



United Nations  
Educational, Scientific and  
Cultural Organization



AALBORG UNIVERSITY

Aalborg Centre for Problem Based Learning  
in Engineering Science and Sustainability  
under the auspices of UNESCO

## Aalborg Centre for Problem Based Learning in Engineering Science and Sustainability *under the auspices of UNESCO*

### STRATEGIC PLAN 2020-25

#### **Introduction**

The Aalborg Centre for Problem Based Learning in Engineering Science and Sustainability (hereafter the Aalborg PBL Centre) was established, under the auspices of UNESCO, following formal approval by the General Conference of UNESCO in November 2013 for a six-year period. In August 2019, the Aalborg PBL Centre was prolonged until 2025.

This document presents the Strategic Plan for the Aalborg Centre for the period 2020-2025. The Strategic Plan focuses on overall, longer-term, strategic areas and activities. This strategic plan will take as a point of departure the original application approved by the General Conference of UNESCO.

Since the start of the Aalborg PBL Centre, there has been an increasing focus on the human and institutional capacity to address the Sustainable Development Goals (SDGs) which have replaced the Millennium Development Goals. There is an increased focus on climate change, poverty reduction and other sustainable development, for which it is urgent to find societal solutions. The pressure to find sustainable innovations to respond to climate crises comes especially young people, although we still see declining student interest and enrolment into engineering and science areas. It is urgent to respond to and find solutions to these contemporary societal challenges and to educate engineers and scientists to be able to deal with them.

The strategic aim of the Aalborg PBL Centre is to connect university activities to activities in private and public organisations for sustainable technological innovation. The overall strategic goal of the Aalborg PBL Centre is to facilitate the active role that universities can play in providing sustainable technological innovations by educating engineers and scientists capable of participating in and contributing to the development of sustainable solutions to present and emerging social, economic and environmental challenges. The strategic emphases and work of the Aalborg Centre also reflect the strategic mission and work-plan priorities of UNESCO, as outlined in the UNESCO Medium Term

Strategy 2014-2021 (37C/4), 40 C/5, volume 1: Draft Resolutions, second biennium 2020-2021, volume 2: Draft Programme and budget, second biennium: 2020-2021.

These include the Global Priorities of Africa and Gender Issues and the second Overarching Objective of the sustainable development goals.

Sustainable development is also a key priority of the programme and budget for the period 2018-2021 for science and strategic objectives in capacity building, engineering and science policy, innovation and technology transfer.

## **Mission**

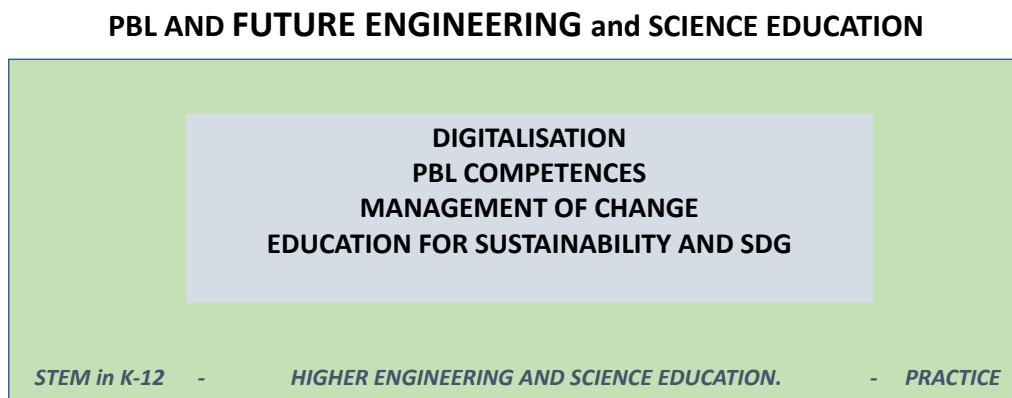
During the first period 2014-2019, the worth of the Aalborg PBL Centre has been shown in the international recognition of PBL as a means to integrate an interdisciplinary approach and sustainability in engineering and science education. In the Ruth Graham report, Aalborg University was nominated as the most innovative university in Europe because of its problem- and project-based approach to learning. By emphasising problem orientation as part of project-based learning, the PBL-models are unique and have the potential of to link and integrate SDGs and global challenges, which are becoming an ever more urgent element of future engineering competence. Educating socially and environmentally responsible engineers and scientists, who are able to establish sustainable innovations in terms of economic, environmental and social concerns and follow the trajectory of globalisation is key to the centre's success.

The strategic mission of the Aalborg PBL Centre will continuously focus on the following, as pointed out in its original application to UNESCO in 2013:

- 1) to create a global society of practitioners, researchers, experts and institutions within the field of Problem Based and Project Based Learning (PBL) in Engineering Science and Sustainability from developing and developed economies in order to change engineering and science education for PBL and sustainability at the national, regional and international levels;
- 2) to establish international research and doctoral training on PBL and sustainability in Engineering and Science Education;
- 3) to provide global education and training for academic staff and students
- 4) to engage in outreach to institutions and schools to attract students to engineering and science and give higher education (HE) institutions and governments open access to a body of knowledge, education, training and other resources to facilitate PBL and Sustainability in Engineering and Science Education.

## Research scope of the Aalborg PBL Centre

To meet these strategic goals, the Aalborg PBL Centre has, during the last five years, developed a research profile which combines research on engineering and science education both internally at Aalborg University, as well as with other institutions. The research strategy, entitled *PBL and Future Engineering and Science Education*, has as its core focus the future of engineering and science education concerning types of knowledge and competences and new PBL blended learning. There are four core topics: Education for Sustainable Development, Management of Change, PBL Competences and Digitalisation, which will be related to the fields of STEM education in K12, HE and Science Education and professional practice. All areas are fundamental and weave into each other, and the integration of SDGs will be dependent on the process of digital learning and management of change.



**Figure 1:** Overview of up-coming areas for AALBORG PBL CENTRE research

The COVID-19 situation has changed the educational landscape in terms of increased use of digital tools. Digitalisation is a condition both for content development in engineering and science education and for learning methods. These changes in 2020 were mostly done overnight, and it is crucial to reflect and reconstruct the resulting learning to optimise the potential of blended learning systems. Student-centred learning is at the core of these transitions, as it becomes even more important for students to create a contextual platform as an angle into the learning of scientific content. In engineering education there will be increasing use of digitalised scientific content learning, as well for collaboration and project management.

PBL competences refer to the fact that PBL is both a learning method for scientific content, but also for creating competences in itself. As Aalborg University has taken initiatives to formulate PBL competences explicitly throughout the curriculum, it provides a unique opportunity to establish frontier research on progression of practice based skills and competences in higher education, which is still unknown territory. Research on PBL and management of change in engineering and science education has been related to sustainability, PBL competence and digitalisation, as it will involve new implementation in the curriculum and often a new organisational approach. Retention,

assessment, comparison of the effect of varied learning methodologies, staff development methods, learning environment, design of projects and progressive PBL learning objectives are just some of the researched topics in this area. There will be *increased research on variation in PBL models, problem types and project types to facilitate the integration of complex problem solving in the engineering and science disciplines*. This will also encompass new collaboration patterns and project management skills.

Sustainability, including SDGs, is also seen as a holistic concept that includes principles, vision, ethics and values involving more complex problem-solving and interdisciplinary approaches. Students working with SDGs need to have a solid and thorough understanding of the disciplines, as well as an interdisciplinary and holistic approach to problem analysis and problem solving.

Finally, in relation to local, national and international partners, the research group has created a unique research profile which adds a PBL perspective to STEM initiatives in primary and secondary schools, as well as vocational and HE. This research profile and its research priorities will form the foundation for the activities which will be undertaken in relation to these institutions, together with a focus on increasing the attractiveness of engineering and science education, specifically in terms of gender parity.

This research profile will form the foundation for the activities to be undertaken.

## **Goals, priorities and activities 2020-2025**

The new emerging technologies (AI and IoT), the challenges addressed by the SDGs, the societal complexity and the pandemic crises all call for development of the future engineering education. During the coming five years, the Aalborg Centre wants to increase the global impact with the following goals and priorities:

1. Research and develop **future directions of engineering competences** by combining academic, entrepreneurial and community-oriented knowledge, skills and competences and develop sustainability profiles for engineers and scientists.
2. Research and develop **learning methodologies** for embracing and integrating problem oriented learning approaches with digitalisation to address the challenges expressed in the SDGs in the education. Training engineers and scientists in complex problem-solving will require rethinking of PBL models to align with variations in learning outcomes and strategies for integration of SDGs.
3. Lead the **global network** for PBL with the aim of influencing the agenda for global and regional capacity building and educational and institutional change.

## 1) Global Network

The Aalborg Centre has established a global network of institutions that already have or want to develop expertise in PBL and sustainability in Engineering and Science Education. We will continue to organise this global network and furthermore facilitate regional networks like the Regional Research Symposium on PBL, held for the first time in India in November 2019. Regional symposia can be organised in other parts of the world as well – and there will be special focus on Africa, India and South America.

The focus on PBL, digitalisation and SDGs will also reflect the development of international, national and local partnerships. International partnerships will also be strengthened by being members of international working groups, networks and professional societies.

- International Research Symposia on PBL co-organised with existing professional national and international organisations
- Develop Regional Research Symposia on PBL and SDGs as a strategy for regional capacity building
- Continue the collaboration with other UNESCO category2 centres and expand the collaboration
- Establish stronger links to African Association of Universities and Aalborg University (AAU – AAU)
- Contribute to develop the Boston network on excellence in Engineering Education
- Participate in international partnerships, working groups, networks and professional societies
- Workshops at both Aalborg University and around the world
- Contribute to the establishment of virtual communities to develop PBL for engineering, science and sustainability
- Continuously develop online tutorials, video and virtual seminars on PBL and sustainability
- Provide exchange of staff between related institutions and welcome visitors
- Open access resources

## 2) Research and PhD programme

Research and PhD training are central to the function of the Aalborg PBL Centre as an organisational change agent. The Aalborg Centre must be able to provide documentation for already existing changes which can inform future developments.

- International research projects and especially the initiation of new projects on combining digital/blended learning, PBL variation and SDGs, which will include interdisciplinary and international collaboration (e.g. biospheres as innovative organic ecosystems)
- Collaborative and joint PhD programmes with partner universities
- Online doctoral training, including online PhD courses
- Emphasise a stronger research focus on women in engineering
- Publish special journal issues and books
- Development of strategies (concepts, methodologies and procedures) for research and evaluation of educational practice

- Open access publications

### **3) Education and training**

Educational activities will also be a fundamental element in training change agents. Activities offered will be research based, but participants' learning outcomes will focus on educational change and innovation. The educational activities are complementary, and minor activities will lead to larger activities.

- Develop adequate strategies for integration of sustainability in existing engineering and science programmes and contribute to specific modules on SDGs
- Train the trainers' programmes related to PBL in engineering and science, including a formal master's degree programme (MPBL), certificate programmes for external institutions
- Tailor-made training and consultancy activities for institutions and individual staff members wanting to implement innovative pedagogy such as PBL

### **4) National collaboration**

During the first period, the Aalborg PBL Centre has increased national and Nordic collaboration, especially within STEM, in K-12. This work will be continued:

- Participate and contribute to the Danish UNESCO National Commission
- PBL and SDGs in the Danish K-12
  - Regional networks with closer collaboration with university colleges
  - STEM master's education
  - National centre for Developing Mathematics Education (Nationalt Center for Udvikling af Matematikundervisning)
  - NAFA (Naturfagsakademi)
  - ASTRA
- Establishment of closer collaboration with companies to align education with professional practices in the area of engineering and IT

### **5) Locally at AAU**

Shared focus on both internal AAU activities and external activities – a win-win strategy. Internal responsibilities:

- Contribute to strategic development and implementations for new directions of PBL including megaprojects, digitalisation and integration of SDGs
- Pedagogical courses in a more digitalised and blended learning mode, e.g. internal staff development programmes (e.g. Adjunktpædagogikum), and contribute to visitors' programme on PBL
- Development of relevant AAU online resources which can be used locally, as well as in global training

- Educating students through courses, workshops and consultancy to develop PBL competences progressively at the bachelor's and master's levels. Furthermore, to support development and evaluation of these activities.
- *Ad hoc* activities for the faculty and study boards

## **Funding**

The Centre will be funded partly by Aalborg University and partly by relevant external funding sources. Several of the activities will be based on participant fees or external funds through the project's cooperation. Obtaining external funds will be a priority to ensure a strong platform for cooperation and development of key projects within PBL and sustainability in engineering and science education.

## **Organisation**

The two faculties of Engineering and Science and the Technical Faculty for IT and Design, Aalborg University, are responsible for running the Aalborg Centre. The centre is part of the Department for Planning and Development, where there is research on Problem Based Learning, Engineering Education, Sustainability and Social Responsibility in Engineering.

The organisation will reflect the basic philosophy of global networking capacity building. There is an Advisory Board with representatives from UNESCO and Member States with responsibilities as outlined in the UNESCO standard agreement for Category 2 Centres, with the necessary adjustments in relation to Danish law.

## **Evaluation**

As in previous years, there will be short annual reports submitted to both the Ministry of Higher Education and Science and longer versions containing the core activities during the years. As UNESCO category 2 centres do have six years contracts, it will be important to evaluate the impact of the activities. Therefore, work will be started to identify key indicators for success with the UNESCO headquarters.