively small module cohort, which may affect the generalisability of the findings.

Keywords: Engineering Education, Social Justice, Sustainable Development, Peacebuilding, Curriculum Design

Please Note: We have not used any references due to the word limit. We would be happy to provide a longer version with all the references if requested.