

Principles of Problem and Project Based Learning

The Aalborg PBL Model



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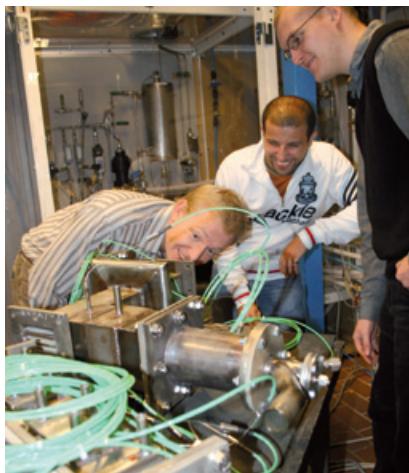
Introduction

Already at its establishment in 1974 the faculty at Aalborg University was interested in an alternative approach to education. From a philosophical and sociological standpoint, they were interested in providing students with an active role in the acquisition and creation of knowledge and the higher academic standards that come with students' necessarily heightened engagement in learning. They were further interested in a redefinition of the role of the teacher in the learning process. Rather than communicating knowledge to students, often in a lecture setting, the teacher was instead to act as an initiator and facilitator in the collaborative process of knowledge transfer and development. A synergy effect—peer learning—emerges in this shared educational process. Together these paradigms influenced the educational model adopted by Aalborg at its inception.

These philosophical underpinnings came to be implemented as a problem-based project oriented model for learning. The model begins with the formulation of a problem, often growing out of a question or “wondering”. This formulated problem then stands as the starting point for learning. Students de-

fine and analyze the problem within an articulated interdisciplinary or subject frame. Working in faculty-supervised groups, the students plan, manage and complete a project which addresses the stated problem. Taken together, the elements of problem, project and group that are the cornerstones of the problem and project based model form not merely a pedagogical approach, but rather a way of organizing learning, teaching and research at the university. Over time, both project and problem based learning have become increasingly popular in higher education. Indeed, these approaches have been implemented around the world in numerous contexts and in diverse applications. **The principles of PBL outlined here articulate the specific details of Aalborg University's problem and project based learning model – also known as the Aalborg PBL Model.**

The aim of this document is to capture the essential components and ideals of the Aalborg PBL Model. Thus the *Principles of Problem and Project Based Learning* may be used to introduce new students, new members of staff, external constituents, etc. to the educational vision that shapes what Aalborg



University do and what the university hope to achieve. The document forms a unique starting point for within-university dialogue about curricula, pedagogy and program development between and across faculties and departments. Furthermore, the document may be used as a source of inspiration for universities world-wide that wish to implement the Aalborg model in their own institutions. Having said this, it is important to recognize that the principles of the Aalborg PBL Model are by no means static or contextually isolated but should always be interpreted in the light of the broader context in which the model is to be implemented and applied.

Each of the nine principles identifies critical considerations for implementation of the Aalborg PBL Model with regard to key dimensions of the university. Each principle opens with a general statement of how *the principles of problem and project based learning* influence that particular dimension of the university practice (e.g. educational vision, curriculum, etc.). Detailed considerations for fulfillment of each principle are identified in the following paragraphs.

The nine principles, though each addressing a distinct dimension of university practice, are necessarily related. As such, an institution's attention to considerations in one dimension will often link directly to that which addresses another consideration. As institutions adopt the Aalborg PBL Model, it is important to view implementation not as a sequence of requirements to be met but rather as a transformation of the educational paradigm according to these considerations that span nearly all dimensions of the university.

The reader is encouraged to become familiar with the broader literature on problem-based learning, project-based

learning and their implementation at Aalborg University. These principles are best read and interpreted alongside a strong understanding of the history and details of these pedagogical approaches. See Appendix 1 for a brief bibliography.

Definition of Terms

Any discussion of project-based or problem-based learning is quickly complicated by the use of specific terms that have a variety of definitions and understandings in the broader literature. The following terms are defined for the purposes of clarifying their use in the *Principles of Problem and Project Based Learning*.

PROBLEM: A problem can be theoretical, practical, social, technical, symbolic-cultural and/or scientific and grows out of students' wondering within different disciplines and professional environments. The problem is the starting point directing the students' learning process and situates the learning in a context. A chosen problem has to be exemplary. The problem may involve an interdisciplinary approach in both the analysis and solving phases.

PROJECT: A project is a complex effort that necessitates an analysis of the target (problem analysis) and that must be planned and managed, because of desired changes that are to be carried out in people's surroundings, organization, knowledge, and attitude to life; it involves a new, complex task or problem; it extends beyond traditional organizations and knowledge; it must be completed at a point in time determined in advance. Projects are necessarily diverse with regard to scope and specific definition. No one specific template or standard exists to define "sufficiency" but rather, these determinations are made within each programme.

EXEMPLARITY: Exemplarity is a principle of selecting relevant specific learning outcomes and content / scientific knowledge that is exemplary to overall learning outcomes. That is, a problem needs to refer back to a particular practical, scientific and/or technical domain. The problem should stand as one specific example or manifestation of more general learning outcomes related to knowledge and/ or modes of inquiry.

TEAM: A team is a group, sharing and working closely together in design, decision making, analysis and reflection. The binding cooperation of members on successful completion of the project is an essential component of the overall approach to learning.

SUPERVISOR: The role of supervisor is one most often held by a faculty member serving as a resource for groups of students engaged in project work. Each student group has one or more supervisors for a project. Supervisor-group relationships do not extend beyond the duration of the project. That is, a student (or group of students) does not have a formal multi-term or multi-year relationship with one particular supervisor. In other educational contexts this type of role might be known as an advisor or facilitator.

PROJECT COURSES: Courses offered as part of a study program that relate directly to the term theme and the students' project work. Students elect to take a project course on the basis of the course's relevance to the project work. In some educational contexts what is defined here as a course might be known as a subject.

STUDY COURSES: Courses required as part of a study program that introduce students to fundamental concepts, theories or skills of a particular discipline. These courses are assessed (examined) separately from the project courses and project work. In some educational contexts what is defined here as a course might be known as a subject.

01. EDUCATIONAL VISION

01

The institution has an agreed-upon and clearly articulated vision for how problem and project based pedagogies are integrated into its institutional objectives. This educational vision informs the development of study programs and curricula, influences the faculty members and students who comprise the institution, and shapes the institution's relationships with key constituents.

01.1 The institution has developed and adopted a systematic framework for the problem and project based approach to education. The systematic framework informs the development of degree requirements, courses and the pedagogical approaches of faculty members.

01.2 In implementing the Aalborg PBL Model, the institution demonstrates an ongoing commitment to its central principles: problem orientation, project organization, integration of theory and practice, participant direction, a team-based approach, collaboration and feedback:

A) **Problem orientation:**

Problems/wonderings appropriate to the study program serve as the basis for the learning process.

B) **Project organization:**

The project stands as both the means through which the students address the problem and the primary means by which students achieve the articulated educational objectives. The project is a multi-faceted and often extended sequence of tasks culminating in a final work product.

C) Integration of theory and practice:
The curriculum, instructional faculty members and project supervisors facilitate for students the process of connecting the specifics of project work to broader theoretical knowledge. Students are able to see how theories and empirical/practical knowledge interrelate.

D) **Participant direction:**

Students define the problem and make key decisions relevant to the successful completion of their project work.

E) **Team-based approach:**

A majority of students' problem/project work is conducted in groups of three or more students.

F) Collaboration and feedback:

Students use peer and supervisor critique to improve their work; and the skills of collaboration, feedback and reflection are an important outcome of the PBL model.

- 01.3** The institution has developed and adopted learning objectives specific to the problem and project based approach. These objectives complement specific program objectives and address student competencies in problem formulation, self-reflection, meta-cognition, and collaboration.
- 01.4** Depending on the educational program and problem, students are encouraged to integrate knowledge from across the traditional disciplines in the project work in order to analyze and solve the problem.

- 01.5** The institution has clearly articulated the scope of implementation of the problem and project based educational model. Though an institution-wide adoption of the educational model provides the greatest educational benefit, the problem and project based approach can be effectively implemented at the faculty

or program level. Course-level implementation presents challenges that significantly truncate the educational benefits and is not sufficient to qualify as problem and project based learning.

- 01.6** Key groups within the university (trustees, faculty, students and administration) demonstrate ongoing support of the problem and project based approach.
- 01.7** Students understand the theoretical framework and practical benefits to the problem and project based model. Further, students are prepared to identify and articulate the strengths of the educational model vis-à-vis their academic and professional preparation.
- 01.8** The institution clearly presents the problem and project based model to key external constituents. Businesses, social agencies and governmental agencies with which the institution interacts are aware of the institution's educational model and support its implementation through partnership with the institution in identifying appropriate problems for students to address.

02. CURRICULUM

02

The problem and project based centered approach shapes the

institution's program curricula, which provide for student orientation to the pedagogical method, explicitly link theory and practice, are appropriately adapted to disciplinary paradigms, and are anchored by clearly articulated educational objectives.

02.1 All programs include first-term credit-bearing academic work that introduces and orients students to the problem and project based educational model. This component of the curriculum addresses e.g. learning theory, problem definition, project management, conflict management, and approaches to collaborative work all within the context of the institution's problem and project based approach. Further, the orientation component provides students with highly-scaffolded project experiences to prepare them for later self-governed group work.

02.2 The program curriculum is mapped onto academic terms (e.g. semesters) according to an appropriate progression with regard to depth



and breadth of content as well as sophistication of project work. This progression is specific to and shaped by the discipline or profession. Specific learning objectives are articulated for the program and associated with each term. These objectives include both overall educational objectives linked to the problem and project based pedagogy and the specific objectives of the program.

02.3 Each program consists of an appropriate balance of orientation courses, study courses, and project-related courses which accompany the students' project work. Depending on the program, timespan and the overall objectives, the project might vary in size. In general, the students'

project work comprises at least 50 percent of their academic credits and, when combined with project course credits, comprise approximately 75 percent of the students' total term credits.

02.4 An appropriate cluster of required study courses introduces students to the patterns of thought, theories, skills and fundamental knowledge of the discipline or profession.

02.5 In each term, a theme is selected to serve as the context in which project courses and projects address the learning objectives. Themes may be fixed due to an overall curriculum program or vary from term to term. The theme

connects to the overall learning objectives and is articulated in a formal statement that is distributed to students and guides their problem formulation and project work. Within the theme and the overall learning objectives, problems and project proposals are to be chosen.

02.6 In each term, a number of project courses are offered, linked to the educational objectives and shaped by the term's theme. Students select project courses according to the courses' relevance to their term project work. (If semesters are governed by fixed themes, central theme related courses replace project courses). These project courses



are sequenced within the term in order to facilitate timely support of students' project work (i.e. the majority of project course credits are offered in the early weeks of the term).

- 02.7** Supervisors ensure that students' problem formulations, through alignment with the term theme and overall objectives, provide a sufficient context for achieving the learning objectives. Further, problem formulations and project work align with the adopted curricular progression (i.e. depth of knowledge and sophistication). Students' problem formulations are allowed to evolve as the students progress in the project work.
- 02.8** The curriculum provides adequate means for students to establish connections between the specifics of the project courses and project work and the broader knowledge and skills of the discipline or profession. Students develop skills for management, synthesis, and construction of knowledge such that they are able to navigate, evaluate, integrate and apply knowledge not explicitly included in the curriculum. The learning involved in establishing these connections and skills are further facilitated by peer students, faculty members, supervisors and assessment activities.
- 02.9** The content of the curriculum is informed by the development/evolution of knowledge within the discipline or profession and by the demands of practice as encountered through application in the project work.
- 02.10** To the extent possible, problems and subsequent project work are informed by the state of the art in the discipline or profession. This is facilitated by ongoing relationships between the university and external constituents such as businesses, social agencies and governmental agencies as well as awareness of disciplinary research developments.
- 02.11** The institution encourages students to collaborate with external businesses and organizations for example through work placements or internships that extend their learning further into the professional world.

03. STUDENTS

03

Students understand the problem and project based educational model and, through that understanding, are able to successfully engage it in order to achieve the institution's educational objectives. In their work, students maintain an institutional culture of authentic collaboration, self-motivation, peer-learning and personal responsibility. The institution supports students in this regard through orientation and the provision of appropriate services.

03.1 Students are able to identify the ways in which the problem and project based approach shapes their academic work and successfully integrate its components as they achieve the broader institutional learning objectives as well as the objectives for their program. In their work, students demonstrate a high level of self-motivation and personal responsibility for learning.



- 03.2** Students possess, and are supported in developing, strong project management skills that enable the timely and successful completion of projects.
- 03.3** With appropriate support from the institution, students are able to negotiate and successfully address the inevitable conflicts that arise in collaborative work. These abilities are developed as part of students' orientation to the problem and project based model and are subsequently supported, as appropriate, by faculty members and administrators. Clearly stated institutional policies identify the scope and nature of supports available to students.
- 03.4** Students contribute to and maintain a strong culture of collaboration, which values active participation in course and project work. Strategies for successful collaboration on project work are presented to students as part of their orientation experiences (i.e., early courses and projects). In their project groups, students formally or informally address expectations regarding academic performance, work patterns, and norms for interpersonal relations. Students show a high level of support for one another in their academic work.
- 03.5** Students play a meaningful role in the administration of degree programs. Channels are provided for student input into curricular development and implementation, term themes, course offerings, and academic policy, e.g. through study board participation or systematic evaluations.
- 03.6** Students actively participate in institutional assessment and evaluation processes. Participation is characterized by a clear commitment to improvement, critical analysis and constructive feedback.
- 03.7** Students actively engage in substantive dialog with faculty members regarding their course work and the application of knowledge within the context of their problem/project. This dialog takes place in a collegial atmosphere that is characterized by mutual respect and the authentic engagement of all involved.

04.FACULTY

04

Faculty members understand and are committed to the problem and project based educational model. The institution ensures that faculty members are appropriately introduced to and understand the model's theoretical framework and are able to handle the best practices by which it is implemented in the curricula and pedagogically. As supervisors, faculty members are directly involved in the project-related work of the students. Faculty members hold primary responsibility for continuously adapting and developing the model to the institution's particular educational and disciplinary context, ensuring integrity of implementation, and guiding its development.

04.1 All faculty members have been introduced, through appropriate means (e.g. orientation, staff development activities, training, mentoring, observation, etc.), to the theoretical framework behind problem and project based learning and best practices in its implementation. Introductory programs address both the broader educational goals of the model as

well as the specifics of its implementation in the relevant discipline or profession.

04.2 Faculty members understand and are able to incorporate best practices in supervising and advising student project groups. They are aware of appropriate levels of direction in the process of advising groups (i.e. not directing student work, yet facilitating students' progress). Faculty members are willing to assist student project groups in managing challenges due to the group work process, for instance problems with the collaborative process, intra-group conflict, project management, etc.

04.3 The institution has articulated, in consultation with faculty members, policies guiding workload as related to instruction, supervision and administration using the problem and project based model. Specifically, the institution has established guidelines for the maximum number of groups one faculty member is able to effectively serve as the primary supervisor for in one term.

04.4 Through their engagement in administrative structures (e.g. committees, study boards, etc.) faculty members are directly involved in the development and maintenance of program curricula as well as their ongoing assessment. Faculty members play the central role in developing term themes which guide students' problem formulations and project work as well as in the organization of term project courses and supplemental academic activities.

04.5 Members of the faculty actively pursue and maintain relationship with external constituents (i.e. others in the academic and professional communities) in order to ensure curricular relevance and to strengthen relationships between the institution and the context within which it operates.



05. ASSESSMENT OF STUDENTS

05

The institution is committed to assessing and evaluating both student performance and program effectiveness. Policies and structures are in place to effectively assess individual student performance within the context of the group project work. A parallel set of policies and structures guide the assessment of students' performance in individual academic work (e.g. study courses). Program effectiveness is subject to formative and summative assessment and evaluation processes that involve faculty members, students and administrators as appropriate. There are clearly demonstrated links between program assessment and efforts to improve existing programs and develop new programs.

05.1 Assessment of students' group project work is conducted in a group setting and stands as the main assessment method. All group members are present for an extended examination involving the group's advisor, additional faculty members from the institution, and faculty members from other universities.

05.2 Examiners guiding the group assessment process pay careful attention to exploring not only the quality of the project work itself, but also to determining the extent to which, through the project work, students have achieved the broader learning objectives and have developed an understanding of the larger theories, concepts and issues as they transfer to different applications.

05.3 Students' project-related course work (i.e. project courses) is assessed within the context of the project work itself. The problem as formulated by the students and the subsequent project work are used by examiners as a lens for determining those aspects of the project courses that are relevant to assess. Forms of both formative (status seminars, peer evaluation, supervisor feedback, etc.) and summative assessment (portfolio assessment, etc.) may be implemented. The greater portion of assessment activity is dedicated to formative assessments, which are designed to develop students' abilities to provide feedback to others and assess their own progress. Alignment as well as validity and reliability are to a great extend important goals.

05.4 Students' academic work (e.g. study courses) is assessed according to clearly documented policies and procedures and learning objectives.

05.5 Though conducted in a group setting, students receive appropriately differentiated individual grades for their contribution to the project work and their mastery of the stated learning objectives.

05.6 The institution engages students, faculty members and administrators in the assessment and evaluation of study programs. These activities take on a variety of forms (e.g. student course evaluations, group feedback sessions), and are conducted during and at the end of each term.

05.7 The institution can document the incorporation of study program assessment data in the decision-making processes related to administration and improvement of existing study programs as well as the development of new study programs and procedures in relation to the context of the problem and project based model.



06. RESOURCES

06

The institution acquires and deploys resources in ways that consistently support the problem and project based educational approach.

In particular, adequate physical space for student project groups is provided. Library and technological resources provide current and comprehensive access to information and systems that enable students to achieve the institution's educational objectives.

06.1 Each project group is provided with work space for the duration of the academic term. This space may be individual rooms for each group or larger rooms divided into individual work areas for each group. Physical space may be supplemented by virtual space.

06.2 Classroom and laboratory space are provided as required by study courses and project courses.

06.3 As appropriate, materials required for completion of project work are provided for groups. A process exists for students to request institutional funding for higher-cost supplies or other non-material

project-related expenses (e.g. travel). Funds for such expenses are distributed and managed within each program.

06.4 The institution's library maintains subscription to key disciplinary and professional journals (preferably through online database subscriptions) in order to provide students with sufficient access to current research publications. Further, the acquisitions for and maintenance of physical collections (i.e. books and hard-copy journals) are guided by identified fundamentals within each discipline and profession (i.e. less time-sensitive material).

06.5 The institution maintains an appropriate array of operational and modern technological resources (i.e. computers, research equipment and software) necessary for students' course and project work. Central to these offerings are resources which facilitate the collaborative work of project groups.

07. PROGRAM ADMINISTRATION

07

The institution has adopted an organizational configuration and established administrative structures that facilitate the effective implementation of the problem and project based educational approach.

07.1 The administration of each program is conducted primarily by faculty members and support staff in a largely de-centralized manner. Administrative decisions, including

term themes, the administration of groups, and course offerings incorporate the input of faculty members and students within each program. Within each program, an appointed term coordinator (often a faculty member) gives oversight to the administration of program details for that term.

07.2 The institution facilitates inter-program and inter-faculty (school) collaboration on project work.



08. EXTERNAL RELATIONS

08

The institution maintains active relationships with key external organizations that support the effective implementation of the problem and project based model. Administrative support is provided to faculty members and students to facilitate and manage their connections with external contacts such as businesses, social agencies, governmental agencies, foundations, and other academic institutions. These external contacts stand as a source for student problem formulations and project work, and the institution's research and project work benefit from these external organizations.

08.1 The institution has administrative structures to facilitate the connections between faculty members, students and external organizations for the purposes of formulating authentic problems and providing authentic contexts for project work. Clearly articulated policies guide project work involving external organizations and ensure that such projects give first priority to the institution's educational objectives.

08.2 The institution has policies and structures to support faculty members and students in negotiating issues of intel-

lectual property rights and confidentiality as they surface in project work.

08.3 Connections with external organizations are leveraged by the institution to provide internship and work placements for students and graduates.

08.4 Connections with external organizations provide the necessary experts who participate in the institution's assessment processes as external examiners of problem solutions.

08.5 The institution's academic programs, project work and research are responsive to the broader context in which the institution operates. Connections with external agencies provide feedback for program maintenance and development, and the institution can demonstrate ways in which this feedback informs decision-making.

08.6 Businesses and organizations with which the institution collaborates are able to articulate a clear understanding of the problem and project based pedagogical approach. Further, these institutions understand the ways in which this model is beneficial to the preparation of its graduates and to the organizations themselves.

09. EDUCATIONAL RESEARCH

09

The institution conducts ongoing educational research into the implementation, adaptation and outcomes of the problem and project based educational model. Linked closely to assessment efforts, this expanding body of research is a means of documenting and disseminating local adaptations and innovations.

- 09.1** The institution systematically gathers data in order to:
 - A)** Document the PBL model for both internal and external purposes
 - B)** Develop an internal system for improving the model
 - C)** Document current and emerging local practices
 - D)** Relate contextualized educational practice to theory
 - E)** Relate data and research findings to other international studies

APPENDIX 1: BIBLIOGRAPHY

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