Strategic Environmental Assessment Curricula & Problem-Based Learning

A Sourcebook for Capacity Building

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Strategic Environmental Assessment Curricula & Problem-Based Learning. A Sourcebook for Capacity Building

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The authors, 2023

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Preface

From 2019-2023 a consortium across Asian and European Universities has jointly worked to develop teaching practices in higher education though our joint Erasmus+ project: Strategic Environmental Assessment for Capacity Development in Higher Education in Asia.

This sourcebook has been developed to support the advancement of capacity development within the Strategic Environmental Assessment (SEA) discipline by using Problem-Based Learning (PBL) approaches in higher-level education. The sourcebook has aimed to inspire high-level education teachers to work with problem-based learning methods and approaches, specifically when teaching SEA. The interactions in the project have highlighted that approaches to teaching and learning differ across universities and countries, and there is no one-solution-fits-all to teaching. In the sourcebook, this is considered by illuminating a range of teaching methods for inspiration.

The sourcebook has been an important basis for the dialogical workshops and meetings among university partners in the consortium. However, it is the hope of the authors and all the university partners that the sourcebook can also be used broadly by teachers and universities seeking concrete knowledge on and inspiration for applying PBL in their teaching of SEA and general teaching.

The sourcebook has been a core element in developing, adapting, and integrating PBL techniques into SEA curricula at the Asian partner universities in the consortium. We have learned that experimenting with teaching and promoting changing teaching approaches in higher-level education can be done at all universities with teachers and institutional support as the main drivers.
We hope that our joy and fascination in developing curricula for SEA based on PBL is seen throughout the sourcebook and that this book can help increase interest in PBL and inspire teaching within the environmental assessment.

On behalf of project partners

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Educating future leaders and SEA practitioners for a sustainable future

Many decisions taken at the policy and plan level can significantly affect the environment. Strategic Environmental Assessment (SEA) is a decision support tool intended to inform decision-making and planning processes to ensure environmental protection, contribute to sustainable development, and ensure public participation.

The sustainability challenges we face are complex, and SEA can support the necessary systems thinking, early integration in decision-making, and transparency and is relevant when creating change towards the United Nations' goals for sustainable development (SDGs). SEA can thus be regarded as a change agent promoting sustainable development (Kørnøv, 2020).

However, there are signs that the potential for increased sustainability through environmental assessment is not being exploited to the extent and at the speed that the global and local sustainability problems call for. One of the reasons for this is that SEA is not a technical tool that is separated from the dynamics of society. SEA is part of a societal context; it is used – and abused – in a societal context that involves wicked problems, uncertainty, and stakeholders with different interests (Kørnøv and Thissen, 2000).

Providing better, scientifically valid information or knowledge regarding a societal decision issue through SEA cannot be assumed to contribute to a better, more sustainable decision. If SEA is to have the intended impact, the approach should be guided by insight into the nature of decision processes and the ways to influence these processes. Acknowledging this has an impact on the way we teach SEA and environmental assessment in general.

Suppose we do not prepare our students for real-life processes in which the SEA is included. In that case, there is a great risk that the potential of the SEA as a sustainable change agent will not be achieved – and, at worst, will not facilitate sustainable development.

The starting point for this sourcebook is to support the education of future practitioners and leaders who will work with and aim to create sustainable change through SEA and to support education in enhancing an understanding of SEA in a societal context.

Problem-Based Learning as the educational method for SEA teaching

The fact that the pedagogical approach to teaching environmental assessment is important has been recognized, and at the same time, it has recently been established that the literature to support this is extremely limited (Morrison-Saunders and Pope, 2021). Scholars have also pointed out interesting trends in environmental assessment education. Gazzola found two trends across European member states: teaching is primarily concerned with the technical aspects based upon physical science-based understandings or a more social science understanding (Gazzola, 2008). This 'polarization' which other scholars also raise (e.g., Owens, Rayner and Bina, 2004; Stelmack, Sinclair and Fitzpatrick, 2005), leads to the conclusion that interdisciplinary approaches involving both physical science and social science understandings are needed to promote critical thinking (Gazzola, 2008).

In PBL, students work with problems in collaboration with the surrounding community and close dialogue with their teachers and supervisors. By engaging with PBL, the students engage in real-world problems related to SEA and sustainability, attempt to find solutions, and ultimately support the agency towards sustainable development through SEA. The students improve their learning skills such as:

- Problem identification and analysis
- Synthesis
- Problem-solving
- Communication
- Collaboration (Larsen et al. 2021)

This sourcebook is intended to give the reader concrete familiarity with PBL by providing practical guidance on how PBL can be introduced and implemented in higher-level education on SEA. The aim is for the sourcebook to be helpful as an inspiration for concrete teaching principles and methods when developing curricula for teaching SEA.

To a vast extent, the sourcebook is based on experiences and examples from teaching SEA at Aalborg University in Denmark, where the teaching philosophy is based on the 'Aalborg Model' for PBL.


WELCOME TO AALBORG UNIVERSITY

It is a central criterion that the sourcebook will be used at multiple universities. Therefore it has been prioritized to include concrete practical PBL cases to inspire how elements of PBL can be implemented at universities with no or limited previous experience with PBL.

Structure of sourcebook

The following introduction to the sourcebook provides the reader with a conceptual introduction and framework to PBL, highlighting central ideas and principles.

Part I introduces how PBL is implemented through project work and gives practical examples of different approaches. This is followed by hands-on examples of planning and implementing problem-based learning activities in different teaching contexts. Part II gives practical examples of how PBL can be implemented through courses and lectures, and part III focuses on implementing PBL through engagement with stakeholders.

Finally, the sourcebook provides an overview of open-source material concerning PBL. In addition, the UCPBL webpage provides several online open-access resources at https://www.ucpbl.net/.

Introducing a PBL framework for SEA teaching

This section will present some of the most central PBL principles and considerations to be aware of when taking a problem-based approach. The PBL model used at Aalborg University, 'the Aalborg Model,' is briefly introduced for inspiration. This can also inspire considerations about to what extent PBL can be implemented at universities. For some universities, new curricula will develop when implementing PBL, while other universities will integrate PBL into existing curricula.

PBL and The Aalborg Model

PBL is a learning-centred approach where students work with and solve problems related to real-life situations, which has been used successfully for more than 40 years. There is no universal definition or practice of PBL. However, one common definition of PBL is: "the learning that results from the process of working towards the understanding of a resolution of a problem. The problem is encountered first in the learning process" (Barrows and Tamblyn, 1980, p. 1).

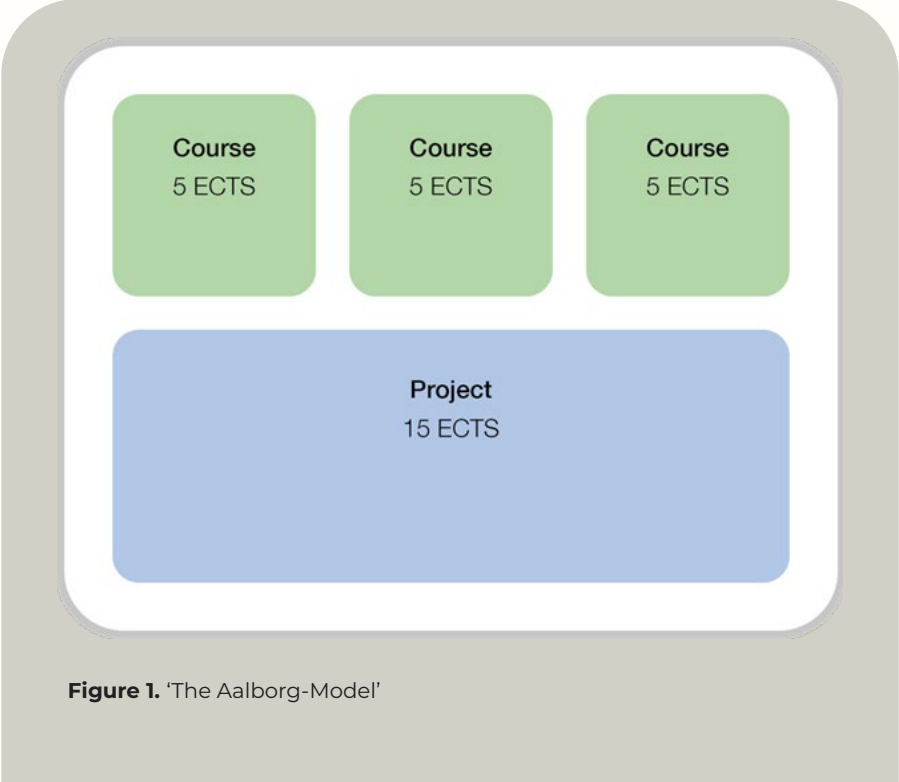


Figure 1. 'The Aalborg-Model'

The landscape of PBL practice varies across institutions and countries, and to give insight into how PBL is practised and institutionalized at Aalborg University, we will take you a bit back in time to explain the history of PBL in Denmark.
In Denmark, the development of the PBL approach started in the 1960s with the student movement questioning students' role as passive receivers of knowledge (Servant-Miklos, 2019). In the 1970s, this shift in the learning paradigm was institutionalized at two universities in Denmark: Roskilde University (1972) and Aalborg University (1974).

At Aalborg University, the PBL approach and its project-oriented approach to learning was the main driver for establishing the university. Thus, PBL was incorporated into the very DNA of the university, having a curriculum prioritizing 50% (or more) of students' learning facilitated through problem-based project work. To this day, project work still takes up around 50% of the learning load and the learning objectives for this part focus on social learning, problem-solving, and societal collaborations.

In Europe, university teaching is calculated into ECTS (European Credit Transfer System). One ECTS equals 30 students working hours. A semester at Aalborg University will typically divide learning activities between courses and project work, as shown in Figure 1.

If you want to read more about the overall framing of the problem-based learning approach at Aalborg University, more information can be found in these videos and introductory readings:

- *Short videos on PBL from our UNESCO Problem-Based Laerning Center: https://www.ucpbl.net/Open+Access+Resources/*
- *A booklet about PBL at Aalborg University: https://www.ucpbl.net/digitalAssets/1069/1069879_148025_pbl-aalborg-model_uk.pdf*

So why take a PBL approach for SEA curriculum development and teaching? Working with relevant and real-life problems has generally been shown to stimulate active learning and motivate students towards reflective and critical problem-solving. The students have well-documented learning conditions for developing and improving their self-directed learning capabilities and increasing their interdisciplinary knowledge and skills. Through the problem-oriented approach, they will develop their management, collaboration, and communication skills, strengthening their professional identity (Kolmos et al. 2008).

Working with PBL will have many effects on students' learning and motivation. The effectiveness of PBL has been analysed and summarized into the following points:

1. Promoting deep approaches of learning instead of surface approaches
2. Improving active learning
3. Developing criticality of learners
4. Improving self-directed learning capability
5. Increasing the consideration of interdisciplinary knowledge and skills
6. Developing management, collaboration, and communication skills
7. Developing professional identity and responsibility development
8. Improving the meaningfulness of learning" (Kolmos et al. 2008, p. 14)

Attaining global and national sustainable development goals require, among other things, enhanced capacity building and curriculum development in higher education institutions. The PBL approach supports the students' engagement with real-life problems and their ability to suggest solutions that address the sustainability challenges – both as students and as future SEA practitioners.

PBL principles

As opposed to traditional learning approaches, the PBL approach moves away from the perception that learning is a matter of transferring knowledge from teacher to student. Instead, PBL is perceived as an active social process where students are responsible for their learning and, through this process, learn to take responsibility for their learning process (Illeris, 2018). Curiosity is seen as the main driver for students' engagement in learning processes, and what facilitates such learning processes in practice is working project-oriented with current societal problems.

The basic characteristics of the PBL mindset are:

- Real-life problems
- A constructivist approach
- Interaction between theory and practice
- Self-directed leadership
- Ongoing reflections (Holgaard & Kolmos, 2021)

The main characteristics of PBL can be summarized in several principles, as shown in Table 1.

Problem orientation	Students work with authentic, complex problems – theoretical or practical
Project organization	Students independently plan, carry out, lead, and communicate about a project process
Experience learning	Students integrate their own experiences and interests
Student-directed learning	Students have the leading role and ownership of the learning process
Team-based collaboration and social learning	Students collaborate to solve problems in an interpersonal way learning from each other
Interdisciplinary learning	Students deal with complex problems and thus need to apply interdisciplinary studies
Exemplary practice	Students can transfer the learning outcome to other situations, including transferring theoretical knowledge to practice

Table 1. PBL principles in short (Barge, 2010; Kolmos, Fink and Krogh, 2006; Kolmos et al., 2008).

The PBL principles also constitute some of the main advantages, and competencies students will gain when working with PBL during their studies. When engaging with students in different concrete teaching activities, there will be different emphasis on the principles. When choosing and planning teaching activities with students in a PBL setting, it will always be an essential consideration to choose activities that emphasize the desired learning in terms of both learning objectives and the learning process. For example, when engaging in project-oriented work, students are given responsibility and tools that facilitate a process enabling them to work in a student-directed manner and organize projects. When working problem based, the teaching should constitute a good mix of activities that will include one or more PBL principles.

The PBL principles also coincide with some general principles for teaching environmental impact assessment by Morrison-Saunders and Pope (2021). Compared to the general principles put forward, a PBL approach could notably support the following:

- Integrating the theory and practice of EA
- Positioning EA as an interdisciplinary process
- Facilitating co-learning and self-learning
- Fostering collaboration and teamwork skills as well as project management and coordination skills

Throughout part II and part III of this sourcebook, the PBL principles will be used in each teaching example to highlight PBL principles connected to each learning activity. For instance, when introducing interdisciplinary SEA workshops, PBL principles like interdisciplinary learning, problem orientation, and exemplary practice are considered the main PBL learning principles indicating expected learning outcomes.

Working with problems

Problems are not randomly picked but are carefully chosen, reflected upon, and adjusted during the learning process. When students or teachers choose a problem to explore in problem-based learning, it is key to consider ongoing work on defining the problem. In PBL, a problem is defined as an unsatisfied situation where there is the possibility of improvement and where consequences of the future outcomes are unknown (Holgaard et al. 2000). When choosing a problem, this will guide the problem definition ensuring that the problem does reflect an unsatisfied situation with the possibility for improvement. For instance, if SEA does not support sustainable planning, this would be an unsatisfied situation to investigate with possibilities of improvements. In the literature, it is also recognized that working systematically with problems related to real-life situations adds students' motivation and sociability to the learning process (Holgaard et al. 2017).

Taking the first step into the process of defining problems entails asking questions like; what is the problem? Why is this a problem? To whom is this a problem? Where is this a problem? When is this a problem? And how are we going to address the problem? To facilitate this process of problem definition, a figure like the one below (Figure 2) can initiate a structured brainstorming process going deeper into the problem, understanding the complexity of the problem, and being able to delimit oneself to the most important and urgent part of the problem (Holgaard et al., 2017; Holgaard and Kolmos, 2021).

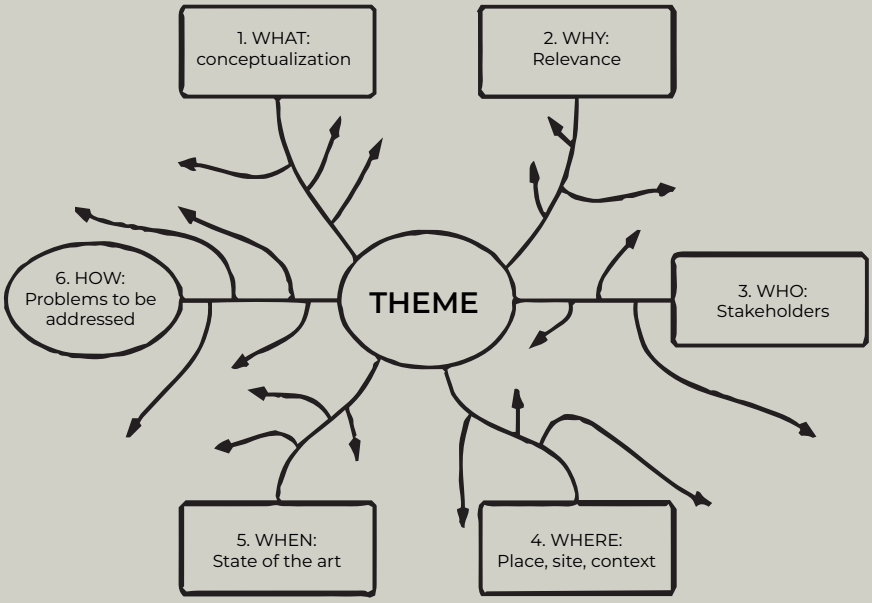


Figure 2. Mapping the problem (Holgaard et al., 2017: 1079).

Mapping the problem is an important and useful tool in PBL when working with semester projects, mini-projects, or cases in teaching. It is used to enable the students to define their problem (steps 1-5) and afterwards reflect upon how to examine the problem and with what methods (step 6) (Holgaard et al., 2017).

Problems and overall environmental challenges can be addressed and worked with in courses or project work. Usually, one will choose to work with more closed problems when working with problems in courses. For instance, when including a case about the difficulties of involving citizens in the SEA of water planning in teaching, the teacher has defined the problem beforehand, and the arena for defining the problem together with students is thus limited. As Figure 3 shows, the problem is more teacher-directed and closed in this situation because students are not invited

to define the problem with the teacher. As examples will show later in this sourcebook, the teacher can also choose to expand the possibilities for working with more open problems defined by students in courses.

When working with projects as part of a course, one will balance closed and open problems as the problems need to be related to the course's learning objectives. When having project work as a formal requirement in parallel with courses during a semester, students can work with more open problems and use resources to de-

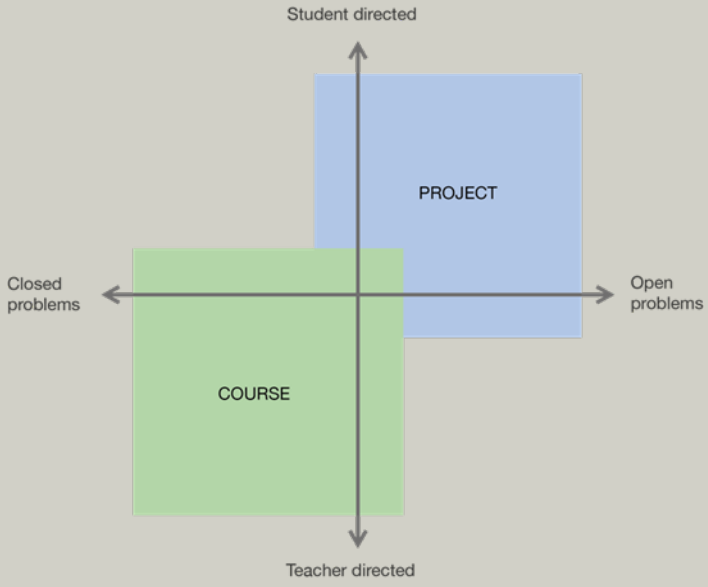


Figure 3. Variations in problems (Redrawing of the figure by Holgaard and Kolmos, 2019).

fine and explore the problems. In this latter process, the problem-based learning process is formed and directed by students, thereby being student-directed, facilitating both students' responsibility and ownership of the learning process.

In the process of choosing how open or closed the problem shall be it is important to consider that it takes time and resources to define a problem. Thus, the framework should be aligned with the time and resources available to the students. In this sense, it is 'quicker' to present the students with a closed problem and make them solve it. However, it should not be ignored that defining the problem builds a crucial competence to analyse a situation and find the key problem to solve; thus, value is added when focusing time and resources on this.

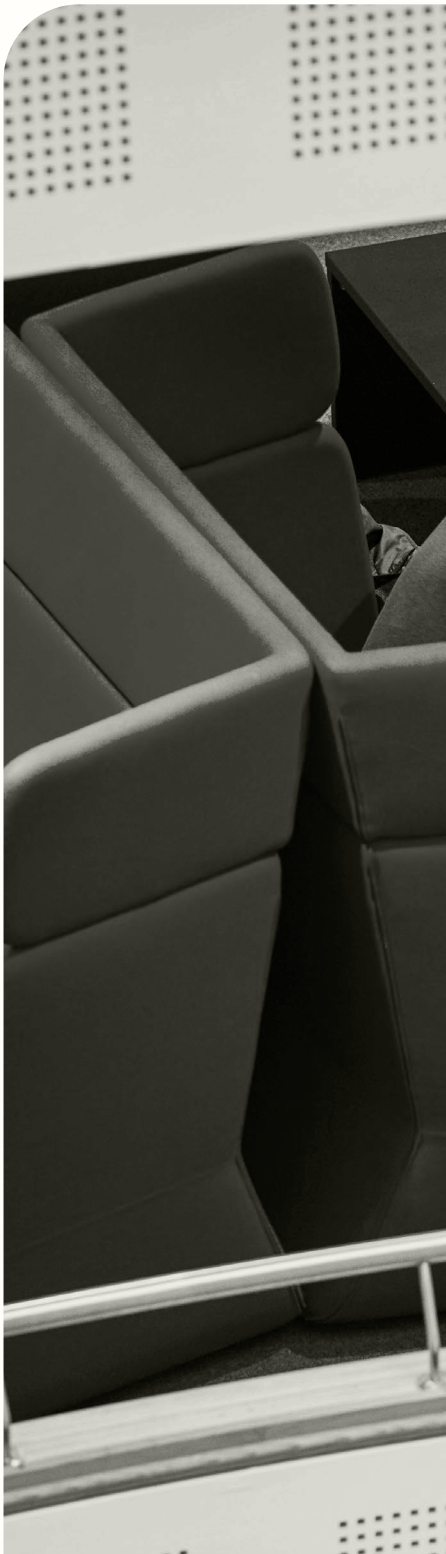
Spectrum of PBL-integration

In principle, PBL can be incorporated into any teaching or learning situation. PBL can be used across a whole institution, an educational program, or a semester and PBL can be used in a particular part of a program (e.g., in a specific course).

Implementing a PBL approach is not done overnight. When integrating PBL approaches into the curricula, there are some overall considerations. It needs to be considered what status PBL shall have in the curricula. There are three strategies for integrating PBL into curricula:

1. ”An add-on and course strategy change to more active learning within the existing courses”.
2. “An integration strategy consisting of a merger of existing courses and integration of skills and competencies like project management and collaboration”.
3. “A re-building strategy which involves re-thinking the role of the university in society and re-thinking the curriculum towards much more flexibility” (Kolmos, 2017, p. 6).

The first strategy can be implemented in any course by prioritizing central elements from problem-based learning. The advantages are that this can be done by individual teachers or teaching teams changing the learning environment individually without significant organizational restructuring. In comparison, the second or third strategy will require more effort on the institutional level coordinating the problem-based learning elements on the system level and involving a wide selection of disciplines. The advantages are that, in this case, there will be support from the institutional level, and thus the change will be more comprehensive.



PART 1.

PBL IMPLEMENTATION THROUGH PROJECT WORK

Introduction

Students engaging in project work is one of the key activities when implementing PBL in teaching SEA. In project work, the students define a problem using the abovementioned approaches and solve it using and training their academic skills.

The following chapters will introduce the different ways of working with projects. At AAU, the project work is institutionalized, meaning that students work with projects is connected to a separate curriculum during each semester. Project work can also be initiated within courses, across courses, or through interdisciplinary projects. In this more practical part of the sourcebook, variations of project work and different PBL activities developed to support the project work will be brought forward for inspiration.

Project work as individual semester projects (15–20 ECTS)

At Aalborg University, the semester project is a central element of the learning process. A typical example of implementing problem-based learning into curricula will, among others, include a demand of 15 ECTS for project work during a semester supported by three courses (each 5 ECTS).

The semester project is initiated at the beginning of a semester, and the students work on their projects during the whole semester concurrently with courses. The students have approximately 4 months to complete a semester project. Group sizes can vary. In the programs at Aalborg University in which SEA is taught, the recommended maximum group sizes are:

- Bachelor level: 1st year, seven students per group; 2nd and 3rd year, five or six students per group

- Master level: 1st year, six students per group; 2nd year, three students per group.

Larger groups have the advantage of having more resources regarding working hours and knowledge. However, they also tend to spend more time on discussions and coordination of their work than in smaller groups. The size of groups can also be affected by the resources available for supervision, as fewer larger groups release more resources for supervision for each group depending on how resources are allocated. The outcome of a semester project is typically a written report, which is handed in towards the end of the semester. The report is between 60 and 80 pages. The semester project typically contains a problem analysis outlining the relevance of the chosen problem, a problem formulation, a methodological and a theoretical framework, an analysis, a discussion, and a conclusion presenting the results.

Furthermore, the students are expected to meet the expectations of the semester's learning objectives (Dahl, 2017). Examples of learning objectives for a project module related to the curriculum for the bachelor's program in Environmental Management and Sustainability Science, in which SEA is being taught, are presented in Annex 1.

Examples of semester projects

The semester project is an excellent opportunity for the student to collaborate with various stakeholders. These projects with external collaboration can be projects where students study processes in practice, as outlined in example 2 below, or projects where students take a more active role, for instance, by participating in or facilitating processes in practice, as outlined in example 1 below. This kind of project work would be supported by the elements in part III, where stakeholders are involved in implementing PBL.

Example 1: Master Thesis at the program Environmental Management and Sustainability Science, Aalborg University

Title: Thinking the Sustainable Development Goals into EA through innovative Applications
Completed: February – June 2022
A project group of two students

The problem addressed the need to integrate the UN sustainable development goals (SDGs) into Environmental Assessment (EA) to improve sustainable effectiveness. It is argued that for this development to happen, concrete tools are needed that can strengthen EA consultants' role and knowledge, as well as the motivation of both consultants and stakeholders to promote the opportunity to influence the formal and informal decisions taken.

To solve this problem, the project group develops a tool to strengthen the role of promoting substantive objectives and sustainability goals in EA. For this purpose, a design thinking approach is taken, where design criteria are established, which guide the development of the tool. The tool is further developed through case testing. The basis of the tool development is literature reviews and theory concerning, e.g., the role of consultants in promoting sustainable development, substantive effectiveness of EA and integration of the SDGs in EA. The project group worked with different stakeholders during the process. They have interviewed consultants and major proponents to understand how they work with sustainability, and they have worked loosely with EA consultants, who have participated in evaluating and testing the tool during development.

A result is a tool which can a) elaborate on the EA consultant's role to mobilize substantive objectives, b) utilize SDGs to influence the design of activities through the development of more substantively oriented alternatives, and c) communicate sustainable modification to activities to stakeholders.

Example 2: Master Thesis at the program Environmental Management and Sustainability Science, Aalborg University

Title: Environmental Assessment of GHG Emission Impacts - a study of current practice and potentials for including life cycle thinking
Period: February - June 2022
A project group of three students

The project addressed the potential for improving the Danish practice of assessing GHG emissions in environmental assessments by applying life cycle thinking (LCT).

Recent research emphasized a need for a more systematic and thorough assessment of greenhouse gas, and LCT in guidance documents is suggested as a potential contribution to GHG emission assessment.

To examine the problem, the project group first examined how GHG emissions are assessed in the current Danish EA practice. This is done through a text analysis of a 102 EA report, which showed that very few reports included Life cycle thinking in the assessment. Secondly, a survey with EA practitioners showed that knowledge and experiences regarding LCA application might be challenging.

The result points out that LCT contributes to getting a comprehensive understanding of the system, reducing the risk of overlooking potentially relevant activities. Also, results show that LCT contributes to a more well-founded and accurate determination of significance.

Project work as smaller individual projects (5 ECTS)

In the first semester of the bachelor's and master's program at Aalborg University, students will do a shorter project at the beginning of the semester. This short 5 ECTS project is an opportunity to practice the semester project form before working with the usual 15–30 ECTS semester projects. Thus, this 5 ECTS project is similar to the semester project, but the timeframe, output, and expectations are lower than with a semester project.
The timeframe of the 5 ECTS project is approximately a month, where the student, concurrently with three courses, works on their project.

The 5 ECTS project is done in groups of four to six students, and each group will be assigned a supervisor to help guide the group work.

The output is a report of approximately 20 pages which the students will present in an oral presentation to their supervisor, an internal censor, and one or two students opponent groups.

Project work in courses through mini projects

One way of organizing project work can be to have a smaller project that is part of a course. The weight of the mini-project can vary among courses. Students can work with a project during 1-2 lectures, or the project can have a more central role taking up half of the course and being the basis of the course examination. These mini-projects can be integrated into a single course or implemented across courses and semester projects, as seen in the model in Figure 4.

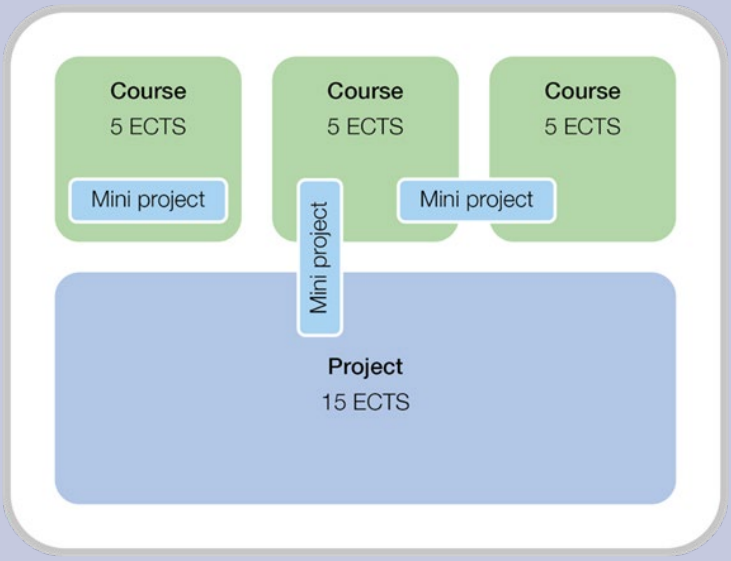


Figure 4. Integration of mini projects in courses

Most often, the theme of the projects will be directed by the teacher, ensuring the course's learning objectives will be achievable within the framework. Thus, the problem will be somewhat delimited. Working with more closed problems is also related to how much time is allocated in the course for the project, as a very open problem takes more time to define, cf. section 2.3.

The preparation for including project work in courses varies but will typically include the following:

- Finding relevant problems related to SEA (see section 2.3).
- Dividing students into groups (see section 3.1).
- Supporting the group work with supervision (see section 3.2).
- Presentation or examination of the project work.

Examples of mini project

There are many ways to work with and incorporate mini-projects as part of teaching and/or learning at the course level. In the following, we give a few specific examples to illustrate.

Example 1: Analysing an area

This mini project is part of a 5 ECTS course in spatial planning and planning theory. The mini project is the last activity in the course and aims to let the students put their knowledge from the course into action in a real-life case. In the model in Figure 4, this is another example of a variation in the upper left corner.

The mini-project is a two-day workshop revolving around developing a particular geographical area. Thus, a well-defined local area has been chosen for this workshop. An example could be an area which faces a significant change with the construction of a new small neighbourhood, and the development of this area has been the subject of much criticism and created a debate about gentrification etc.

Before the workshop, the class is given a list of literature that everyone is expected to read through to get a general understanding of the case in advance. Furthermore, the class is divided into seven groups, and each group is given an assignment before the workshop, which must be presented on the first day. Examples of tasks are:

- *One group is expected to present a stakeholder analysis in which they present the most central stakeholders based on newspaper articles,*
- *One group is expected to present how the cultural environment and nature are included in the debate about urban development in the area,*
- *One group is expected to present how the municipality has been involved in the process and present their involvement in a timeline,*
- *One group is expected to present the central arguments in favour of the development of the area, and*
- *One group must present the central arguments against the area's development.*

On the first day of the workshop, the groups present the results of their assignment to each other. This way, all the presentations feed into a common understanding of the case. Furthermore, the developer in charge will present the new urban development.

During the second day of the workshop, the students:

- *go on an excursion to the area with a local guide, and*
- *plan and carry out interviews with a minimum of five local citizens,*

Lastly, on the second day of the workshop, the students - based on all the information - are asked to make a spatial analysis, mapping the structures in the area (e.g., the green structure, the building structure, the transport structure) and compare the different viewpoints they have been presented with during the workshop.

The exam for the course is a written exam with questions related to the case and connecting the case with the rest of the course curriculum. In addition, the students must formulate an exam question themselves and answer it as part of the exam.

Example 2: Role play in a mini project

This mini project is part of a 5 ECTS course where the theory of science and planning theory is linked to planning practice. In this example, the mini project is placed in the middle of the course and aims to allow students to train to bring their professionalism into play across disciplines and sectors, organize as a team and utilize each other's strong competencies. In the model in Figure 4, this is the variation in the upper left corner.

The mini project is built as a 2-day workshop inspired by role play. This is facilitated in the following way. The class is divided into three teams, one focusing on environmental, urban, and energy issues, respectively. From the standpoint of these three foci, the teams must work together to solve a planning case. For example, the case could be to find locations for geothermal facilities in a municipality, where locations must consider both an environmental, urban, and energy viewpoint and legislation. The students have been asked in advance to familiarize themselves with the case. For this, they have been given a few sources but are also expected to spend time finding knowledge about the case themselves.

The process is intended to mimic a planning process in an authority where different professional teams are part of a planning process. On the workshop day, each team must organize themselves and choose a team leader and a spokesperson. In addition, each team is assigned a faculty member as a sparring partner with knowledge relevant to their focus. This person thus acts as a consultant in the role play. During the workshop, the teams have meetings with their consultants. The teams must agree on how often and when these meetings should occur.

On the first day of the workshop, the teams have the task of establishing a joint list of criteria for locations of the geothermal facilities – criteria that match their focus. For example:

- *The environmental team might want criteria that avoid areas where the facility might endanger groundwater resources.*
- *The urban group might want criteria that do not interfere with plans and wishes for future urban development.*
- *The energy group might want criteria that allow for enough energy to be produced.*

First, the teams are given time to work independently to develop their criteria suggestions. Here they can meet with their consultant. After that, the groups meet and negotiate their criteria; where there are conflicting criteria, they must decide on what gets included in the list. Each group sticks to their character and defends its criteria and interest. In the negotiations, the team leaders and spokespersons are responsible for leading discussions. At the end of the first day, they must agree on a joint list of criteria for choosing locations for the geothermal facilities.

On the second day of the workshop, the three teams are tasked with finding appropriate locations that live up to their established criteria. Again, the team first work separately to create locations that match the criteria before meeting the other teams to negotiate a joint set of locations. During the last part of day two, the spokespersons must prepare a joint presentation of their results.

At the end of the second day, the teams will jointly present their process and suggestions to a planner related to the case, in this example from the municipality, who will listen and give feedback on the presentation. At the end of the workshop, the students must hand in a joint list of criteria and locations, including their arguments for the choices they have made.

Example 3: Analysing a socio-technical context

This mini project is part of a 5 ECTS course on different approaches to the socio-technical context of planning. The mini project is placed at the end of the course and aims to facilitate a direct input that can be used in the larger semester project (15 ECTS) that the students are also working on. The model in Figure 4 shows the variation in the middle of the upper part.

The mini-project takes the form of two sessions. In the first session, the lecturer gives a presentation of some of the main theories of how change happens in society, also linking to the previous lectures in the course. Based on this, students are asked to work in their project group, discussing how they see the process of creating change related to the topic or case they are working on within their semester project. The groups work based on discussion questions such as:

- *How do you understand 'change' in your project?*
- *Which barriers to implementing change can you identify in the 're-gime'? Which 'niches' are there in your case? Can you identify possible and/or needed niches to support change? Which specific pressures in the 'landscape' can you see as influencing the 'regime'?*
- *In which way can (or can't) the theories presented in the course ex-plain the problem(s) identified in your semester project?*
- *How can co-production and planning be implemented in your semes-ter project to act as a change agent?*

Based on the discussions, each group will prepare a presentation of their ideas, which they will present to students and lecturers at the last session of the course. Here they will get feedback from those present for their ideas that can be used in their semester projects.

An example of a mini project between two courses could be a semester focusing on energy planning and systems. Here, there could be a course on energy technology and energy system analysis as well as a course on impact assessment. A joint mini project could be focused on students preparing an energy plan for an area, using their knowledge and tools from the courses to analyse the current energy system, assessing the impacts of the system and possible changes, and using this to plan an energy system.

From mini to megaprojects

As a relatively new initiative, Aalborg University has started a process where students are encouraged to work interdisciplinary with megaprojects. A megaproject consists of several students' subprojects from various disciplines clustered around major sustainability problems and societal challenges (Winther et al. 2020), as illustrated by the SDGs in Figure 5.

The overall purpose of introducing megaprojects at Aalborg University is to emphasize interdisciplinarity across the entire university and develop a learning environment where students can work to solve big societal problems about sustainability.

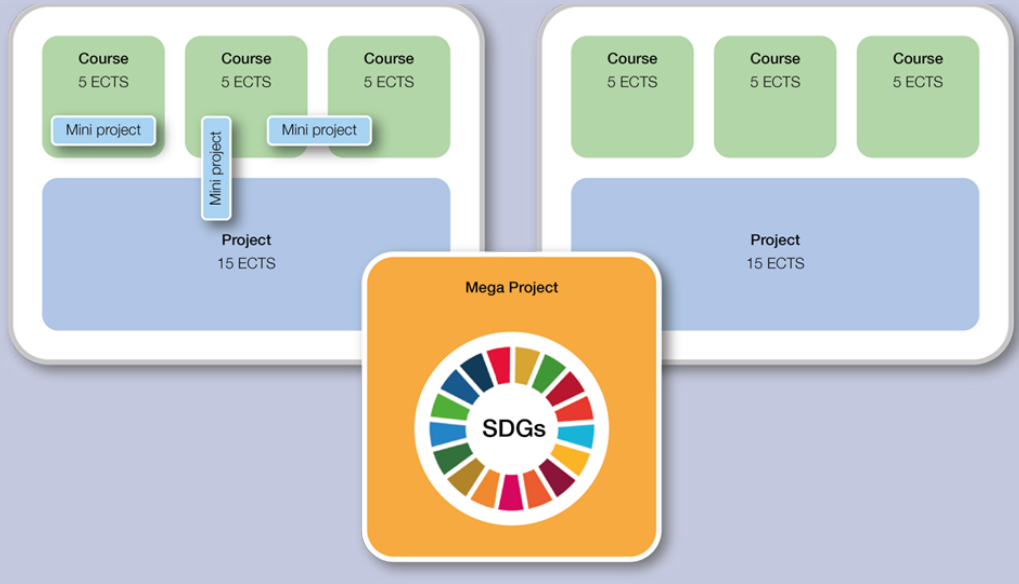


Figure 5. Mega-projects supporting interdisciplinarity across departments and educational programs , example of including the Sustainable Development Goals (UN 2015) across educations.

Megaprojects are extracurricular initiatives and differ from ordinary projects at Aalborg University as they include students from different programs or faculties, resulting in broader interdisciplinarity. This provides the students with experiences in collaborating across disciplines during their studies.

The topics of the megaprojects all relate to sustainable development goals, and examples of overall themes which students have been able to join are: Simplifying Sustainable Living, The Circular Region, and Better Together.

For inspiration, please see: www.megaprojects.aau.dk


PARKES
WATER PUMP
GATE
GREENMAN P

Activities to support project work

Project work can, as shown above, be implemented to different extents during a semester, considering the institutional setup. Supporting students' progress and learning process with different activities during the project work is important for students working with projects throughout a semester and with projects related to courses.

This section will outline central supportive PBL tools and approaches to show how the more practical project work is supported through group formation, collaboration in project work, supervision, and the exam.

Group formation

Starting up any group-based project work will begin with a group formation. The group formation process is essential to the PBL work form (Bundgaard et al., 2021). When forming groups, several factors must be considered before choosing which method to use. What is the length of the project work? What are the teacher's resources? Do the students know each other? Does the process include partners from practice?

Bundgaard et al. (2021) have outlined nine dimensions of group formation processes. The most central to consider are outlined in the following:

- Duration: how long is the period from the beginning of the group formation coordination until the conclusion of the group formation?
- Subject focus: Is the general theme of group formation defined by the coordinator or the study regulation? (For example: Does the learning objective guide a certain focus, for instance, public participation in SEA?) Based on the general theme, the groups will have to identify the problem(s) and agree on a problem they want to explore.
- Relational focus: How are the social dynamics among the students and other reflections concerning, e.g., their skills, strengths and weaknesses in a group collaboration? Are there, for instance, group constellations to be avoided due to earlier experiences with group work or personal issues?
- Physical frames: Where should the group formation process physically be located?
- The number of students: How many students does the group formation process involve?

- Group size: How many students should be in a group? (Often between three and seven depending on, e.g., time available and funds allocated for supervising hours)
- Diversity in students: What are the characteristics of the group of students? Are they a homogeneous or heterogeneous cohort?

See Bundgaard et al. (2021) for a more thorough description.

The primary purpose of the group formation process is to group students to work closely together for a longer period. Simultaneously the group formation process often facilitates a process where relevant topics for the project work will be developed and reflected upon, which starts the process of defining the problem. The group formation process will thus be different depending on how open or closed the problem definition is beforehand cf. section 2.3. Another issue that defines the group formation process is to what extent teachers or students organizes the process. One way of viewing the difference between models is presented in Figure 6.

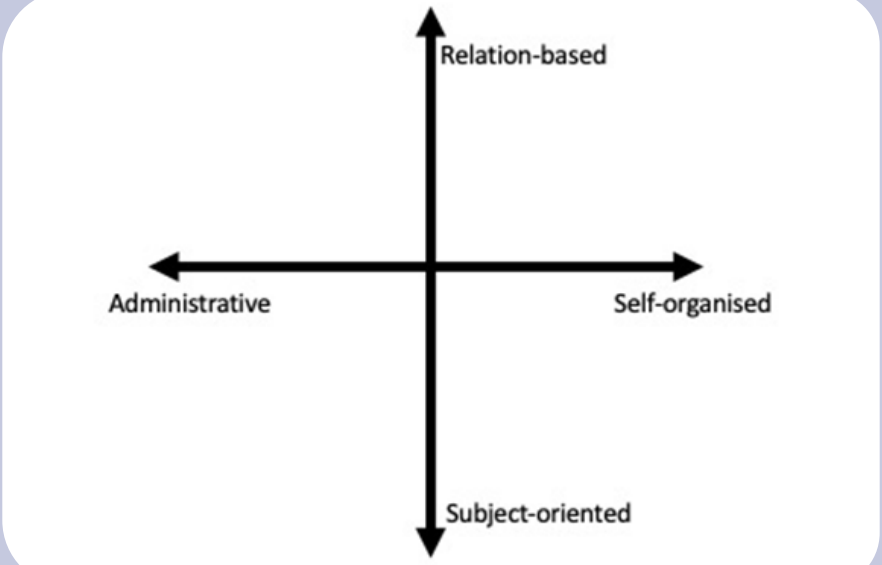


Figure 6. Four models of group formation.

As illustrated in Figure 6, a group formation can be placed on a scale between being self-organised by students and being carried out by the administration and on a scale between being based on relations between students and being based on subjects and interests from the students. The endpoints of the scales are presented in Table 2.

Type of group formation	Approaches and purpose (PBL)	Time required
A. The administrative model	The teacher or the administrative personnel organizes the group formation. Students are divided into random groups or guided by issues like balancing gender, age, nationality, the field of study etc. The purpose of choosing this approach can be a pedagogical argument for establishing groups focusing on a specific grouping of students. For example, to encourage students to work in a specific mix of disciplines or with new fellow students. Also, there can be arguments like lack of time and limited resources when choosing a group formed and managed by teachers or administration.	1-5 hours
B. Self-organising model	The students are in charge of the group formation. The group formation can take place using different methods (see the example in the box below). This approach will typically only be feasible if the students, to a certain extent, know each other beforehand and if they have experience with group formation processes and can thus take the initiative and steer the process themselves. The teacher will guide the framework for the group formation (e.g., the number of groups that should be formed), providing space for the group formation to take place and possibly setting the overall theme (e.g., Strategic Environmental Assessment, Land-use planning). Also, there is always a risk that the process will run into difficulties, and the teachers will have to get involved to support the students.	1-14 days

Relating the examples below to Figure 6 and Table 2, example 1 is a subject-centred model, which is predominantly self-organised as the students take charge of the process but are supported by the teacher throughout. Example 2 is subject-

Type of group formation	Approaches and purpose (PBL)	Time required
C. The relation-based model	In this model, group formation is based on relations over the subject. Here, is it relevant to explore students' identity (e.g., defining who you are and what role you normally take in group work) and motivation (e.g., which elements are important to me when I work in groups?) and let this be the basis for creating groups with a good mix. This model can be feasible and relevant when students come from different backgrounds and disciplines (e.g., educational background, work experience, age, motivation, geography, and family) and there is a wish to form mixed groups.	1-14 days
D. The subject-centred model	In this model, group formation is based on the subject of relations. Here, brainstorming, initial research and exchange of ideas are key elements so that students can form ideas for projects. This can be done in many ways, as shown in the examples below. Based on the ideas and interests of the students, the groups are formed around separate subjects. Before beginning this process, it is important to highlight to the students that this process should focus on the academic and not the relational aspects.	6-8 hours

Table 2. Different approaches to forming project groups (C and D inspired by Bundgaard et al. 2021).

centred but is predominantly administrative, as projects are suggested by staff, and the process is steered more by the teacher. Example 3 is a relation-based model, predominantly administrative, as the teacher forms the groups with input from students.

Specific methods for group formation in process types B and C

Example 1: In plenary, a forum is established where all students can produce ideas for a problem to investigate based on an introduction to the framework for the project (resources, topic etc.). All ideas are written in a visible spot in the classroom. At this stage, there might be 25 relevant project proposals. To limit the number of project proposals, students are encouraged to give three votes to prioritize the project proposals they want to work with. After this session, the students are encouraged to discuss the remaining project proposals in groups. The group discussion is supplemented with a sum-up session in plenary to ensure visibility, openness, and progress among students and teachers. After these sessions, students themselves have defined relevant topics to work on. There is one rule of thumb for such a process; the group formation is not finalized until everyone is in a project group. One of the purposes of having an open group formation process is that when students explore and define their project topic, it enhances ownership, responsibility, and engagement in their work.

Example 2: Teachers, external lecturers, or relevant stakeholders (e.g., alumni working in government, consultancies, and municipalities) are invited to propose project ideas related to the topic. The teacher initiates, and invites proposals, coordinates a procedure for the presentation of the project proposals and the following group formation, and coordinates and supports the process with students. The project proposals should leave some opportunities for the students to map the problem themselves and, through methodological and analytical work, come up with ideas or recommendations for how to solve the problem.

Example 3: The teacher sends a questionnaire to students asking them to characterise themselves as group members and describe their motivation and level of ambition. Based on the answers from students, the teacher matches them into groups with a good mix of students who will take different roles, are motivated by some of the same things, and have a similar level of ambition.

Supervision

Another essential means to support the project work in semester projects or projects related to courses is supervision. Supervision is about equipping "the students to take control of their own learning" (Kolmos et al. 2008, p. 17) instead of telling the students what they should learn and in what order they should learn it. The supervisor's role is to support the students independently, determining what they need to know and how they can best obtain this knowledge (Kolmos et al., 2008).

During regular meetings with the group, the supervisor acts as a facilitator for the project work (Dahl, 2017). The supervisor has professional knowledge of the topic the students are working with and can support their investigation of the problem and their learning process. The supervisor is not a teacher in the sense of providing data or answers. The supervisor asks reflexive and critical questions and interacts as a discussion partner with inspiration and professional support (Holgaard et al., 2020). Open questions are often asked to inspire the students to think for themselves, especially in the beginning. Supervisors can even ask questions that he or she does not know the answer to but would help the students be reflective, open-minded, and critical.

Students are responsible for managing their cooperation with the supervisor during the supervision process. Students are responsible for scheduling meetings with the supervisor, sending an agenda and materials beforehand, and taking minutes from the meeting. The supervisor attends the meeting prepared, considers if the agenda should be extended, and gives the students the responsibility of managing the meeting. At the beginning of a project, the supervisor's role will often be to ask questions like; why is this a problem? Moreover, to whom is it a problem? (cf. Figure 2). Later in the process, the supervisor will go into the more professional context-specific discussions, give concrete feedback on the written material, and finally discuss and guide the project group in what directions to take when finishing the project.

The supervisor is also responsible for supporting the collaborations among the students and helping them navigate their differences. Although students are encouraged to align expectations for their group work and performance initially, differences and conflicts among students are unavoidable. The conflicts may not be visible to the supervisor or group members, as a large part of conflicts often are tacit (see also section 5.3 on collaboration). Suppose the group manages to bring relevant conflicts to the surface and productively discuss them. In that case, this will support both new learning and the development of personal and collective conflict management skills. In time, if they become very skilled at this process and start to appreciate not only their learning but also the learning of others, they are moving towards becoming high-performing teams (Bøgelund and Nørgaard, 2020). The supervisor is responsible for supporting the individuals and groups to develop these skills and helping them experience that "conflict and differences are a good thing and something that brings them along in a learning process" (Bøgelund and Nørgaard, 2020:1847).

The resources used for supervision differ depending on the task and the number of students. The resources should cover everything, including preparing for and participating in supervisor meetings and seminars and arranging and participating in the exam.

Collaboration in project work

Collaborating on projects can be both a challenging and an educational experience. To ensure that students have the best conditions for collaboration, the process is supported by different initiatives.

During the first semesters at Aalborg University, students are introduced to the importance of aligning their expectations for the project and their collaboration (Holgaard et al., 2020). Students are to work very closely together for a 1–5-month period, and discussing the many interests and expectations among group members at the beginning of the process will make the project smoother and the group better prepared when disagreements or conflicts occur. Examples of issues that can be discussed are ambition, preferred working methods, preferred working hours, and special needs. Students are encouraged to document their alignment of expectations in a written collaboration agreement, re-align expectations, and revise the document during the project period (Kolmos et al. 2008). Below, you can find an example of a collaboration agreement made among students.

Example of a group collaboration agreement

Meeting times:

- *We meet from 8.15 am to 4.15 pm for group work.*
- *On days when we have courses from 8.15 am to 4.15 pm, we will not meet for group work.*
- *We will all participate in the Problem-Based Learning course and the course in Planning, but the group doesn't need to participate in the mathematics course, as this does not relate to the project work in the group.*
- *As far as possible, keep the weekends free.*

Report:

- *We write in google docs.*
- *It is okay to work from home, but we will also have meetings in the group room.*
- *All discussions regarding deadlines must always occur face to face and not on "social media".*

Group work:

- *An agenda is created - for each day and each week.*
- *Joint meetings every morning and afternoon.*
- *A log book is written for each day - if a member has been absent, he or she must check the log book.*
- *Fixed roles and tasks among group members - these change every week.*
- *Evaluations of the project's progress every month.*

Communication:

- *Respect and honesty.*
- *Receive and give constructive criticism - be good at receiving and formulating this.*
- *Google Calendar is used.*
- *Communicate with the other group members - in the Facebook group, for instance, if you are late.*

Social:

- *Every morning, everyone tells how they are feeling.*
- *Many social activities - shared breakfast, dinner, and field observations.*

Agreements are held:

- *Deadlines and agreements in the group are met. If not, the following measures have been agreed upon:*
- *You bring cake the next day if you arrive late.*
- *If the deadlines are exceeded repeatedly concerning the project writing, this will be discussed with a single group member, and if this does not work, it will be discussed in the plenary.*
- *If none of the above works, contact the supervisor. It must always be discussed face to face.*

The group's goals and vision:

- *Everyone does their best - we strive to write the best possible project within the agreed meeting time.*

Aligning expectations not only relates to the collaboration among students but also the collaboration between the students and the supervisor. At the beginning of the collaboration, a discussion about the role of the supervisor, students, and supervisors' expectations of the process can help facilitate mutual understanding of what to expect from each other. This alignment or collaboration agreement can also be summarized in a written document (Holgaard et al., 2020).

In a group of four to six people, the members will have different strengths and weaknesses. It can be important for each group member to be aware of their own and the other group member's strengths and weaknesses to ease the collaboration in the group. The team roles are described in Kolmos et al. (2008, p. 47-49) and includes team roles like 'specialist', 'completer', and coordinator. Awareness of the group's collected strengths and weaknesses will also expose which roles are not represented in the group.

As student and supervisor, it is relevant to know the most common phases a project group experiences when working together during longer semester projects. Lennéer-Axelson and Thylefors (1993) have described five phases:

1. The initial phase is characterized by uncertainty, vague norms, and roles and some power struggles.
2. Honeymoon phase with "nice" communication, unity, generosity, and idealization.
3. Integration phase with crystallization of roles, creation of subgroups, deeper communication, and a "we"-feeling.
4. The phase of conflicts where the power must be divided, alliances created, and where there is a need for management.
5. Maturity is the last phase where teams hopefully will reach clear goals and roles, mutual respect, clear communication of facts and feelings, constructive criticism and consensus" (Kolmos et al. 2008, p. 26).

Knowing which phase the group is going through will support the collaboration. For example, realizing that you are on your way to establishing group norms that ultimately will create a sense of coherence and it is just a phase can take away some of the heat of the discussions.

As stated previously, conflicts can occur in group work and have a stimulating and productive effect on project groups. If conflicts are suppressed or ignored, they can develop into a destructive threat to the group and, thus, their project work. Conflict in group work often arises concerning differences of opinion concerning methods, procedures, resources, or the actual direction of the project. One way to address the project group's conflicts is to regularly revisit the collaboration agreement. A review of the collaboration agreement is an opportunity to talk about issues related to one of the points agreed upon (e.g., meeting times, communication, the group's goals) and be able to refer to the agreement which was made in the beginning (Holgaard et al. 2021).

Project analysis is a means used to support the project work and support students in reflecting on and learning from the project process. The process analysis is a small report the students prepare during their project work that includes reflections concerning what they have learned, not from the specific topic they have worked on during the project but from engaging with fellow students in the group work. During the first semesters at Aalborg University, the students are presented with various tools to guide their project work. These tools are directed toward the management of projects and towards learning in the project group. The process analysis has been developed to support the students' reflections and learning from planning and carrying out a project by requiring them to reflect upon their learnings. In practice, the students produce a report containing reflections on project planning and management, collaboration in the group, collaboration with the supervisor, individual learning approaches in the group, and recommendations for subsequent projects. This report enables the students to provide structured reflections on their learning and discuss this at the oral exam.

Midterm seminar

A central part of the PBL approach is ongoing evaluations during the project period. This especially accounts for the semester project, which runs over an extended period. When students document their process and their collaboration, they do evaluations related to the process (see 3.4.2.2), but this usually does not include evaluations of how the content of the project is progressing, which learning have come into play, and what new path and inspirations to follow when working with the specific problem. To support such ongoing evaluations, a midterm seminar can be helpful.

At the midterm seminar, the students present their project, ask questions concerning doubts etc., and receive feedback from supervisors and fellow students. This seminar facilitates a learning process where students set aside time to evaluate their project, their choices, and the content of their work, asking questions like: Are we addressing the right problem? Are we on the right track with the project? Is there something we need to change concerning methodologies or theories? Did we miss any important aspects of the problem?

Before the midterm seminar, the group will send a draft of the project and the elements to the supervisor and an opponent group, who will prepare questions and feedback

Project examination

In this section, the framework for the project exam carried out at Aalborg University will be presented as an example for inspiration. See section 13 for input for course exams.

The exam for a semester project at Aalborg University is based on the written project report and is conducted as a group exam. The examination is a seminar with the supervisor as the main examiner and moderator supported by an internal or external examiner. Typically, 30–45 minutes are allocated per student, which means that a group of five to six students will attend a 4–4.5-hour oral group exam.

The project exam at Aalborg University consists of three elements:

1. A joint presentation where each student presents one or more key points in the project and puts them in perspective. Such a presentation would typically include the relevance of the problem, the chosen methods, the theoretical framework, the results etc. The presentation is organized jointly by the group and should be a coherent product, but the individual student has responsibility for the specific part of the presentation. Typically, 6–10 minutes are allocated per student for the presentation.

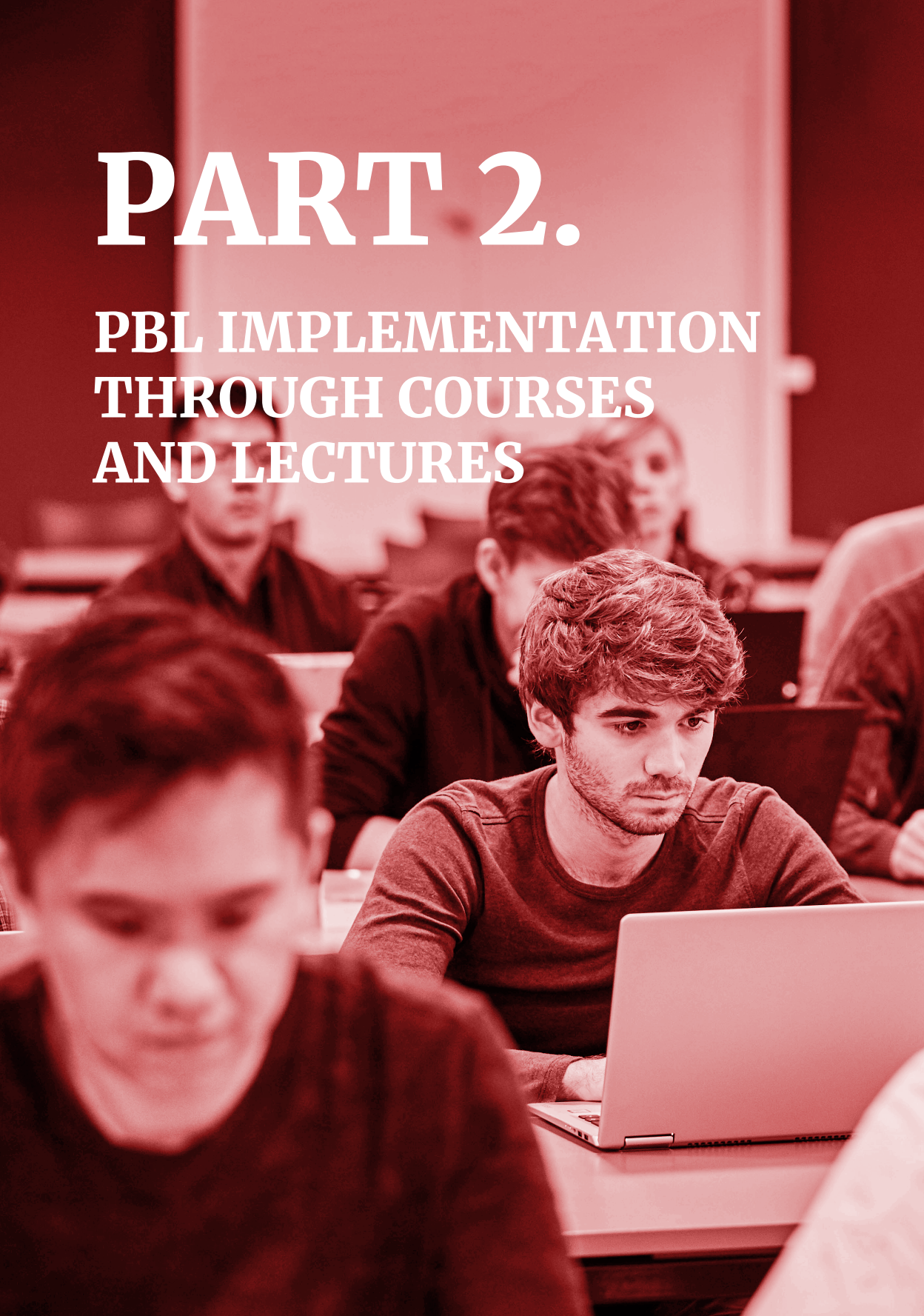
2. One or more joint discussion sessions where the entire group is asked about the problem formulation, the strengths, and limitations of the selected methods, discuss the findings and reflect critically on these, contextualization and the like. The entire group is addressed together, and the examiners evaluate who contributes and how good the contributions are. The questions here can be truly open, i.e., they are not necessarily the type where the examiners know the answers if the oral exam will typically also include questions for individual group members related to the project work (Dahl, 2017). It can also be beneficial to let the questions reflect the learning objectives for the project to ease the next stage (3).
3. The report and the oral examination are assessed and graded based on learning objectives related to students' knowledge, skills, and competencies. The supervisor and examinator grade the students' performance individually based on the content and relevance of the student's answers and their level of activity during the discussions (Dahl, 2017).

The learning objectives will often include PBL skills or competencies, which will thus also have to be examined. In the first year of bachelor programmes at Aalborg University, the students will also have to include a presentation of their group work and be able to reflect on this during the discussions.

Learning goals related to PBL can be directly linked to collaborative PBL project work. Learning goals can also be more indirectly aimed at the competencies PBL should foster, such as identifying and analysing a problem, reflecting on solutions and pointing to a sustainable solution to the problem. Relating to the PBL principles shown in Table 1, learning goals could, for example, reflect the following:

- Problem orientation: Students should be able to identify and analyse a problem.
- Project organization: Students should be able to plan, carry out and communicate a project process.
- Experience learning: Students should be able to reflect on their own experiences and use them
- Student-direction: Students should be able to account for and argue for their choices in directing the project.
- Team-based collaboration: Students should be able to collaborate and function in a team.
- Interdisciplinary learning: Students should be able to work with complex problems and work in an interdisciplinary manner.
- Exemplary practice: Students should be able to apply their theoretical knowledge to practice.

Such learning goals can be examined by turning them into questions for students to answer and reflect on.



PART 2.

PBL IMPLEMENTATION THROUGH COURSES AND LECTURES


LEDEUX

Introduction

Working with PBL in SEA courses and lectures can be done in various ways. Even though lectures are typically teacher-centred and often provide a limited possibility for interaction between the teacher and the students, they still represent a not insignificant part of SEA curricula and have great potential value for the students. Recognizing the value and importance of courses invite students to reflect on and examine the role of lectures in a PBL curriculum. As outlined in Figure 7, SEA-related courses or individual lectures can range from courses based on active participation and learning to courses dominated by one-way communication.

This second part of the sourcebook outlines concrete examples of how we can work with active learning in SEA courses and use PBL elements and principles. Choosing between the different elements in a course will be based on the learning objective(s) the elements aim to facilitate. The chapter does not contain all possible methods for integrating PBL elements into SEA teaching. We are fully aware that there is a rich and varied experience and practice within SEA teaching, so examples are merely meant for illustration and inspiration.

In the following, each example is written as a self-contained description and includes recurring topics: Purpose and learning objective, PBL elements, the time required, materials needed and process guide.

A general and important message to course teachers is "to make the PBL process more explicit and to allow the students to experiment and create their learning system. Otherwise, the utilization of PBL...will not lead to the learning of PBL skills but might remain as tacit knowledge" (Kolmos, Bøgelund and Spliid, 2019, p. 456). Introducing new learning approaches at universities does mean changes. A simple and practical way to start is by setting aside one timeslot a week to engage students with the PBL, for instance, through supervision, project work or student collaboration.

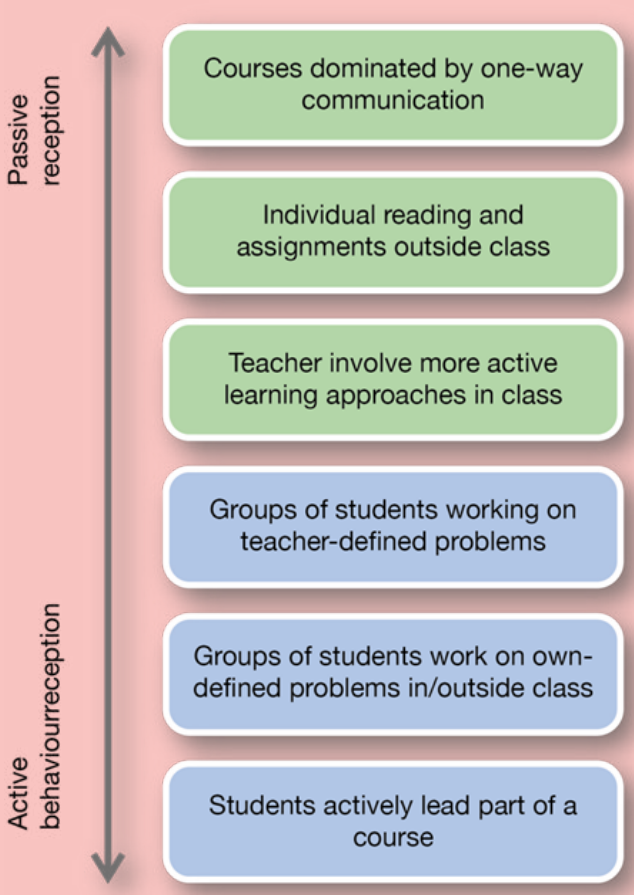


Figure 7. Spectrum of approaches to lectures as part of the PBL curriculum.

SEA competence mapping by students

Students participate in a SEA course with experience and knowledge, which to a lesser or greater degree, relates to SEA. A competency mapping is introduced to get an overview of students' competencies before the course starts and use this in the planning of the course. An example is shown in Figure 8. This competency mapping encourages the students to reflect on their experiences and learn about the SEA curriculum's core elements. Similarly, the teachers get a picture of what competencies and potentials are present among the students.

Purpose and learning objectives.

- To create a reflective room for the students.
- To stimulate self-directed learning.
- To support the teacher in the more detailed planning of a SEA course and inspire them to actively engage with the student's competencies and experiences during the course.

Time required.

The teacher needs time to prepare the content-related questions and set up the survey. It is advised that the students receive the survey 2 weeks before the course starts to secure enough time for the teachers to analyze the results.

Materials needed.

Electronic survey or paper version.

PBL elements

PBL is a student-directed approach to learning, and students are responsible for their learning. The competency mapping process supports the students in becoming aware of their competencies, how they relate to the course content, and which competencies they seek to acquire. This places the student in an active learning process reflecting upon learning and taking ownership of learning. This mapping also supports the experience learning element of PBL, as it provides the teacher with knowledge about students' experiences with SEA, which can be integrated into the learning process during the course.

SEA competence mapping

1. How to you assess your own competencies in relation to Strategic Environmental Assessment (SEA)?

	I have great knowledge and experience from practice	I have great knowledge	I have some knowledge (e.g. attended a course)	I am a novice (knows the basic)	I am a beginner (knows nothing/little)	I do not know
The objectives and roles of SEA	○	○	○	○	○	○
SEA regulation and guidance	○	○	○	○	○	○
Methods for assessing environmental impacts	○	○	○	○	○	○
Decision making processes in which SEA engage	○	○	○	○	○	○
Stakeholder engagement / public participation	○	○	○	○	○	○
The UN/global Sustainable Development Goals (SDGs)	○	○	○	○	○	○

2. What do you want to learn through your participation in the course? (name three learning objectives)

Figure 8. Example of competence mapping (DCEA, 2021).

Continuous case work mixing theory and practice

Learning SEA entails learning the theory and important concepts and how to carry out actual assessment work needed in the different steps of the process. This practice of impact assessment can be difficult to truly familiarise yourself with without practice, so this teaching method is focused on the students practically testing what they have learned in theory working with a continuous case. This learning process can be structured in sessions changing between presentations by the lectures on the various steps in the SEA process and the students in groups carrying out that step on their practical case.

PBL elements

Problem orientation is the main driver in this approach, where students work on a current case of SEA. Through this learning process, students engage in exemplary learning as they are confronted with real-life problems, where they must apply their theoretical knowledge and find solutions. This is an active and student-directed process, where students in a team-based collaboration plan facilitate and take responsibility for their learning.

Purpose and learning objectives.

- To train the students in carrying out SEA in practice transforming the theory, they learn into practice.
- To increase the ability of the students to use concepts correctly.
- To make the students reflect on the process, e.g., on the pros and cons of the SEA process in practice and how to work with these in practice.

Time required.

The activity can be scaled up or down in terms of time, depending on the tasks the students are given, e.g., what parts of the assessment process they should carry out.

Materials needed.

Cases of current SEA need to be identified, and the students need to be able to find material concerning the activity under assessment as well as information about the environmental issues and status at the appropriate level matching the activity. They should have enough material to carry out a meaningful impact assessment, even if only on some environmental factors.

Process guide.

1. Preparation.

- Cases and materials must be identified, and each group must be assigned a case. Depending on the situation, the groups can also work on the same case, or groups can choose a case themselves. However, it is recommended that the teacher identifies the cases that can be chosen to ensure beforehand that sufficient information is available.

2. Teaching sessions.

- In the teaching sessions, the teacher first introduces a step in the SEA process, e.g., scoping, and based on this; the students prepare a scope for their case. Then the teacher presents the next step, e.g., the assessment and the students work on assessing impacts for their case based on their scoping. And so forth.
- The students' work is supported by guidance from the teacher or other professionals.
- The students can present their work in various ways, e.g., in a report or by presenting it to their peers. In any case, feedback is provided by the teacher and possibly peers. The reports or presentations can also have various timing, e.g., they can report back between each step or make a final report at the end.

Physically designing an interactive SEA stakeholder analysis

Stakeholder analysis plays a central role in the SEA process. Often the stakeholder analysis is carried out as a desktop exercise, lining up affected and interested stakeholders in a certain case. This exercise will take the point of departure in students' projects or real-life SEA cases, such as SEA in water management or SEA in infrastructure planning. With the point of departure in these contexts, students will start lining up affected stakeholders in the field, marking, for instance, power relations or other relevant topics. This mapping of stakeholders shall inspire the creation of a physical 3-dimensional design of students' stakeholder analysis creating a learning situation where students engage with their senses. In this process, students physically design their SEA stakeholder analysis using all available materials (cardboard, dough, pens, glue, etc.).

Designing a stakeholder analysis physically in three dimensions facilitates other ways of learning and adds new discussions and learning to the process of understanding the roles and interrelatedness of interest and stakeholders in a SEA process. This exercise can be introduced at the beginning of a course to focus on the many interests and stakeholders in a specific SEA, and during the course, students can re-visit the physically designed stakeholder analysis to elaborate further on the analysis and, for instance, reflect upon how the positions of stakeholders change during a SEA process.

PBL elements

The problem orientation is a main element in this approach to stakeholder analysis. Here, the focus is on students' ability to work with and understand the nuanced picture of how interests, stakeholders and institutional settings are interrelated. Combined with the team-based collaboration and experience learning, the interactive group learning process of physically designing and re-designing the stakeholder analysis throughout a course contributes to understanding the societal context and complexity.

Purpose/learning objectives.

- To work in an active learning process of identifying and analysing interests and stakeholders.
- To get a nuanced understanding of and reflect critically upon relations between institutions, organizations, and civil society.

Time required.

Planning the workshop will take 4-6 hours, depending on the topic and the number of students. The workshop can be carried out in a 2–4-hour session considering a follow-up workshop of 2-4 hours.

Materials needed.

For this kind of workshop, a lot of material can be used: cardboard paper, modelling wax, yarn, markers, post in assorted colours, steel wire, fabric, etc. Consider asking students to bring creative materials to the workshop themselves.

Process guide.

- A short lecture about stakeholder analysis (approx. 30 min.)
- An introduction to the design workshop (approx. 10 min.)
- Students map stakeholders and start creating and forming the physical design of the stakeholder analysis. (approx. 2 hours). Rules: no use of letters or numbers.
- The teacher circulates.
- The students present their physical SEA stakeholder analysis designs, and fellow students give feedback on the content of the analysis.
- After the workshop, the students store the stakeholder analysis design and revisit it to qualify it during the course.

Strategic thinking through gaming

SEA is an environmental assessment instrument where the word strategic makes the difference. For example, SEA can strategically create development conditions that enable a transition to sustainability. Paradoxically, not much attention is often given to this strategic attribute in SEA. Being strategic means that SEA should address the strategic dimension in development decisions (such as in policymaking, planning, programming, and even in major projects development) and that SEA should act strategically concerning the decisions to which it applies. This strategic positioning of SEA means the moments when SEA interacts with decision processes, but also what are the contributions SEA brings in terms of issues, priorities, or even alternative options to be considered. Therefore, learning about SEA requires learning how to think strategically in SEA.

The reasoning behind this approach to teaching strategic thinking is that it is better done using games that require adopting different strategies to resolve a problem. That way, the students become aware of their strategic competencies. Then students should use a current case of SEA to learn the related problems and discuss why those are problems, distinguishing between symptoms and root causes of problems and comparing the issues, and priorities, that relate to symptoms and root causes.

Purpose/learning objectives

- To increase the ability of students to think strategically in SEA.
- To work in an active learning process to identify the strategic dimension in SEA.
- To make the students reflect on why SEA should be used strategically, what it means and how to work in practice.

PBL elements

Problem orientation and exemplary practice are elements of this approach, where students in the second phase work with a specific SEA case and discuss problems related to this. Also, students work in groups and can learn from each other's reflections in a team-based and social learning process.

Time required
First, run a quick game. Students work in groups, and groups use different strategies to resolve a problem for about 30 minutes to 1 hour so that they understand the logic of strategic thinking (get them to discuss their different strategies). Then use a problem tree and, for a 2–4-hour session, run the application to a current SEA case.

Materials needed
Create or collect games that can be quickly used (chess game, mime game, others). Prepare a problem tree in a big A0 or A1 sheet, and colour post-its so that students can work with symptoms and root causes of problems.

Process guide
Set students in groups.

Game:

- Depending on the game, the groups will receive materials (e.g., a chess board). Students can be encouraged to "invent" games by themselves. Groups discuss results at the end of the game (or by the end of the allocated time), comparing strategies.

Problem tree:

- Prepare an example of a problem tree and get groups to prepare their own problem tree.
- Present the current case and get groups to discuss the problems related to that case, using post-its to distinguish symptoms from root causes. Allow a critical review of the group's work, stimulate a discussion, and allow a second round to correct and review the identification of symptoms and root causes.
- Groups should then discuss priorities and issues to be considered in the SEA

Dilemma game

The dilemma game confronts the students with different dilemmas in the context of SEA. The activity is action-oriented, where the students come up with their suggestions for action options and solutions. The dialogue must focus on the different perspectives of participants and create reflection, as the dilemmas do not have an obvious right or wrong solution.

The activity helps build up critical reflection and develop the student's individual 'moral/value compass' as a preparation for their upcoming practice.

Purpose and learning objectives

- To create reflection and knowledge sharing through dialogue on dilemmas concerning environmental assessment, planning, and decision-making processes.
- To stimulate awareness and a critical discussion about integrity and professionalism in SEA practice.

PBL elements

Problem orientation, experiential learning, and student-directed learning are key PBL learning elements in the dilemma game. The dilemma game gives students direct experiences in reflecting on real-life contextual problems. Here, students actively engage in and learn how contextual factors, institutional structures, power relations, and politics influence SEA influences. The process facilitates active student-directed learning as the teacher does not transfer knowledge directly to students. Instead, the students are active and take ownership of the reflection and learning.

What is a dilemma?

A dilemma is when someone is faced with a difficult choice between two or more often equally unpleasant possibilities.

Time required

Preparation time is required for developing (and possibly printing) the dilemma cards. The initial method introduction takes about 15 minutes. The actual gaming takes approximately 30 to 45 minutes, depending on the number of dilemmas. In the end, 15 to 30 minutes are needed for plenary reflection and exchange of experiences.

Materials needed

Dilemma cards: The use of the cards opens up a conversation about situations that SEA practitioners and planners may encounter in practice. Developing the dilemma cards, therefore, reflects the specific context of SEA. An example of a dilemma card used in SEA teaching is shown in Figure 9.

Process guide

1. Introduce the exercise.
2. Define the format: The participants are divided into groups of three to five students

   And then to the playing:
3. Engage with the dilemma: One participant reads out the first dilemma, and everyone alternately expresses their attitude to the dilemma.
4. Group discussion: The groups then discuss the dilemma and their bids for options and solutions.
5. Agreeing or disagreeing: If everyone agrees on what is crucial to succeeding in finding a solution, place the card in the middle of the table with the back side facing up. If you cannot agree, the card is placed with the text facing up.
6. Next round: The group moves on to the next dilemma.
7. Exchange: Experiences and reflections in plenum.

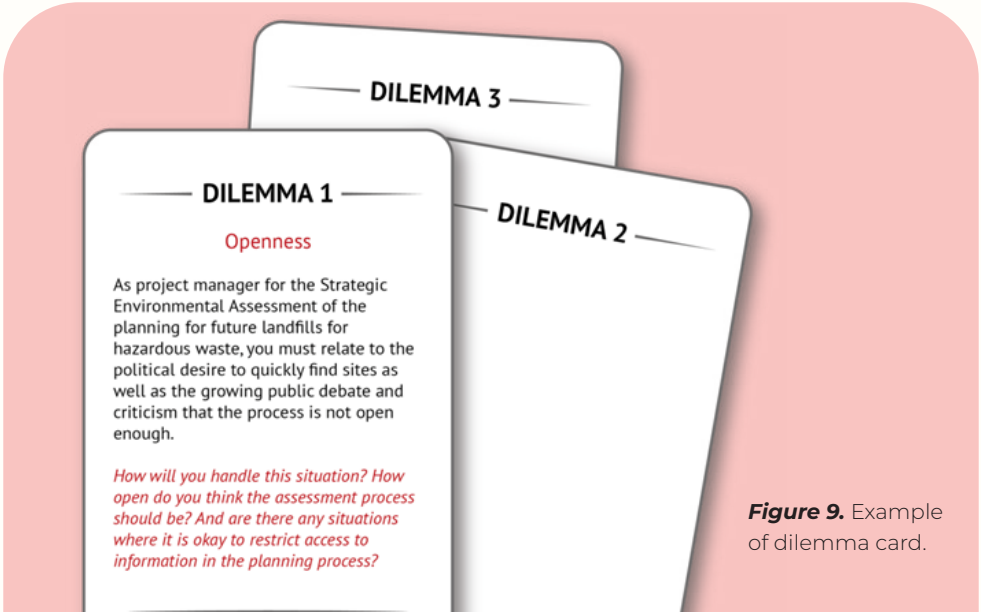


Figure 9. Example of dilemma card.

Interdisciplinary SEA workshops

The sustainability and societal problems which SEA engage with are increasingly complex and require solutions transcending disciplines. The complexities of challenges like climate change and biodiversity require new ways of thinking and overcoming 'traditional' disciplinary ways of educating and solving problems.

The interdisciplinary workshop intends to create an interplay between students with different knowledge and experience in joint problem-solving. The cooperation also includes the teachers.

Purpose and learning objectives

- To encourage interdisciplinary SEA and interdisciplinary cooperation among students and teachers.
- To link knowledge and science from different disciplines to generate solutions to real-world problems.
- To create an arena in which the students experience and reflect upon their discipline, others' discipline and the potential complementarity for problem-solving.

PBL elements

The interdisciplinary workshop supports the PBL principles of interdisciplinary learning and probAlem orientation, engaging students in a process where real-life problems are the point of departure. In problem-solving, students collaborate team-based, mobilizing knowledge from different fields. This also has an element of exemplary practice as students can transfer the learnings to other sectors and their future practices.

Time required
The time required for an interdisciplinary workshop varies depending on the scope and scale of the workshop. Preparation is critical and requires teachers to agree on the format, participants, problem, format, and timeline. The workshop is not recommended to be less than 6 hours.

Materials needed
The materials will vary according to the specific activities and disciplines involved. However, some basic items should always be considered, such as name tags, large sheets of paper, coloured pens and chalk, white- or blackboards, and post-its.

Process guide
Workshops vary widely, and the following is one process for illustration.

Prepare the ground and do the planning

1. Teachers representing the disciplines within SEA meet as a team to make the joint planning of the workshop. In practice, one teacher likely reaches out to another to explore the interest and possibility of interdisciplinary PBL cooperation.
2. The teachers define the problem, issue, topic, or question to be addressed in the workshop.
3. A joint scheduling and student invitation is made.

At the workshop:

4. The teachers present the rationale for taking an interdisciplinary approach and present the identified problem of the workshop.
5. The workshop format and plan are presented, hereunder the request that 'DNA' from each discipline be included and visible in the developed solution.
6. The interdisciplinary groups (4-6 people) start with a presentation of group members.
7. Round 1a: Exchange of disciplinary perspectives on the problem, creating a common language.
8. Round 1b: Developing preliminary ideas, including:
    - Information retrieval as inspirational data,
    - 'mock-up' of the solution
9. Round 2: second iteration, idea elaboration
10. Presentation by each group in plenary, including discussion of the solution

Example 1: Interdisciplinary workshop linking art students and environmental management students

Students from two educational programmes at Aalborg University engaged in an interdisciplinary workshop to reach a joint solution to a sustainability problem. Bringing art-based approaches with sustainability science led to a successful experience and novel solutions that neither of the two groups of students would have arrived at separately. The results of the interdisciplinary approach to PBL are documented in Heinrich and Kørnøv (2021). The process and methodology involved are presented in the process guide above.

Example 2: Interdisciplinary workshop using role-play

As a variant of the interdisciplinary workshop, students were asked to work on the same case from different angles as a case was chosen for a situation where a local authority wanted to develop geothermal energy facilities. The students were divided into three groups and were tasked with 1) developing criteria for possible locations of the geothermal facilities and 2) pointing out possible locations. Each group was tasked with working from and representing a specific perspective, namely that of the local authority energy planning department, the environmental department, and the spatial planning department. The groups worked part of the time separately on each part of the task, and part of the time, they participated in structured meetings with the other groups where they could exchange information and negotiate so that they, at the end of the workshop, had an agreed joint list of criteria and suggestions for locations that worked from all three perspectives. To finalise the workshop, the students presented their results to representatives from the local authority.

Through the workshop, the students brought into play the knowledge and tools they had acquired through their studies. Working from different perspectives and having to also work together gave rise to critical reflections on the importance and value of working across disciplines – both in your practice and when working with others – as well as reflections on how to do this in practice.


SUSTAINABLE DEVELOPMENT GOALS

Scoping a SEA-case

Putting theory into practice as exemplary learning is a key approach to active learning in a PBL setting. One way of doing this is to let the students work in groups performing a scoping on a current SEA case. Scoping is one of the critical stages of any SEA and has significant implications for the following process and the final reporting. Thus, the students must gain practical and reflective experience with scoping, hereunder its significance for not only efficiency but also the quality of a SEA.

The learning can be deepened by also focusing on discussions and feedback based on the results the students come up with. This can be coupled with engaging stakeholders by inviting a stakeholder connected to the case to present the case and/or to provide feedback on the results of the students' work.

Purpose and learning objectives

- Let the students put what they have learned concerning scoping into practice.
- To deepen students' knowledge by providing feedback and discussions of their practical work.

PBL elements

The approach focuses on active student-directed learning and team-based collaboration, with students working in groups, actively solving a task, and choosing appropriate methods. Further, the principle of exemplary learning is key, with students applying what they have learned in theory to a case in practice.

Time required
Depends on the size and complexity of the case and how much knowledge is provided to students (see materials needed), and the size of the groups (and thus their resources). An estimate is 2 to 3 working days for groups of three to five students.

Materials needed
The students need material and knowledge about the SEA case to perform a scoping. This will include some materials given to them, e.g., descriptions of the activity to be scoped but also finding knowledge and data needed for the scoping can be part of the task for the students. The balance between providing material for the students and letting them find it themselves must be struck, considering what is feasible given the timeframe.

Process guide

1. Presentation of the SEA case

- To begin the process, the students must be presented with the case and the task. This can be done in writing or in an oral presentation, which will also allow the students to ask clarifying questions.
- As a variant, the presentation of the case can be given by an external stakeholder involved in the case – having stakeholders involved can be highly motivational for students (see also part III).

2. Scoping by student groups

- Based on this, the students work on the scoping. They can be offered shorter sessions of supervision to support the students and their learning during the work.

3. Scoping document

- Finally, the students write up the scoping document and potentially prepare a presentation of their results.

4. Feedback

- Importantly the students should be given feedback; as stated in the beginning, this can involve an external stakeholder. A basis for this preferably is an oral presentation by the students in plenary.
- A possible way of raising discussions and reflections is to compare the results from the groups and see whether they agree on what is scoped in and out and their argumentation.

Course examination

Course examination in a PBL environment, as in any other teaching setting, is focused on testing to what extent the students have achieved the learning objectives for the module. If PBL is built into the learning objectives, it should thus also be tested to what extent the students have achieved the PBL-related skills or competencies. Beyond this, the type of exam can vary as much as any other; it can be oral, written, case-based, evaluating a mini-project or an assignment etc.

Examples of PBL-related learning goals

That students...

- *Can identify, analyse, and assess project-relevant sustainability problems and consequences from an overall perspective.*
- *Can analyse and assess theoretical and practical problems and develop and assess solutions that favour sustainable development.*
- *Can choose impact assessment methods and tools for ex-ante sustainability assessment.*
- *Can manage a study project in an interdisciplinary and intercultural PBL learning environment.*
- *Can independently structure and reflect on project management activities and carry out a subject-specific and interdisciplinary study project.*

Time required

The time required for the examination itself can vary significantly depending on the type of exam. Importantly, the exam requires time for design, preparation, examination, grading, and feedback to the students.

Materials needed

The required materials depend on the type of exam. Consider whether there is a need for a room, the possibility to show a presentation or a whiteboard to draw on.

Process guide

1. Consider learning goals: As stated, the exam is based very much on the learning goals, and these should be decisive in deciding the type and design of the exam – what should be tested and how is that best done?
2. Design the exam: Decide on the type and design of the exam; the possibilities are many, and some examples are shown below. One aspect is whether the students should be examined individually or as a group.
3. Preparations: Secure materials and other practicalities, including providing the students with information and any preparation they should do beforehand.
4. Examination: Carry out the examination.
5. Evaluation: Grade the exam and provide feedback to the students.

PBL in the course examination

There are many ways of including PBL considerations related to skills or competencies in course examinations. The approach to learning will also influence which type of exam the teacher chooses to use for the evaluation. Having a PBL approach will exclude the use of multiple-choice assignments, as this does not facilitate central PBL principles like problem orientation, exemplary learning, or interdisciplinarity.

One way of including PBL in a written course exam is, besides assignments that relate to the more technical understandings of the course, to ask the student to reflect upon how they would like to develop and strengthen their skills and competencies in the future. By reflecting upon their strengths and weaknesses and what they would like to improve, the students take responsibility for their learning.

Example 1: Examination through casework.
As part of an individual written exam, the students are given a SEA report and asked to evaluate its quality based on their knowledge from the course. This tests both their specific knowledge of SEA and quality and their ability to apply this knowledge in practice (exemplary learning) and to identify problems in the SEA report (problem orientation).

Example 2: Examination based on a mini project.
The groups oral examination is based on the students' assignments during the course. The students are asked to present the assignment to the evaluators, who then move on to asking questions and raising discussions related to the assignment and testing the knowledge base that the students used to carry out the assignment.

PART 3.

PBL IMPLEMENTATION THROUGH ENGAGING WITH STAKEHOLDERS

Introduction

Engaging with stakeholders becomes an important part of PBL when looking at the principles in Table 1. For instance, working with problem orientation through real-life problems, project organisation and the communication of projects all builds on engaging with stakeholders to provide insight into practice. Engagement with society and societal stakeholders can have various forms, from conducting interviews or dialogues with stakeholders to facilitating workshops and collaborations between stakeholders and students.

The interaction with the surrounding community can generate knowledge valuable for students' learning processes, and the collaboration can also generate knowledge together with communities, facilitating local changes (Gibbons 1999). Stakeholders typically included in the SEA teaching situation could be planners from the municipality, consultants working with SEA, citizens who have had experiences with a SEA process, or citizens who are affected by a SEA but not yet involved.

The following sections describe examples of how to engage with stakeholders – in both courses and project work.


AALBORG UNIVERSITET

Guest lectures

Having guest lecturers can serve many purposes related to PBL and active learning. Guest lecturers can introduce students to real-life implementation and practice of SEA in a specific and complex context. Part of this can also be to introduce students to actual problems and challenges concerning the implementation and practice of SEA. Guest lecturers can be integrated into course work, providing depth and practical perspectives to what the students have learnt from lectures and reading. They can also be integrated into project work, for example, by introducing a case or a problem which the students can work with or as part of an introduction to a broad topic within which the students must find a problem themselves. The experience with guest lectures is an element which is highly motivating for students, strengthening their engagement in the topic at hand. Different purposes of guest lectures are shown in Figure 10.

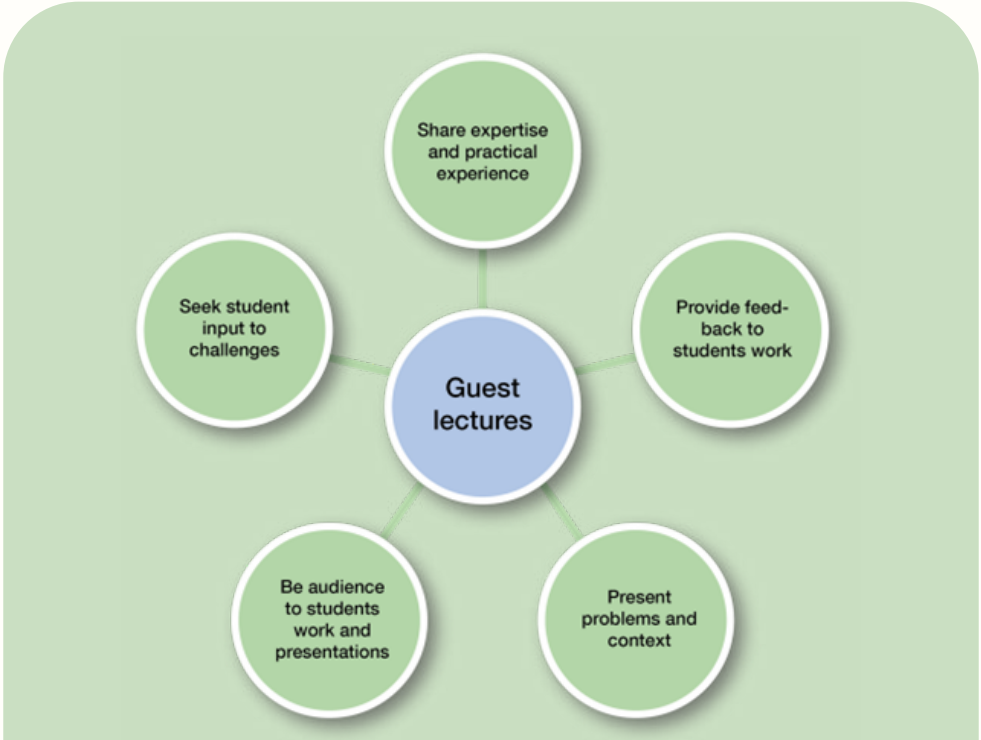


Figure 10. Different purposes for inviting guest lecturers.

Purpose and learning objectives.

- Give the students insights into the practical and complex implementation of SEA.
- Deepen and consider the knowledge obtained by students through other learning methods.
- Motivate students.

Time required.

Time must be set aside for the guest lecture; ideally, enough time for a thorough presentation from the guest lecturer and for the students to ask questions.

PBL elements

Which PBL elements are crucial in guest lectures can differ depending on the set-up and purpose. However, the element of exemplary practice in most cases is very strong, as guest lectures will connect practice and what the students are learning in theory. An example of an exception to this is if it is a purely academic guest lecture, e.g., by a visiting scholar.

Excursions

Excursions – like guest lectures – can serve different purposes, giving students the opportunity to experience and get insight into the physical reality of what they are working with. This can, e.g., be an excursion which illustrates something they have heard about in theory in lectures or a visit to an organization or development they have worked with – or will be working with – as a case in lectures or project work. Giving the students this opportunity to experience sites in practice is highly motivating and provides the students with hands-on experience that can deepen the knowledge they achieve in lectures and other work.

PBL elements

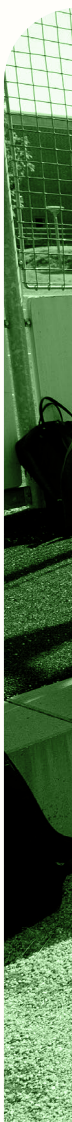
Again, problem orientation is the main driver of this approach. Allowing students to experience sites and organisations in practice provides learning, which can give insight into real-life problems related to SEA and improves students' basis for working with and solving these. Bringing the learning situation into practice also adds an element of experiential learning, which students can bring with them in their future studies and practice.

Purpose and learning objectives

- To motivate students
- To improve the student's knowledge of cases and places related to SEA and thus improve their work with these
- To give the students insights into the practical and material implementation of SEA

Time required

Excursions can be anything from a 2-hour visit to activities occurring over several days.



Example of excursions

1. *As part of an example of SEA of a waste handling strategy used in lectures, students and teachers visit a local waste handling facility to learn from staff about the facility and its framework conditions.*
2. *Students and teachers join a local guide on tour presenting a specific urban area, its population, structure, challenges etc. This urban area is afterwards the focus of the student's project work, where they work with a development plan and SEA for the area based on their knowledge from, among other things, the tour.*

Interviewing stakeholders

Interviews of stakeholders are a much-used method in project work but can also be used in courses and lectures. Interviews can be conducted to provide knowledge about specific cases, or methods students work with. It can also be focused more on the SEA process and the role of SEA practitioners. Depending on the aim of the interview, the characteristics of the stakeholders who are relevant respondents can vary, e.g.:

- Stakeholders who possess specific knowledge or have first-hand experience with the topic or case the students are working with
- Stakeholders who are experts or laymen
- Stakeholders who are interviewed as individuals or as representatives of an organization or a community

Thus, the choice of stakeholders is important and should be guided by the aim of the interviews and, ultimately, the problem being explored.

PBL elements

In this approach, problem orientation is key, as interviewing stakeholders provide the students with insights and knowledge about real situations and problems. Also, the students have an active and leading role in planning, completing, and analysing the interview, which makes this a very student-directed approach to learning.

Purpose and learning objectives

- To deepen the knowledge of students on the chosen topics – beyond what they can learn from desktop studies
- To provide the students with current and topical insights into problems and their context
- To form a basis for the students reflecting on SEA practice and their role as coming SEA practitioners

Time required

The time required for an interview varies, but time needs to be set aside both for proper preparation, carrying out and documenting the interview and finally for analysing the data. Two important issues concerning time are 1) to always allow ample time to make practical arrangements with the stakeholders about the interview, this process often takes more time than expected, and 2) to avoid long interviews as stakeholders often do not have much time.

Materials needed

Students should be able to speak with the stakeholder, e.g., in person (which might require travel) or via telephone or online platforms. Also, the students should have the tools to document the interview, e.g., through a recording device or written notes.

Process guide

The process of preparing for an interview is described in various methodology guides. Generally, the process includes the following:

- Choice of respondent and scheduling interview
- Research before the interview and prepare an interview guide
- Carrying out and documenting the interview
- Analysing interview data

Examples of interviews

1. *As part of a project working on an evaluation of the screening in SEA, students interviewed several SEA practitioners from a range of authorities and consultancies to learn about their experiences with screening, the usefulness of screening, the challenges of conducting screening etc.*
2. *As part of a course on SEA, SEA practitioners are interviewed by students to draw up their professional profiles. Here, the students ask about, e.g., educational background, tasks in SEA, values, how they see their role, and how they collaborate with colleagues and external stakeholders. The profile forms the basis for students discussing and reflecting on their profiles and their coming role as SEA practitioners.*

Course assignments proposed by external stakeholders

As stated previously, working with problems rooted in actual and current situations facing stakeholders is both motivating and educational for students and teachers. One way of incorporating this into courses is to get stakeholders involved to formulate and pitch tasks for groups of students plus review their work after completion. The activity will often be placed in the last part of a course, creating good conditions for students to apply the knowledge they have gained through the course and train them in handling and working with the complexity of real situations.

PBL elements

Working on assignments proposed by stakeholders provide students with a rich opportunity for exemplary learning, transferring the theoretical knowledge they have gained to practice in the settings provided by the stakeholders. Also, emphasis is on problem orientation as the stakeholders point to real-life problems the students can work with. Often, this also means focusing on interdisciplinary learning, as the students will need interdisciplinarity to deal with real-life problems.

Purpose and learning objectives

- To motivate students to come up with viable solutions to the presented problems.
- To put knowledge and tools into play and train applications.
- To attain competence in communicating with stakeholders by receiving and understanding the task they are given and presenting their work and solutions.

Time required

Time needs to be set aside for a session where the stakeholders present the tasks to the students and then again for the students to present their work to the stakeholders. The student groups need an appropriate amount of time between these two sessions to work on the tasks. How much time is needed must be assessed based on the tasks and balanced with how much other coursework the students have during the period.

Process guide

1. Preparation:

- Stakeholders should be approached to make agreements on their participation and to agree on appropriate tasks for the students.
- The students should be divided into groups, and each group should be assigned a task.

2. Session 1:

- The stakeholders present the tasks, including the background and context and any information the students need for their work.
- Students can ask questions.

3. Group work:

- Students work on the tasks in groups.
- Perhaps offer one or two guidance sessions with teachers to check in on the students and support them and the quality of their work.

4. Session 2:

- Students present the results of their work on the task to the stakeholders, teachers, and the other students.
- Stakeholders and teachers comment and give feedback on the results.

Examples of stakeholders and tasks

- *A municipality is working on a SEA of a river basin management plan. How should the municipality go about this? What elements should the process include, which stakeholders should the municipality focus on, and how?*
- *A regional authority oversees planning for raw materials excavation and has an excavation site where the resources will soon be depleted. How should the excavation area be used and designed after the activities finish? What potentials and needs should be included in the planning, and how can they materialise into a concrete spatial plan? And how can SEA contribute to these issues?*
- *A municipality has a small community with poor drinking water quality.*
  What measures can be suggested as part of a plan to improve water quality? What should a SEA of the plan focus on?

Project collaboration with external stakeholders

Collaborating with the local community gives students great experiences with engaging in current issues related to SEA and problem-solving in the local area of the university. It also creates an opportunity of sharing knowledge between the university and the community. In this specific case, we elaborated with four local stakeholders who represented a non-governmental organization (NGO), the municipality, and a local waste company, all working within the field of SEA. These participated in two meetings with students and a midterm seminar evaluating the first findings of the students' projects.

PBL elements

Students gain competencies from an interdisciplinary approach to working with partners from practice. The approach has active and student-directed learning and social learning elements when collaborating with partners from practice, discussing and reflecting upon the practices they are engaging in. Problem orientation is also key, as they are facing very authentic problems and working with them together with external stakeholders. This gives a broad understanding of the complexity of problem-solving.

Purpose and learning objectives

- How SEA and environmental planning are carried out gives, among others, insights into stakeholder networks, decision-making, policy level, and sustainability goals in local planning and NGOs.
- At an early stage in students' education, they get experience with participating in planning.

Time required
The time used for each partner participating in the process is 5–10 hours. Coordinating the process is time-consuming, and you must map your network and estimate how many external stakeholders are expected to use and how many resources to spend on establishing networks with relevant partners from the local community.

Material
There is a need for students and stakeholders to meet at least two times physically during the process. Usually, the students will visit the local partner. For the midterm seminar, there is a need for a location where partners, students, and teachers can have the seminar.

Process guide
Planning the process:

- The teacher meets with relevant partners in the local community and explores topics of relevance to SEA.
- Students are presented with several real-life topics in the local community and choose a specific topic of interest.
- Students and local stakeholders have two meetings talking about the specific topic for the student projects.
- Midterm seminars are held – students present their initial project ideas, and the external partners give feedback.

Participation in public meetings

Public participation is an important part of any SEA process; thus, this is also an important element of any training in SEA. One way of working with PBL connected to public participation is for the students to participate and observe in an actual public participatory process such as a SEA public meeting. The students may define or be given specific roles when participating in the public meeting. Different roles for students are illustrated in Table 3, in which a distinction is made between more passive participation in the form of observation, interactive participation and finally, participation where the students actively engage in the meeting.

Students' roles:	**Observation**	**Interaction**	**Engagement**
	The students observe, map, and study the meeting, the participant's behaviour, arguments etc.	The students interact with participants before, during and/or after the meeting. E.g., through surveys or interviews.	The students participate in the public meeting – asking questions and proposing perspectives on the SEA case.

Table 3. Roles and levels of involvement of students in public meetings.

To facilitate reflection and learning from the experience of participating in a public meeting, students are asked to hand in an analysis based on a framework they developed or one given to them beforehand. There can be variations of tasks, e.g., students can be assigned a predetermined public meeting by the teacher, or it can be part of the task for them to find a meeting themselves, and the task can be performed in groups or individually.
Participation in public meetings can be part of the student's project work or a SEA course.

Purpose and learning objectives

- To obtain deeper insights into how public participation is carried out in practice.
- To train the skills of the students for analysing and evaluating a public participation process.
- To help the students reflect on how participation processes can be improved and how they would design a participation process.

PBL elements

Student-directed learning is very present in this approach, as the students are physically present in a current public participation process and are also active in analysing the process. Through this approach, students work problem-oriented when being asked to identify problems and point to possible solutions in their evaluation of the process. Participating directly in a public meeting gives a concrete experience, which the students can use later, adding an element of exemplary practice.

Time required

Time must be set aside to present the task to the students, preferably at a lecture. After that, students need time to participate in the meeting and write their analysis. Depending on the approach, students also need enough time to find a public meeting (if the teacher does not assign one).

Process guide

1. Preparation:
- Preferably, students design the framework for their observation and analysis. Alternatively, the teacher prepares the framework. This can take many forms, e.g., observations point and questions the students should be able to answer – see an example in the box below. Depending on the approach, relevant public meetings should be identified.

2. Students work:
- If the teacher has not chosen to do this, the students design a framework for analysis and find a relevant public meeting.
- Students attend the public meeting and prepare their analyses.
- The analysis is handed in or presented in plenary during the SEA course.

3. Feedback:
- Feedback is provided to the students by teachers and possibly also by peers.

PBL elements

Example of a framework for analysis
Which stakeholders are represented?
What types of arguments do different stakeholders use? (Factual, emotional, value-political, etc.)
How are opinions/statements articulated?
How are citizens' questions answered?
What different views on planning can you identify?
What is the opportunity for influence?
What skills do citizen meetings require of a planner?

Communication with societal stakeholders

When engaging with societal stakeholders, it is important to consider how the results of the work carried out by students are communicated to the stakeholders who have engaged with them. Some forms of communication that can be considered are:

- An academic report of the project.
- A scientific article in a peer-reviewed journal.
- A popular article in a newspaper or professional periodical.
- A summary, brochure, or other shorter and more accessible written product.
- A poster, which can be displayed, e.g., in a local community.
- A short video presentation.
- The students give an oral presentation of their work and results, ideally followed by Q&A and discussion.

PBL elements

Communication with societal stakeholders supports the learning of disseminating research-based knowledge to SEA professionals and non-professionals and directly supports the PBL principle of exemplary learning.

As for all communication, it should be designed to fit the target audience. Thus, communication can take many forms depending on the level of engagement ranging from a stakeholder who has been a close collaborator on a student project to the wider society. Another consideration is that the form of communication fits the type of stakeholder, e.g., an academic report might be appropriate for a professional expert stakeholder, while a more easily accessible flyer or oral presentation might be more suited for a local non-expert community.

Examples of communication products

1. *A student wrote a short article based on her thesis and posted this on her LinkedIn Profile. She disseminated this to the relevant professional network.*
2. *A student made a short 3-minute video describing the theme and her findings. The video was made through an open-source platform.*
3. *Students wrote a short article for a national professional magazine distributed to local authorities and consultants.*
4. *Students did a podcast in which they communicated their findings. A third party interviewed the two students.*

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Annexe 1 – Examples of learning objectives

The text below is an example of learning objectives. The examples stem from the curriculum for the "Bachelor of Science (BSc) in Engineering (Urban, Energy, and Environmental Planning)" and the master programme Environmental Management and Sustainability Science (EMSS), which is part of the curriculum for "Master of Science in Engineering (Urban, Energy and Environmental Planning)". The text is direct quotes from the curricula. It is a text selection from the curricula and does not represent the full curricula. The first two examples are learning objectives from courses, and the latter is from semester projects.

Learning objectives from the course *Strategic Environmental Assessment*

The course module is 5 ECTS.
Students who complete the module acquire the following:

Knowledge

- Has advanced knowledge of impact assessment methods concerning a broad environmental concept.
- Has knowledge of and understanding of the life cycle thinking's specific application in impact assessment.
- Is knowledgeable about the interaction of strategic environmental assessment (SEA) with decision-making processes and societal development.
- Is knowledgeable about rules and practices for participation in connection with SEA, as well as understanding the usefulness of bringing different types of knowledge into planning and development processes, including lay knowledge and local knowledge.

Skills

- Must be able to identify and collect information for use in SEA as well as to assess the quality and relevance of the information base concerning the use.
- Must be able to perform a SEA.
- Must be able to select relevant impact assessment methods for use in a specific context.
- Must be able to communicate impact assessments verbally and in writing.

Competences

- Can critically assess the quality of a SEA performed.
- Must be able to be critical of the use of SEA as a tool concerning its purpose, seen in a larger societal context.
- Must be able to identify and involve relevant actors in SEA.

Learning objectives from the course *Sustainability Assessment and Societal Decision Processes*

The course module is 5 ECTS.
Students completing the module acquire the following:

Knowledge:

- Knowledge of different technical impact tools and methodologies applied for ex-ante sustainability assessment.
- Knowledge and understanding of the socio-technical context in which ex-ante impact assessment is developed and used.
- Knowledge and understanding of how impact assessment connects to societal decision-making on, e.g., large infrastructures, technologies, or spatial developments.
- Can understand and reflect on decision-making theories.

Skills:

- Can choose impact assessment methods and tools for ex-ante sustainability assessment.
- Can integrate technical analyses of bio-physical and social variables in the assessments and decision-making processes.
- Can analyse and assess theoretical and practical problems and develop and assess solutions that favour sustainable development.
- Can communicate results of assessments to both other peers and non-specialists.

Competencies:

- Can handle complex assessment situations.
- Can participate critically and reflexively in impact assessment to secure more sustainable planning and decision-making at the societal level.

Learning objectives from the project in Sustainability Management in a Societal & Institutional Perspective

The project module is 15 ECTS.
Students completing the project module acquire the following:

Knowledge:

- Have thorough knowledge and understanding of institutional and social framework conditions, actors, and challenges for sustainability management.

Skills:

- Can analyse and understand the handling of environmental problems on a societal level, including the integration of environmental policies, instruments, and institutional aspects.
- Can identify, analyse, and assess project-relevant sustainability problems and consequences from an overall perspective.
- Can formulate and analyse proposals for strategies within the environmental field, which are based on an analysis of the technical and institutional conditions.
- Can understand, use analytically and critically reflect on relevant quantitative and qualitative economic, sociological, environmental and/or engineering methods.
- Can independently collect data concerning relevant problems and assess the quality and reliability of the used data.
- Can explain the general structure and methods of the project. Must also be able to reflect critically on sources and use accurate source referencing.
- Can manage a study project in an interdisciplinary and intercultural PBL learning environment.
- Can independently structure and reflect on project management activities and carry out a subject-specific and interdisciplinary study project.

Competencies:

- Can combine relevant theories, understandings, methods, and analyses to form a synthesis towards the preparation of specific strategies and plans directed towards institutional and social framework conditions.
- Can independently reflect on and take responsibility for own learning, professional development, and specialization.

Learning goals from the master thesis in *Environmental Management & Sustainability Science*

The project module is 30 ECTS.
Students completing the project module acquire the following:

Knowledge:

- Thorough knowledge of relevant theories and methods concerning the chosen problem and can reflect on them.
- Can describe the used theories so that the special characteristics of the theories are brought to light and, in this way, document understanding of the possibilities and limitations of the used theories within the concerned field of problems.
- Know the scientific-theoretical and methodical embeddedness of the used theories and can reflect on them.
- Have thorough knowledge of the research embeddedness of the chosen problem, including knowledge of the most important national and international research in the field.

Skills:

- Can identify a research problem that is relevant to society.
- Can give an account of the relevance to the education of the chosen problem, including a precise account of the core of the problem and the professional context.
- Can independently plan and carry out a master's thesis on a high professional and academic level.
- Can give an account of possible methods for the solution of the problem formulation of the project and describe and assess the suitability of the chosen method, including an account of chosen limitations and their importance to the results.
- Can analyse and describe the chosen problem by using relevant concepts, theories and empirical investigations.
- Can analyse and assess the results of empirical investigations, whether it is the student's investigations or those of others, including an assessment of the importance of the investigation methods to the validity of the results.
- Can point out relevant future strategies, possibilities of change, and/or solution proposals.
- Can impart knowledge of the problem to both professionals and non-professionals.

Competencies:

- Can form a synthesis between the professional problem and theoretical and empirical investigations and make a critical assessment of the synthesis formed and the other results of the project work.
- Can independently integrate the problem as part of an interdisciplinary discussion and development work.
- Can independently acquire the newest knowledge in the field and are on this background, capable of continuously developing professional skills and competencies.

Annexe 2 – Resource Library

Chapter 2

What is Problem-Based Learning?

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Chapter 3

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Chapter 4

Megaprojects

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Chapter 5

How to work with PBL in courses and lectures?

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Chapter 6

Engaging with stakeholders in PBL

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Strategic Environmental Assessment is a core planning tool used worldwide for long-term sustainable decision-making. This book brings the Strategic Environmental Assessment into a teaching practice focusing on how to practice and develop teaching using Problem-Based Learning as a main approach. The book introduces problem-based learning in the context of Strategic Environmental Assessment, as well as hands-on examples on how problem-based learning can facilitate teaching of Strategic Environmental Assessment both in the classroom, though project work and together with stakeholders.

The book is targeted teachers in higher educations and others who teach and carry out capacity building within Strategic Environmental Assessment, who want to get inspiration for their teaching and explore methods for working problem based with students.