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INTRODUCTION

Despite having been through another year of lockdown and several virtual conferences and webinars, the speed of change at Aalborg University (AAU) has not slowed down. The Aalborg problem-based learning (PBL) model is under re-construction in response to the demand of curriculum flexibility and the emphasis on the creation of individual learning trajectories. The Aalborg UNESCO PBL Centre (UCPBL) has always aligned research with internal curriculum initiatives on the different programmes. Sometimes our research is ahead of practice, while at other times it documents existing practice.

Three interdependent change tracks have recently emerged in the Aalborg PBL curriculum: interdisciplinarity, PBL competences, and digitalisation which will influence the coming research agenda for UCPBL. STEM (science, technology, engineering, and mathematics) into SSH (social sciences and humanities) and SSH into STEM is part of a new strategy for the university. Interdisciplinarity, which combines STEM and SSH should be included in all programmes. Interdisciplinarity is a familiar term in engineering education; engineering students have been offered courses in science, technology, and society (STS) and economics for decades. However, this new initiative extends our traditional understanding of those topics. The new approach responds to the challenging sustainable development goals (SDGs) and complexity. It will be implemented through a variety of smaller and larger interdisciplinary projects solved by teams comprising members from a broad range of programmes and project groups from different programmes working together

on an educational mega project. Therefore, new variations of projects will emerge, and we will need to develop a new taxonomy for interdisciplinary competences.

When project length and the scope and scale of complex problems will vary from single disciplinary problems to much more interdisciplinary problems and projects, it will be easier for students to reflect on their PBL competences as they will be able to compare variations of project experiences. This might facilitate the development of meta-competences so they can recontextualise the knowledge and skills they acquire in one situation within new and different ones. Transfer and transformation, two core elements in the learning of PBL competences, should be generic, transferable, or transversal in nature. So another aspect of the coming research agenda will be to study the learning of PBL competences and how they can be applied.

No new curriculum changes will be possible without the integration of digitalisation, an embedded part of all educational practice. Micro-credentials (credits for smaller digital learning units) are a new element of digitalisation. They provide for more flexible education pathways, including lifelong learning. However, they may make degree programmes less coherent; what will this mean from the perspective of general education? This must also be addressed in future research together with the combination of digitalisation and enhanced international collaboration.

Research at the UCPBL goes beyond internal developments at the university; for in-

stance, we are engaged in international outreach, especially academic staff training. What are the key components of success in training and educational change? We are also conducting a national STEM outreach programme in schools and upper secondary schools, a context that differs greatly from that of higher education and thus, calls for the recontextualization of PBL. The UCPBL has several new externally funded projects in this area, and some of these are described herein.

During the past year, our global outreach has increased. We have not been able to travel, but we organised the International Research Symposium on PBL (IRSPBL2021) as a virtual conference. It was held in conjunction with PBL2021. More than 650 participants from 51 different countries signed up, the highest number of participants ever for one of our conferences. Meanwhile, the Regional Research Symposium on PBL (RR-SPBL2021) in India had 615 participants. In spring 2021, we hosted a series of webinars with paper presentations from the IRSPBL2020; 350 participants attended. We are currently preparing for IRSPBL2023, which will be held in Boston at the Massachusetts Institute of Technology (MIT) and Harvard University.

We have also developed an online PhD programme, and we are preparing for the first cohort of students from India to be enrolled.

In 2021, the UNESCO Engineering Report (which focuses on SDGs) was published. The UCPBL contributed with a chapter on the future of engineering education. The report has been translated into several languages.

In January 2022, Aalborg University will establish the Institute for Advanced Study of PBL (IASPBL), which will comprise staff from every faculty in the university. The IASPBL will function as a matrix organisation in which academic staff retain a connection to their departments while working closely with colleagues involved in PBL research to create a complementary research programme. It will be led by Professor Thomas Ryberg, who is currently employed as a professor in PBL and digitalisation at the UCPBL.

On the staff side, several staff members are currently on maternity leave. In 2020, Associate Professor Pia Bøgelund decided to move to a new research group. We employed several research assistants this autumn and enrolled two new PhD students and an assistant professor. Organisations like ours are like living mechanisms, and we expect to see further changes in 2022. We start the new year with the employment of two professors: Xiangyun Du and Euan Lindsay. Xiangyun has been employed on a part-time basis, but as of January 2022, she will be full-time. Euan Lindsay will take up a professorship in PBL and Digitalisation in Engineering Education.

January 2022

Anette Kolmos



GLOBAL NETWORK AND CAPACITY-BUILDING

VIRTUAL CONFERENCE YEAR By Anette Kolmos

IRSPBL2021

In 2021, we were involved in hosting a series of webinars as a follow-up to IRSPBL2020, where we decided to run all paper presentations as webinars. The webinars were attended by approximately 350 participants, and we received very positive evaluations.



When we postponed IRSPBL2020, we were hoping to host a physical conference (in August 2021). However, by the end of February, we realised that this would not be

possible, so we adopted a digital format comprising three conversations between various experts.

The first conversation—on regional developments in engineering education—involved four previous IRSPBL hosts: the IRSPBL2013 Professor Khairiyah Mohd Yusof (UTM Malaysia); IRSPBL2017 pro-rector Ismael Peña (Universidad Nacional de Colombia, Colombia); IRSPBL2018 Professor Jian Lin (Tsinghua University, China); and RRSPL2019 and RRSPL21 Professor Gopalkrishna Joshi (KLE Tech, Hubli, India). All speakers reported a movement in the countries towards more student-centred learning and an increasing popularity of PBL.

The second conversation addressed PBL and sustainable development. Dr Peggy Oti-Boateng (UNESCO, France), Professor William Oakes (Purdue University, US), and



IRSPBL2021 opening session

Professor Daniella Tilbury (Research Chair in Sustainability in Higher Education, UK) all stressed the fundamental role played by engineering in achieving the UN SDGs. Higher education institutions still have much to do to equip and educate professionals with the competences they need to build a more sustainable future.

The third conversation focused on the future of engineering education and addressed challenges and future perspectives. Professor Amitava 'Babi' Mitra (MIT, US); Professor Fawwaz Habbal (Harvard, US); Professor Jakob Stoustrup (Aalborg University, DK); and Ruth Graham (Educational Consultant, UK) addressed challenges such as student motivation, the need for more lifelong learning, and systemic change. They emphasised rethinking the universities as a source of innovation and the need to develop new skillsets.

The next IRSPBL2023 will be hosted by MIT and Harvard University. The main theme will be educational transformation.

PBL2021

The IRSPBL was followed by PBL2021; the two conferences were announced as PBL Week. PBL2021 was a collaboration between Aalborg University's PBL Future research project and the PANPBL Association. This conference had also been postponed previously. No papers had been presented between



2020 and 2021, which meant that a substantial number of papers were presented at the conference. Professor Richard Miller (previous president at Olin College, US), Professor Laura Czerniewicz (Centre for Innovation in Learning and Teaching, University of Cape Town, South Africa), and Professor Diana Dolmans (Maastricht University, The Netherlands) gave keynote speeches.

Networked Learning Conference

In 2021, UCPBL was involved with the planning of the Networked Learning Conference 2022 (NLC2022). Since 1998, the biennial Networked Learning Conference has provided a forum for the critical examination and analysis of research in networked learning – particularly in higher education and lifelong learning. The NLC2022 conference is to be held as a hybrid event at Mid-Sweden University in Sundsvall, Sweden in May 2022.



Conference themes will include:

- Conceptualisations of networked lifelong learning as a blended, boundless, or hybrid phenomenon
- Networked learning across the lifespan (early childhood, school, work, and retirement)
- The role of sustainability in networked learning
- Ethical perspectives on networked learning (e.g., equity, inclusivity, social justice, and values)
- The role of artificial intelligence, big data, and learning analytics in networked learning

THE INDIAN PERSPECTIVE By Anette Kolmos

The RRSPLB was launched in November 2019, and the second event was held in 2021 as a virtual conference. It was free of charge, though all participants needed to obtain a certificate from a UCPBL online course. This was a new idea and it worked perfectly. Problem-based learning in India is relatively new to many academics, so the online courses provided an introduction to the concept and how it can be applied. Encouraging several participants from each institution to attend was also a

success. The conference was attended by 615 participants from 110 different institutions and 15 different states. Most of the attendees were from Maharashtra, Telangana, and Karnataka. Several of the workshops and keynote addresses were hosted by colleagues from UCPBL and its associates. Most importantly, RRSPLB2021 featured several high-prestige international speakers which is important when national change is being initiated. Xavier Fouger from Dassault Systemes found similarities between PBL and the Indian concept of jua-gad (creativity in making things work or innovating with limited resources).

Valedictory:
19th June - 5.00 am to 5.30 pm

Chief Guest :



Prof. Rajive Kumar
Member Secretary,
AICTE

President :



Prof. Thimme Gowda
Vice Chairman,
KSHEC

Organising Chair :



Prof. Gopalkrishna Joshi
Executive Director,
KSHEC

RRSPBL 2021
Regional Research Symposium on PBL
June - 18th & 19th, 2021
www.rrspbl.co.in

Event Partners



Organized By
Karnataka State
Higher Education Council,
Bengaluru

In collaboration with
Aalborg Center for Problem Based Learning
in Engineering Science and Sustainability,
under the auspices of UNESCO

Inauguration
18th June - 9.00 am to 9.30 am

Chief Guest :



Prof. K. Kasturirangan
Former Chairman ISRO and
Chairperson NEP Drafting Committee

Guest of Honour :



Prof. Anette Kolmos
Director, Aalborg UNESCO Centre for
PBL in Engineering Science and Sustainability

Presiding by :



Dr. C. N. Ashwath Narayan
Deputy Chief Minister, Minister for Higher Education,
IT, BT and Skills, Government of Karnataka

ABOUT - PBL

PBL as a pedagogy provides opportunities for students to learn and practice the competencies required by profession in the 21st century. The objective of RRSPLB 2021 is to bring together academicians, researchers, and practitioners in India and connect them to global experts in PBL to deliberate on the current state of PBL practices in India. RRSPLB aims to build a community of PBL practitioners and researchers in India who will collectively work towards disseminating PBL in India. RRSPLB will host a range of keynotes, workshops, and panel discussions which will be facilitated by national and international experts who are pioneers in the field.

www.rrspbl.co.in

Institutional Partners



Sponsors



RRSPBL 2021 programme

Plans are underway to stage RRS PBL in November 2023. It will be hosted by one of the very few PBL colleges in India, Vishwaniketan, located south of Mumbai in the state of Maharashtra.

A PBL CERTIFICATE PROGRAMME IN COLLABORATION WITH INDIA By Xiangyun Du

In 2021, UCPBL was involved in the organisation of a pedagogical change agents development programme designed to support engineering teaching staff in India to sustain their implementation of PBL by focusing on the long-term impact of educational development. The 12-month programme aims to construct student-centred learning models such as PBL for application in the participants' pro-

grammes and classrooms, encourage scholarship in teaching and learning, and advance pedagogical leadership and agency. It aims to help participants cultivate their teaching/pedagogical leadership skills and become change agents and not simply reproduce teaching techniques for information transmission. The programme is currently awaiting sponsorship.

The screenshot displays a Zoom meeting interface for the RRS PBL 2021. The main content area shows a slide titled "RRSPBL 2021 Regional Research Symposium on PBL" held on June 18th & 19th, 2021. The slide includes a table of workshop-wise participants and attendance, along with logos of sponsors and institutional partners.

Workshop name	Registrations	Attendance	Percentage
1. PBL Problem Characteristics	258	190	74%
2. Accelerating PBL	302	232	77%
3. Model Based Systems	98	80	82%
4. What Does it take to change	271	169	62%
5. CDIO	289	235	81%
6. Reflecting and Learning	205	120	61%
7. Break through AI	215	132	62%

Participants visible in the meeting grid include Rajive Kumar, Prof. B. Thimmegowda, and Rohit Kandakatta. A chat window at the bottom shows a message from Dr. Saravana Perumal S, TCE: "A more productive symposium. Th..."

RRSPBL 2021 screenshot

NEW RESEARCH PROJECTS

INTERDISCIPLINARY PBL METHODOLOGIES IN ENGINEERING EDUCATION AND WORK (INTER-PBL)

By Anette Kolmos

STEM into SSH and SSH into STEM – students need to develop more interdisciplinary competences. On September 1, 2021, a new four-year project was launched for this purpose. It is funded by Poul Due Jensen Foundation and Aalborg University.

Companies require graduates who can work in interdisciplinary teams. At Aalborg University, students primarily learn to work in disciplinary teams, and they need to learn how to apply their collaboration and project management competences in interdisciplinary contexts. Inter-PBL will contribute to the development of innovative educational models—nationally and internationally—to teach engineers to work proactively and interactively in an interdisciplinary work environment, deal with complexity, and contribute

to sustainable development. Inter-PBL will develop curri-

culum models to show how students can learn generic interdisciplinary competences. It will be based on the following case studies: (a) new curriculum practices in interdisciplinary projects where students work on sustainability problems across educational programmes (b) interdisciplinary projects in companies; (c) transdisciplinary projects where universities and companies work on common problems.

The goal is to develop:

- theories, methods, and tools for collaboration in a variety of interdisciplinary projects, taking inspiration from companies' best practice
- theories, methods, and tools for learning PBL competences in interdisciplinary projects and meta-competences for the transformation of learning
- curriculum models for enhancing the quality of existing national and international PBL models that address interdisciplinarity

Inter-PBL will allow for better interdisciplinary collaboration in student teams and companies based on analyses of educational and business cases. It will also contribute with new knowledge of how meta-reflection might be essential for the development of generic PBL competences. Meta-competences are necessary to participate in complex and interdisciplinary project processes in companies and education.

For more information, please contact Professor Anette Kolmos





LabSTEM Nord is an action research project that aims to encourage motivation and interest in STEM and STEM careers through an integrative and problem-based learning approach to STEM teaching across the entire educational system, with a focus on transitions and learning trajectories. The project facilitates the co-creation of problem-based STEM-teaching through an online teacher community, supported by STEMLab workshops, inspirational seminars, and digital resources (e.g., on PBL, digital literacy, and gender equality in science education). The project is funded by the North Denmark Region; the total budget is DKK4.2M. Current partners include UCPBL (project lead); University College North (teacher education); TECH College (vocational school); five primary and secondary schools; five upper secondary schools; and three technical high schools. The project will continue to invite partner schools to participate and expand collaboration across and throughout the educational system. It is part of a network of LabSTEM projects initiated by the University of Southern Denmark that will be rolled out across the country this year and the next.

NAFA
– SCIENCE EDUCATION ACADEMY
By Lykke Brogaard Bertel

NAFA is a national programme established to improve science education in Denmark through:

- competency development of teacher educators at university colleges
- development of models for flexible continuing education for science teachers
- research-based knowledge of science education at the Center for Excellence in Science Education (CESE)

Partners include all Danish university colleges for teacher education, University of Copenhagen, University of Southern Denmark, Aalborg University, and Aarhus University. The total budget is DKK200M (€26.8M – to be allocated according to ongoing internal project proposals). The programme is funded by Novo Nordisk Foundation and VILLUM Foundation. Aalborg University is represented at CESE, where it assists in developing research strategies, conducting practice-based strategic and related research. It has also been involved in the establishment of a PhD programme for science education in Denmark.



TRAINING AND DISSEMINATION ACTIVITIES

ONLINE PHD PROGRAMME By Xiangyun Du

To further enhance the research profile of AAU in the field of PBL, and address a global audience, a doctoral programme was launched in 2021 to attract young international researchers and educational practitioners who are interested in the development of PBL and its contribution to education and society. The programme encompasses basic, applied, developmental, and action research aimed at creating educational change.

The programme will be offered using a blended mode. It will include online activities (e.g., courses, meetings with supervisors, and research work) and face-to-face activities (e.g., seminars and summer schools).



The programme will encourage participants to explore the range of PBL developments. Potential topics include:

- PBL epistemologies – research on fundamentals and the philosophy of PBL within and across socio-cultural contexts
- Variation in PBL approaches – research on diverse approaches to PBL practices including curriculum, course design, implementation, assessment methods, and evaluation of PBL outcomes
- PBL competences – research on the diversity of PBL-related competences
- PBL, digitalisation, and networked learning – research on PBL and PBL development in a digital world
- PBL and interdisciplinarity – research on the disciplinary and interdisciplinary aspects of PBL
- PBL and culture – research on diverse cultural and intercultural issues related to PBL
- PBL implementation and organisational change – research on how PBL can be implemented in various social, organisational, and cultural contexts
- PBL and sustainability – research on how PBL supports the integration of sustainability in higher education
- PBL across diverse educational levels and subjects (e.g., STEM)

In 2021, initial efforts were made to build institutional collaboration with higher education institutes in India with the assistance of

- Professor Gopalkrishna Joshi, Executive Director Karnataka State Higher Education Council, Bengaluru, Karnataka, India

- Dr Rohit Kandakatla, Director of KGR College of Engineering and the adjunct faculty Centre for Engineering Education Research: KLE Technological University
- Professor Sandip Inamdar and Professor Vikas Shinde, Directors of the PBL COE, Vishwaniketan, Khalapur, Mumbai, Maharashtra, India

A plan for a pilot PhD programme is underway in India. It will include approximately six candidates, all of whom teach engineering in India. The programme will be offered in a blended mode and will be organised locally by Vishwaniketan in collaboration with UCPBL. It is expected that the candidates will be enrolled during the spring of 2022 and will begin their studies in August 2022.

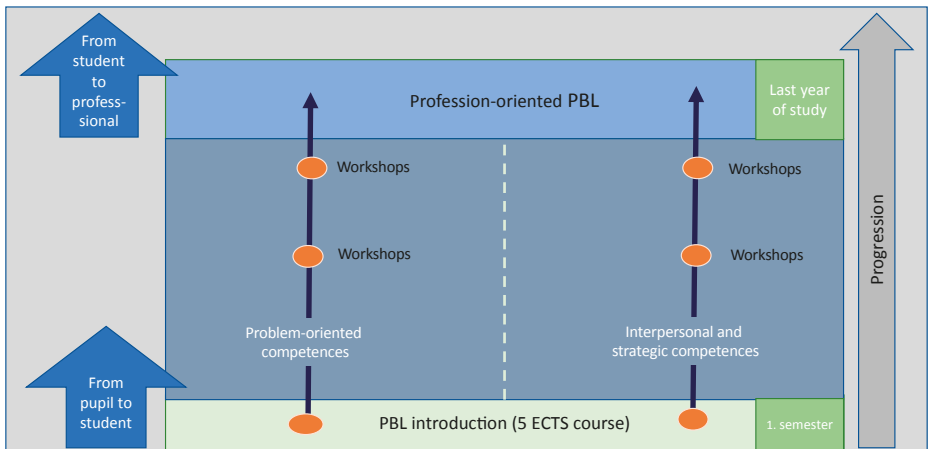
We hope that the PhD programme will be extended to other regions, including Africa.

IMPLEMENTED MODEL TO SUPPORT PROGRESSION OF PBL COMPETENCES

By Bente Nørgaard and Jette Egelund Holgaard

UCPBL has been in the lead of implementing a new model for the progression of PBL competences (as shown in the figure below) in all engineering and science programmes offered at AAU.

When students enter Aalborg University, they complete an introductory PBL course which provides them with a foundation for contextual, collaborative and reflective learning, and an established baseline of management and leadership capacity for self-directive learning in project settings. We developed this course further by adding the new model of progression of PBL competences to provide a personal learning path for students to guide them throughout their studies.



Model for the progression of PBL competences



After the first semester, workshops to support the development of PBL competences are implemented in alignment with the learning objectives in the curricula and the PBL practice of students. During the spring of 2021, UCPBL developed several workshops in collaboration with the study boards within the Faculty of Engineering and Science, and the Technical Faculty of IT and Design. The workshops were developed to cover various PBL aspects and address problem orientation, interpersonal competences, structural as well as reflective competences. You can find a list of current workshops [at the UCPBL website](#).

At their first semester, master level students are required to reflect and articulate their PBL competences. This focuses on the individual student and their PBL

competences. We have developed a guide and a workshop for this purpose to help students prepare a draft PBL competence profile highlighting their specific strengths in handling problem-based learning and project work. At this stage, this serves as a platform for outlining targets for further development and opens for supplements of domain-specific competences. The overall aim is that students become able to articulate their competences when entering new collaborations and organisations – in particular, their future workplace. You can find more information about the PBL competences workshop at [the UCPBL website](#), and look into the developed material [on our Moodle page](#).



GRUNDFOS/AAU HACKATHON
By Henrik Worm Routhé and
Maiken Winther

As part of the Inter-PBL project, a hackathon was launched at Grundfos in Bjerringbro in August 2021. To facilitate an interdisciplinary setting for problem-solving and innovation and develop collaborative and structural competences, the first AAU/Grundfos Hackathon brought together students from all faculties.

The event took place at Grundfos Academy in Bjerringbro. The participants stayed for three days and worked on problems defined by Grundfos. In total, eight students participated – seven students from Aalborg University and one from University College of Northern Denmark (UCN). They came from the engineering, humanities, social science, and IT and design faculties.

The students were given two problems. During the event, they participated in small workshops and worked in groups to come up with possible solutions. On the third day, each group gave a representation, and the

winners were selected by staff from Grundfos and Aalborg University.

Overall, the students found the experience very useful. They appreciated having the opportunity to collaborate with a company and work through complex and challenging problems. The Hackathon is a novel way of involving companies in interdisciplinary work at Aalborg University, and it is hoped that it will continue to benefit all those involved.



Winning group, AAU Hackathon 2021

FORMULATING COMMON PRINCIPLES FOR DIGITALLY SUPPORTED PBL

By Niels Erik Ruan Lyngdorf and Thomas Ryberg

In the autumn of 2021, an exciting new internal project for developing common principles for digitally supported PBL began as part of AAU's digitalisation strategy. The project is led by Professor Thomas Ryberg and aims to formulate a set of principles that will guide AAU on how digitalisation can support and develop our model of education, that is, the AAU PBL model. The project builds on previous work on digitalisation at AAU, such as the PBL Future project, PBL Digital, the implementation of digital

competences in the formal curriculum, and needs relating to current principles of PBL at AAU. The task group consists of representatives from all faculties and campuses since the principles will be implemented university-wide.

The first phase of the project from August 2021 to January 2022 progressed from desk research on existing comparable work, to the development of a taxonomy, and finally to a draft of the final principles. The desk research covered the aforementioned initiatives at AAU, examples from institutions internationally, and other relevant research. The principles, which are presented below, were chosen because they were seen as important elements of



AAU's model for education and because digitalisation has the potential to challenge and develop them.

Diversity, Accessibility, and Inclusion

This principle aims at diversifying our approaches to educational practice and thereby increasing accessibility and inclusion. Digitalisation can be used to develop multimodal practices and increase the number of ways we educate students with different conditions and needs.

Participation and Empowerment

Participation and empowerment must be understood from the student's perspective if their involvement and engagement in their own educational choices and processes are to be enabled and prioritised.

Collaboration and Openness

Digital technologies will continue to provide new ways of collaboration and sharing resources based on openness at many levels, for example, internally in and across groups, at course level, semester level, programme level, across semesters and programmes, across time, and across universities both nationally and internationally.

Variation

Students should be exposed to a variety of teaching and learning experiences throughout their education. Therefore, curriculum design and concrete teaching should embrace variety as a central principle when designing and delivering courses.

The project will continue through the spring and autumn of 2022, when the draft developed by the task group will be presented and discussed with key stakeholders. The hope is that they will engage in discussions of the above principles, offer examples of practices that support those principles, and create a wealth of open digital resources for PBL.

PHD DEGREES AWARDED

In May 2021, Concetta Ianniello successfully defended her PhD thesis entitled "Story of a Silent Revolution: Investigating Teachers' Role in Conceptualizing and Implementing a Curriculum Innova-

tion in Italy." Her supervisor was Anette Kolmos from UCPBL, with Associate Professor Aida Olivia Pereira de Carvalho Guerra from UCPBL as co-supervisor.

SELECTED PUBLICATIONS

2021

Bertel, L. B., Askehave, I., Brohus, H., Geil, O., Kolmos, A., Ovesen, N., & Stoustrup, J. (2021). Digital transformation at Aalborg University: Interdisciplinary problem- and project-based learning in a post-digital age. *Advances in Engineering Education*.

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The screenshot shows the website for the Aalborg Centre for Problem Based Learning in Engineering Science and Sustainability. The header includes the Aalborg University logo and the VBN logo. The navigation menu contains: Home, Profiles, Projects, Publications, Activities, Research Units, Facilities, Press / Media, and a search bar. The main content area features a large image of a person in a white lab coat. Text on the page includes the center's name, its affiliation with the Technical Faculty of IT and Design, Department of Planning, and contact information: Phone 99407962, Email ucpbl@plan.aau.dk, and Address Rendsburggade 14, 9000 Aalborg, Denmark. A map shows the location in Aalborg. A navigation bar at the bottom lists: Overview, Fingerprint, Network, Profiles (27), Projects (80), and Publications (1073).

Research Output



262

Book chapter

242

Article in proceeding

211

Journal article

53

Paper without publisher/journal

305

More

Please visit our research portal VBN for a full list of research articles and publications



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