AALBORG UNESCO CENTRE FOR PBL

ANNUAL REPORT 2024

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AALBORG
UNIVERSITY

Centre for Problem-Based
Learning in Engineering
Science and Sustainability

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FOREWORD

Management team: Xiangyun Du, Bente Nørgaard, Euan Lindsay, and Aida Guerra

Empowering global change through PBL – celebrating a decade of advancing sustainable development, leadership, institutional transformation, and youth well-being.

2024 marked the 10th anniversary of the Aalborg UNESCO Centre for Problem-Based Learning in Engineering Science and Sustainability (UCPBL). Over the past decade, the Centre has become a global leader in advancing PBL as a catalyst for sustainable development in higher education, combining research excellence, transformative practice, leadership development, and institutional change.

This year, we deepened collaborations across the African continent, including South Africa and Kenya, while expanding our global network in India and Ukraine. These efforts built on ongoing work in Asia, North America, South America, and across Europe, complemented by major domestic engagements such as the AAU 50-year anniversary PBL workshops and Folkemødet debates. Projects such as the PBL Pedagogical Development Certificate in India and capacity building in Ukraine showcased the versatility of PBL as a methodology for advancing leadership development and driving sustainable, institution-wide transformation.

In line with Aalborg University's mission-driven innovation strategies, we also emphasised youth well-being through targeted research and action, applying PBL to support young people in developing the competencies, agency, and re-

silience needed to thrive in complex and changing contexts.

UCPBL continues to advance the conceptual and methodological foundations of PBL research, integrating complexity theory, systems thinking, and sustainability perspectives, and refining multiple methodologies. These contributions bridge research and practice, driving change from classrooms to institutions.

In 2024, we celebrated three PhD graduations: **Nicolaj Riise Clausen**, **Dan Jiang**, and **Henrik Worm Routhe**, each making significant contributions to self-directed learning, learner agency, and student leadership in interdisciplinary projects.
Looking ahead, we remain committed to addressing global challenges while meeting local needs towards a more sustainable future.

THE CENTRE

The Aalborg Centre for Problem-Based Learning in Engineering Science and Sustainability (UCPBL) is a category 2 centre under the auspices of UNESCO. The centre was formally launched in 2014.

The overall strategic goal of the Aalborg UNESCO PBL Centre, UCPBL, is to facilitate universities, and other higher education institutions, to take an active role in educating engineers and scientists so they can participate and contribute to the development of sustainable solutions to the present and emerging social, economic, and environmental challenges. UCPBL conducts world-renowned research in problem-based learning within engineering and science education and teaches problem-based learning.

GLOBAL NETWORK AND ACTIVITIES

Global network North-South, South-South, East-West

North America
- Research projects
- Researcher Exchange

Europe
PBL certificate and training on demand (e.g., Middle Leadership Poland)

South-east Asia
- A collaborative Erasmus project on Educational for Sustainability **Staff Development for PBL**

(40 educators from six universities Vietnam, Laos, Bangladesh)

South America
- Regional PBL network
- Regional PBL conferences

African countries
Consortium for IRSPBL 2025 – South Africa

Multiple external grants in progress

Supporting regional networks

India
Regional Research Symposia on PBL (RRSPBL) 2024

PBL certificate program with 40 engineering educators from five institutions involved.

Australia
- Research projects
- Researcher Exchange

Establishing a global network on PBL is a key initiative of the Aalborg Centre. The network aims to connect researchers, educators, practitioners, and institutions, to share knowledge and experiences on integrating PBL into engineering and science education. During 2024 UCPBL have organized, hosted or and participated in several activities. Highlighted activities:

National

In June Associate Professor Bettina Dahl Søndergaard participated in Folkemødet at Bornholm www.Folkemoedet.dk together with National center for development of Math teaching. Together, they hosted engaging debates on education-related topics. One of the highlights was co-organising and co-moderating a debate titled *"Are vocational educations second-rate?"* — a thought-provoking session that addressed persistent stereotypes and explored how they can be challenged.

Week 47, November 18th – 22nd we celebrated Aalborg University 50-year anniversary with a variety of workshops on

PBL. UCPBL shared the event in our global network and attracted participants from e.g. Germany, India, UK, China, Denmark, Poland and more.

In addition to the celebration UCPBL conducted the second of the semiannual Advisory Board meeting as a hybrid meeting, with both participants present and online.

International

At the **SEFI European Convention** for Engineering Deans, 12-14 June 2024 in Sheffield, Professor Lindsay gave a keynote talk entitled "Is Higher Education still Fit for Purpose? The Technology Dimension". His talk focused on the evolution of higher education, and how the affordances of new technology provide both new opportunities and new threats to the way higher education operates.

A group of 9 members of UCPBL participated in the **SEFI** Annual Conference, held at École Spéciale de Lausanne (EPFL) in Lausanne, Switzerland. The conference brought together over 550 participants from across Europe and beyond, making it one of the most vibrant gatherings in engineering education this year. Our team gained valuable insights into innovative teaching practices, the role of emotions in engineering education, and strategies for embedding sustainability and ethics into curricula. The conference also provided a unique platform for networking and knowledge exchange with peers, re-

searchers, and industry leaders, which will inform and inspire our ongoing work in engineering education.

Director of UCPBL, Professor Xiangyun Du and Associate Professor Aida Guerra represented the Centre at the **Conference on AI-supported PBL in K12** (schools) in China Oct26-28.

The Regional Research Symposium on Project-Based Learning (RRSPBL-2024) were hosted at **Anurag University**, Hyderabad in collaboration with the UCPBL and **Indo Universal Collaboration for Engineering Education (IUCEE)**. Xiangyun Du, Euan Lindsay, Niels Erik Ruan Lyngdorf and Henrik Worm Routhe participated in the symposium. During their stay in India, they visited schools and universities.

Advisory board

UCPBL members served in advisory boards capacities for a range of organizations and journals. This year we extended to GELYDA. GELYDA is a new international organization dedicated to understanding, supporting, and improving expanded opportunities for learning, development, and thriving in schools, afterschool and summer programmes, and communities. www.gelyda.org

PBL Training

Academic Leadership for pedagogical change via/towards PBLAAU PBL training days (SA)

In May, National South African IEC team engaged in a specially designed workshop titled *"Academic Leadership for Pedagogical Change via/towards PBL."* Tailored specifically for the South African context, the workshop aimed to support academic leaders in driving pedagogical transformation through Problem-Based Learning (PBL).

The objectives of the workshop were to:

1. Identify and critically analyze individual and collective teaching challenges within participants' institutional contexts.
2. Reflect on current teaching roles and competencies and align them with the skills required to effectively facilitate student learning.
3. Redesign teaching, learning, and assessment practices using the principles of constructive alignment.

4. Develop a strategic roadmap for implementing pedagogical change within their respective institutions.

This initiative fostered deep reflection, collaborative dialogue, and actionable planning, equipping participants with tools and perspectives to lead meaningful educational change.

Enhancing Institutionalized Transformation through Design, Implement and Evaluate a PBL Pedagogical Development Certificate Program for HITAM, India

This project supports educational transformation in Indian higher education for engineering by strengthening pedagogical leadership among university lecturers. Through a multi-cohort development programme, participants are empowered to design student-centred learning models, engage in the scholarship of teaching and learning, and act as local change agents. The initiative promotes sustainable, institution-wide change by building both individual and organisational capacity for innovation in teaching.

The project is led by Professor Xiangyun Du. Assistant Professor Juebei Chen, Associate Professors Aida Guerra, Associate Professor Niels Erik Ruan Lyngdorf and PhD Student Henrik Worm Routhe participates in the project.

AAU, Aalborg Municipality and K12

Aalborg University, three Danish schools, and Future Nation School in South Africa have formed a unique partnership around problem-based learning. Students and teachers from both countries have collaborated on projects, sharing perspectives and tackling global challenges together. The project also contributes valuable insights into the research area of PBL in K12 education. A major outcome will be a conference in South Africa in November 2025, bringing together schools from around the world. This project is led by Associate Professor Lykke Bertel Brogaard

and Associate Professor Niels Erik Ruan Lyngdorf.

Orientfond-Supported Project with National University of Shipbuilding in Mykolaiv (NUoS), Ukraine

A partnership with the National University of Shipbuilding (NUoS) in Mykolaiv, Ukraine—funded by the Orientfond—advances educational transformation through Problem-Based Learning (PBL). The initiative aims to foster institutional transformation and local empowerment through the implementation of Problem-Based Learning (PBL).

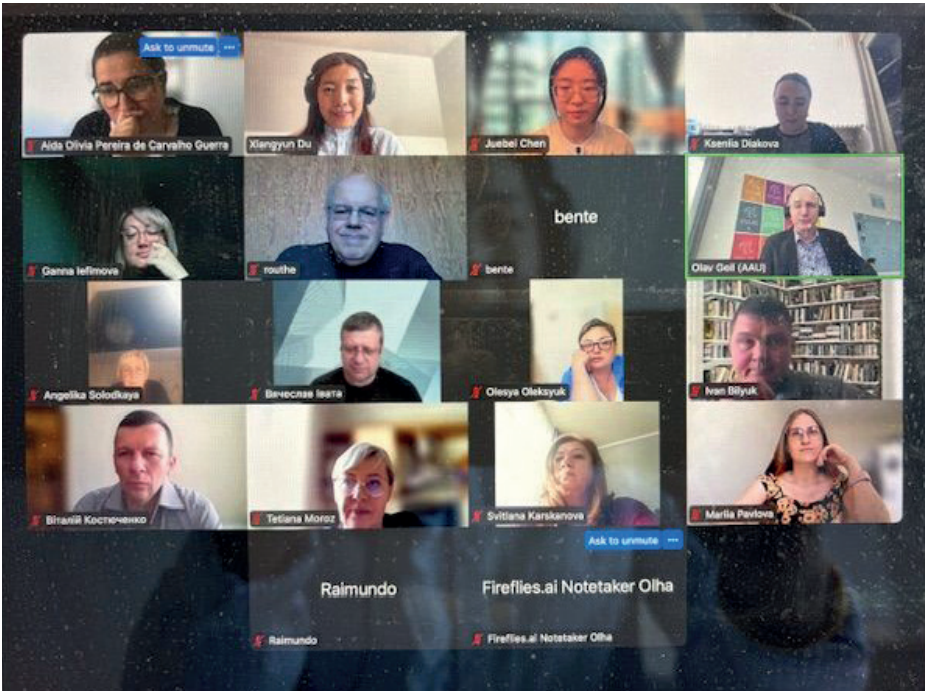
The project combines capacity-building with research to explore how PBL can drive sustainable educational change in the Ukrainian context. In addition to capacity-building efforts, the project integrates theoretical and empirical research to explore how PBL can serve as a catalyst for educational innovation and sustainable development in the Ukrainian context.

The project is led by Xiangyun Du, Aida Guerra, Bente Nørgaard, Henrik Worm Routhe, Juebei Chen, Niels Erik Ruan Lyngdorf. Xiangyun is the project leader on behalf of Department of Sustainability and Planning.

PhD Course

Study Circle on PBL research in education – from design to publication

In 2024, a new initiative was launched to support the development of early-career



researchers within UCPBL and IAS PBL. Led by Professor Xiangyun Du (UCPBL), the PhD Study Circle on PBL Research in Education – from Design to Publication offers a focused learning environment for PhD students working with problem-based learning (PBL).

The study circle spans 6–8 months and includes six sessions where participants engage in peer review, writing exercises, experience sharing, and feedback from senior researchers and supervisors. The initiative provides a valuable supplement to existing PhD courses by offering a more targeted focus on PBL research design, theory, methodology, data analysis, and academic writing.

Learn How Creative Thinking Can Transform Your Research

Organised by Research Assistant Søren Hansen

The course offers a deep understanding of creative thinking in research and aims to enable PhD students to make room for creative thinking and methodology in their research. The systematic use of creative thinking can be particularly helpful in generating new ideas, hypotheses, experimental designs, and data interpretation as well as in the communication of research.

Mixed methods

Organised and taught by Professor Xiangyun Du. Lecturers include Associate Professors Aida Guerra and Juebei Chen

The course intends to support participants in developing interdisciplinary inquiry skills by analysing the needs for mixed-method research and designing mixed-method research using diverse strategies. A problem and project-based learning approach is adopted in this course, involving participants working in groups on real-life issues identified on their own.

PBL and Facilitations skills

Organised and taught by Professor Xiangyun Du and Associate Professor Aida Guerra. Taught by Associate Professor Juebei Chen

This PhD course aims to help students understand and reflect on Aalborg University's systemic PBL approach. Participants will learn about the Aalborg PBL model, collaborative project work, and how to facilitate and manage various projects and problems.

Professional Communication

Organised by Professor Euan Lindsay

Taking both a theoretical and practical approach, the course is intended to help PhD students become aware of the many dimensions of effective communication and to develop their competencies to prepare them for communicating in a professional research context.

In 2024, a total of two courses were completed.

Project Management and Interpersonal Skills

Lecturers include Henrik Worm Routhe

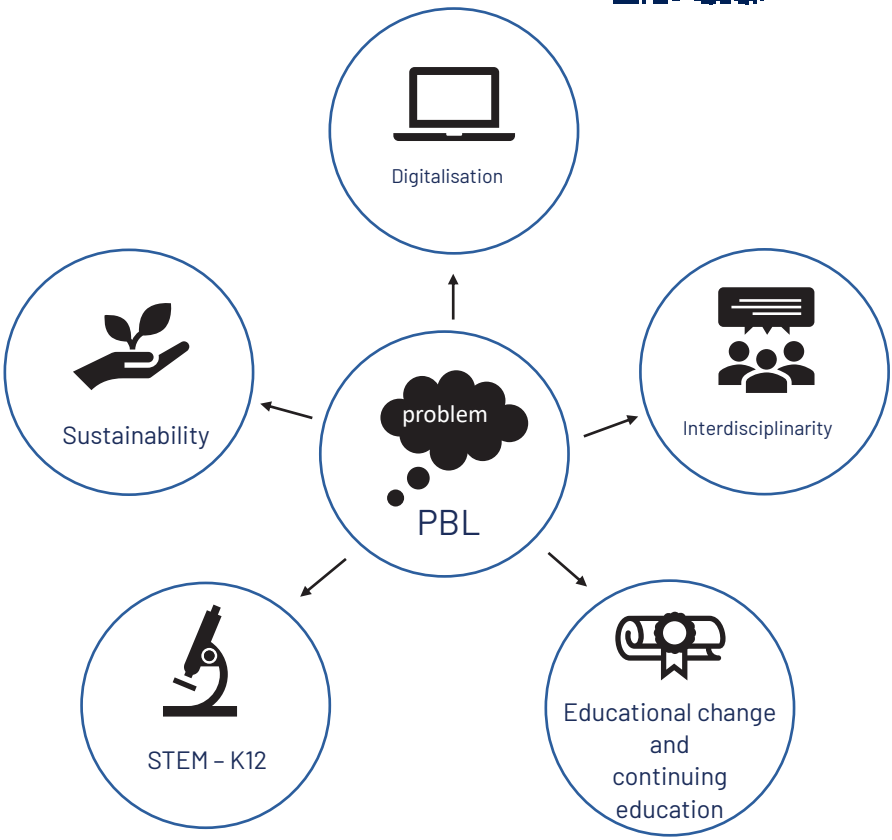
This practical workshop helps PhD students manage their projects by focusing on both project management skills in a creative, unstructured university environment as well as interpersonal skills, especially in cooperation with supervisors and stakeholders.

In 2024, a total of two courses were completed.

KEY RESEARCH

Topics and link to website
Aalborg Centre for PBL in Engineering Science and sustainability research on several topics related with problem-based learning, and engineering and science education, which some are financed and supported by external partners and grants.

See more here **Aalborg Centre for Problem Based Learning in Engineering Science and Sustainability — Aalborg University's Research Portal (aau.dk)**



Highlighted new projects

Digital Twins for Abundant Feedback: Novel Feedback Paradigms via Explainable Multilingual Natural Language Processing

This project uses natural language processing (NLP) to develop digital twins of assessment and feedback processes, aiming to provide scalable, explainable, and multilingual feedback to students. By combining frontier research in engineering education and multilingual NLP, the project explores how students engage with feedback and advances our understanding of effective educational practice.

The project is led by Professor Euan Lindsay (UCPBL) in collaboration with Johannes Bjerva, Department of Computer Science.

ENVIHEI: Student-centered learning for ENVIronmental sustainability at Higher Education Institutions

The ENVIHEI project develops and tests innovative, student-centred learning materials to integrate green competences in higher education, addressing key challenges in the EU's GreenComp framework. The project focuses on empowering engineering students and their lecturers to support the green transition and foster responsible citizenship.

Activities include the co-creation and piloting of educational materials, lecturer training, and a winter school for students. Using transformative learning approaches—such as PBL, real-case studies, and service learning—the project promotes transferable, practice-based sustainability education across diverse higher education contexts.

Associate Professor Aida Guerra and Postdoc Dan Jiang (UCPBL) participates in the project, which is led by Universidad De Leon and includes collaboration with Universiteit Hassel, Politechnika Slaska, and Montanuniversitaet Leoben.

PhD project: Generative AI in Science Education, PhD student Anne Sofie Brodersen Lütken

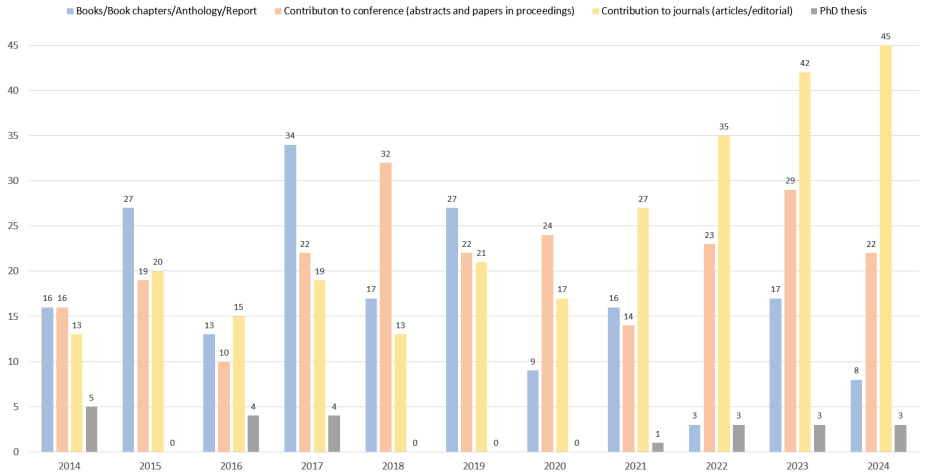
The project focuses on the use of generative AI in science education in primary school and is linked to CESE's themes on student experiences and educational resources.

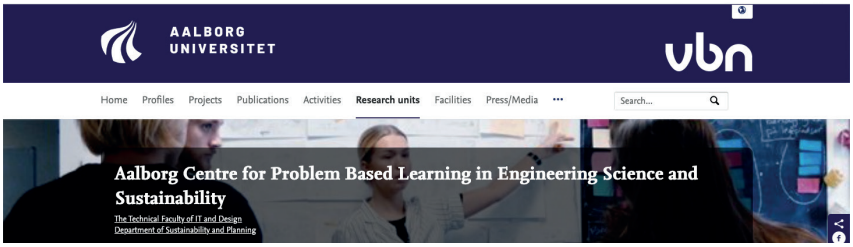
The project is funded by the research initiative NAFA's (Naturfagsakademiet NAFA) Center of Excellence in Science Education (CESE). Main supervisor Stine Ejsing-Duun (UCPBL); Co-supervisor Claus Auning, UC SYD

PUBLICATIONS

Members of the UCPBL continue to be closely involved in engineering education and international science communities, by participating in their international conferences (namely SEFI, ASEE, FIE, AAEE, etc.), being members of their boards (namely REEN) and guest speakers, and by hosting workshops and seminars (e.g. BNU Expo and SEFI).

One important part of the Centre's dissemination activity is the reporting and publication of research outcomes through conference and journal articles.





You can see the full list of our participation in projects and publication of research outcomes on our research profile **Aalborg Centre for Problem Based Learning in Engineering Science and Sustainability – Aalborg University's Research Portal (aau.dk)**

PHD DEGREES AWARDED

Nicolaj Riise Clausen
Nicolaj defended his PhD thesis titled "*Self-Directed Learning in Problem-and Project-Based Learning: A Study of Self-Direction in the Aalborg PBL Model*" February 15th, 2024

Dan Jiang
Dan defended her PhD thesis titled: *Engineering students' Perspectives on the Learner Agency Development in an Intercultural PBL Context in Denmark*" March 7th, 2024.

Henrik Worm Routhe
Henrik defended his PhD thesis with the title: "*Management and Leadership in Interdisciplinary Projects in Engineering Education*" on October 1st, 2024.

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