

If PBL is the answer, then what is the problem?

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ABSTRACT

Danish PBL-based higher education institutions espouse the qualities of problem-based projects but actual practice shows a somewhat different picture. The predominant use of project catalogues and the formal requirements imposed by accreditation inhibit central intentions behind problem-based project work and there is now a danger of employing the PBL format, i.e. the elements of project elements in a routine-wise fashion rather than as essential enhancers of knowledge construction.

In this paper we identify and analyze problems of routinisation of project work based on students' and supervisor's perceptions of project work; this is done in the context of undergraduate degree programmes in the Department of Computer Science at Aalborg University. We address/ identify the need for a further discussion of the conflict between the espoused ideals of PBL and the actual practice at PBL-based higher education. Our findings also point towards the need for practice based on action research into new ways of structuring problem-based project work in different settings. In particular, much greater attention should be devoted to the practice of semester coordination.

Keywords: Problem based learning, learning environment, quality of learning

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INTRODUCTION

In 1999 the Bologna Declaration proposed a European Higher Education Area in which students and graduates from higher education institutions should be able to move freely between countries. Since then there have been many efforts at both European and national levels to standardise higher education, and one such instrument has been that of setting up national accreditation agencies.

At the same time the OECD Innovation Strategy stresses the primacy of skills in innovation processes including objectives of creativity and entrepreneurship. This arguably calls for reforms in higher education wrt. the type of teaching that can bring about these skills. Besides content and procedural knowledge, this implies skills for thinking and creativity as well as social and behavioural competencies.

Problem-based learning (PBL) is one such form of teaching and exists in several different incarnations. PBL has the potential to promote complex, integrative and possibly transformative learning that can mobilize productive and creative capacities in the individual and combine into personal learning as the learners re-think themselves in relation to the problem field and the context of learning. The problem is the central driver for learning and the critical factor, and the need to analyze non-trivial, ill-structured problems calls upon individual and collaborative efforts to challenge conventional thinking.

In Denmark, Aalborg University and Roskilde University have pioneered PBL in the form of problem-oriented projects as the main core of their curricula since the early 1970s. However, after 40 years, PBL is now at risk of becoming ritualized into a set of formalised procedures where problems are restricted so as to acquire deliverable knowledge in the form of an explicitly exam-directed product, i.e. the project report. Likewise, teamwork dynamics often become inhibited by students forming homogenous groups that focus more on the end product, i.e. writing a project report, than on the learning process. We refer to this phenomenon as routinisation, by which we mean a superficial, instrumental deployment of PBL characteristics that leads to rather superficial and reproductive learning instead of deeper developmental and creative types of learning. The routinisation can be related to fewer resources being allocated to project supervision and to the fact that the teaching staff has become very diverse and often involves project supervisors with little or no previous experience of PBL projects.

This paper explores the contrast between espoused and actual use of PBL philosophy in student projects in Danish higher education and how the actual practice leads to a routinisation of PBL project work.

Firstly, problems in projects tend to become overly well-defined because of the widespread use of project catalogues. They often seem convenient, but can be detrimental to problem-based

learning. Moreover, the national accreditation process for higher education has forced universities in Denmark to introduce so-called semester descriptions that describe the content and practice of its teaching activities, and this includes the project modules of all degree programmes. These fixed descriptions can seem to impose limits on the possible scope of projects and may therefore also lead to a routinisation of PBL project work.

In this paper we give a critical assessment of these developments, which seem to go hand in hand. We analyse examples of restrictive PBL practices from our own educational context at Aalborg University, based on regulations and formal evaluations of teaching, and we analyse a qualitative survey carried out among 4th semester students in the Department of Computer Science at Aalborg University.

We argue that PBL in its capacity to foster developmental and transformative learning based on creativity and divergent thinking requires enabling learning conditions, which are not compatible with routinisation. Moreover, we discuss what might be essential enabling factors in a PBL context and based on our observations, we propose practical ways of countering the routinisation. We present and discuss viable ways to revitalise PBL practices and how these can provide ways to counter the unfortunate tendencies in such a way that the problem can once again become the main driver in PBL practice. In this context, we describe and analyze an experiment in a degree programme in computer science at Aalborg University that aims to do away with project catalogues. We base our work on student evaluations and statements from supervisors.

PROBLEM-ORIENTED PROJECT PEDAGOGY IN THE DANISH TRADITION

In the Danish tradition for PBL, the focus has been on problem-oriented, project-structured pedagogy with an emphasis on interdisciplinarity. Problem-based projects as a way of learning developed in the 1970s when more students were admitted to Danish universities than ever before and the labour market demanded graduates whose skills were more relevant and specialized. At the same time the student movement was interested in anti-authoritarian, critical and student-centered approaches to learning. The Danish Students' Federation published a leaflet in 1970 that called for new degree programmes based on the principles of problem-oriented, interdisciplinary and participant-directed project work where faculty members were to provide assistance in problem solving. The studies should be socially relevant and there should be no exams. Finally, the German school of critical pedagogy was becoming increasingly influential. These factors together shaped the development of the problem-based project pedagogy and the emergence of two new universities where problem-based project pedagogy would form the core of the degree programmes, namely in Aalborg and Roskilde.

Knud Illeris has been one of the main drivers in this development, drawing on the critical pedagogy in the German tradition of Negt and Wagenschein. The emphasis of the problem and its relevance are particularly insisted upon by Illeris:

If the solution, or at least the elucidation of the problem, does not appear as a personal challenge, the conditions for accommodative learning are not present and thus neither the conditions for the development of creativity and flexibility. (...) Accommodative learning is a demanding process that requires commitment. You accommodate only in situations that are relevant to yourself and what you are doing. (Illeris, 1974, pp. 82f, translated by Andersen and Heilesen, 2015).

Illeris identifies the following stages of a problem-oriented project:

1. Introduction and definition of the framework for the project work,
2. Introduction of methods and the general subject area,
3. Social introduction and group formation,
4. Choice of topic and problem to be worked on,
5. Formulation of the project idea,
6. Writing, evaluation and corrections of the project. (ibid.)

Thus, in order to engage in accommodative learning, students have to work on relevant, real life problems guided by the project methodology in order to mobilise systematic knowledge-based research approaches. The methodology reflects the principle of exemplarity of working problem-based in order to achieve the learning objectives. This has proved a challenging aspect as the problem may find it difficult to mobilise a “sufficiently broad overview of the subject area” (De Graaff and Kolmos, 2003, p. 658). Subsequently, PBL practice has fostered a distinction between various degrees of problem orientation resulting in three fundamental PBL project types: the task project, the discipline project, and the problem project (Kolmos, 1996). The first two are teacher determined mono-disciplinary problem tasks based on content planning and method direction in order to satisfy the curriculum and the study programme. Only the third type designates a fully fledged project as “[t]he problem formulation directs the choice of disciplines and methods and the problem itself arises from the problem-oriented theme” (De Graaff and Kolmos, 2003, p. 660).

THE ROUTINISATION OF PROBLEM-BASED PROJECTS

We now look at how project-structured pedagogy is carried out in practice 40 years later at Aalborg University.

The organisation of projects

From a purely formal perspective (as per the university regulations) the activities of a project at AAU are structured just as described by Illeris (1974). A project almost always takes a semester, accounts for half of its teaching activities and is carried out by groups of students with an appointed supervisor. The activities within a semester are coordinated by a *semester coordinator* who is always involved in the teaching activities of the semester – either as a supervisor or as a lecturer responsible for a course. The coordinator often compiles a project catalogue (see section 3.2), oversees the formation of groups and may also meet with the other supervisors assigned to the semester. Moreover, the semester coordinator is responsible for writing a final evaluation report at the end of the semester. This report is based on written comments provided by the project groups that were formed and by the lecturers and project supervisors involved.

The following excerpts are all taken from the semester evaluation reports from the Board of Studies for Computer Science from the autumn of 2014.

In a semester evaluation of the INF6 semester (the final semester of the undergraduate informatics degree programme) the semester coordinator writes

The students have, like the students from the previous year, very limited experience with independently developing a problem statement in their project work. They see this semester as “more loose”. Future semester coordinators should devote some time to summarizing PBL at the start of the semester. [*Semester coordinator A*] (The Board of Studies for Computer Science 2014, our translation)

Here is another expression of concern. In the semester evaluation of the SW8 semester, which is the 2nd semester of the graduate programme in software technology, the semester coordinator writes

It is now commonplace that one, as a supervisor, starts receiving manuscripts soon after the first meetings with students and that these manuscripts follow a fixed template for the entire project report. Typically this template is based on the report that the students wrote in their most recent project, only with the actual content left out. The manuscript sports a table of contents so that one can tell

where the manuscript fits into the report and what remains to be written. This template is typically followed for the entire duration of the project.

- One rarely comes across an actual problem statement in reports. The problem is often described with a clear delimitation and unambiguous content. Often simple scenarios are described, in which the need for a solution appears unproblematic and absolute.
- The reports frequently lack a chapter about the choice of theory and method. The project is frequently seen as a large construction assignment with well-defined tasks and known solution strategies.
- Many students wish to choose their project from a project catalogue instead of stating a problem themselves. The freedom involved in making one's own decisions is sometimes seen as a source of uncertainty. [*Semester coordinator B*] (The Board of Studies for Computer Science 2014, our translation)

Contrast this with the semester evaluation of the DAT4 semester, which is the 4th semester of the undergraduate degree programme in computer science. Here the semester coordinator writes:

The students were well motivated this semester because the courses fit together and the project work was mostly a check list. [*Semester coordinator C*] (The Board of Studies for Computer Science 2014)

This semester coordinator is clearly not concerned by this but rather sees it as indicating success. Overall, the above comments clearly indicate that it is possible, even legitimate to carry out a project *without* problem orientation at a university supposedly based in PBL.

Project catalogues

Stage 4 of the life cycle of a project as described by Illeris is that of choosing a topic and a problem to work on. To this end, project catalogues are widely used in the degree programmes at Aalborg University and Roskilde University.

In the guidelines from the Faculty of Engineering and Science at AAU the practice is described as follows.

The semester coordinator must ensure that the project supervisors submit project proposals to the secretary of studies via Moodle at the beginning of the semester. ... (The Faculty of Engineering and Science, 2016, our translation)

As can be seen from the above, project proposals are made by supervisors and describe the methods to be used in solving the problem described. The guidelines from the Faculty of Health Sciences are even shorter.

Project catalogues will be available no later than at the beginning of the semester. These catalogues will be published via the web page of the relevant degree programme. (The Faculty of Health Sciences, 2016, our translation)

Project catalogues are also used in the Faculty of Arts in degree programmes such as psychology:

A project catalogue will be compiled and made available from Moodle in mid-January together with a detailed plan of the introduction to the semester. (The Board of Studies for Psychology, 2015, our translation)

Here are two examples from project catalogues from the undergraduate programme in computer science.

[Proposal 1] Word of Mouth Recommender System

...

In this project your task will be to build a system where word of mouth is used for recommendation purposes. You are welcome to use the data available online ...

These data need to be correlated in order to create a recommender system based on that. You will need to compare the algorithm at least with collaborative filtering.

[Proposal 2] Parameter Sweeps using a RESTful Web Service

...

To improve on this, we can take advantage of a compute cluster to parallelise the task by verifying hundreds of models concurrently. Then, we can employ heuristics for selecting "good" parameter variables to avoid exploring all combinations. This is exactly what this project proposes.

- The students should develop a small parameter sweeping client that uses an existing RESTful web service to perform and distribute the model checking task using UPPAAL... The web service API enable the client to submit model checking jobs to a high performance compute (HPC) cluster and allow clients to retrieve the results upon completion.
- The students are expected to investigate heuristics and implement heuristics for selecting parameters during the parameter sweep.

As these examples show, a typical consequence of this approach is that students choose a proposal containing a solution method, but *not necessarily a problem*. This fits well with the notion of discipline projects and that of so-called task projects (Kolmos, 1996).

Another source that provides insight into the role played by project catalogues is that of the so-called accreditation reports introduced as a means of evaluating and providing/denying official accreditation of higher education degree programmes in Denmark.

The following passage from an accreditation report for Roskilde University shows that the expectations at this university are exactly the same as at AAU.

During the visit to the university the management emphasized that the students obtain a close contact with the teachers through project work, where they receive supervision. Moreover the management supplied the information that a project catalogue has been made available through the homepage, in which researchers clarify what they are working on this particular semester, and in which there are concrete proposals for project topics. In this way the project catalogue is a catalogue of inspiration for students. The students stated that the project catalogue is a very good idea but also that, since only 4-5 teachers have contributed with research projects and proposals for project topics, the existing project catalogue was seen as being of limited value. (The Danish Accreditation Institution, 2011, our translation)

Formalisation leads to routinisation

The Danish institution for accreditation originally required every degree programme offered at an institution of higher education to be assessed and accredited every 5 years; since 2007 this has led to a large number of accreditation surveys, each resulting in a lengthy accreditation report (Aalborg University, 2014). This requirement has now changed, in part because of the large documentation overhead involved, to accreditation at the level of institutions. The accreditation activities will gradually shift away from individual degree programmes to concerns at the institutional level. Even so, the process of accreditation will still require substantial and detailed documentation of the activities and structure within the degree programmes offered. Semester descriptions have become a common way of producing this kind of documentation, and the process of preparing these puts an emphasis on well-defined activities that are easily seen to live up to specific learning goals.

A look at the accreditation reports for the degree programmes at Aalborg University (2015) reveals that they often have long discussions of the interdependencies between course activities but in some cases very little mention of the role played by problem-based projects. Sometimes the value of project work is directly questioned by the accreditation panel:

The university states that the meetings contained discussions of topics of a general nature – *such as the value of project work* – and topics specific to the concrete degree programmes (Aalborg University, 2014, p. 14, our translation and our emphasis)

WHO OWNS THE PROJECT?

The original intention was that students should own the problem of a project. In a paper from 2009, Lone Dirckinck-Holmfeld from Aalborg University writes in a guest editorial for a special issue of IJEDICT about PBL ((Dirckinck-Holmfeld, 2009):

According to Illeris (1981), enquiry, on its own, does not constitute the basis for an active process of acquiring knowledge through critical reflection: “A problem is not a problem in a psychological sense if the person who has to work with it does not experience it as a problem.” (p. 83, our translation). Therefore, participant control is an interrelated principle. When students themselves define and formulate the enquiry, they have a conscious relation of ownership to it, and they experience it as a problem (anomaly), which implicitly encourages involvement and motivation. Participant control and the ownership of the problem setting are therefore seen as fundamental for the students' engagement in the learning process.

Participant control implies that the institution or the teacher cannot fully guide or control the learning process. Problem formulation is always a leap in the dark and as such challenging. It is the subsequent theoretical and empirical enquiry that really displays the results of the collaborative learning situation. Supervisors can help to promote and formulate exemplary problems through negotiations, dialogues and enquiries about the problem area.

In the short official description of problem-based learning at AAU this ideal of participant control and ownership is also espoused (Aalborg University, 2014):

Once you have formed a project group, you need to define a problem together that you want to examine. The problem forms the basis of your project and you are to a great extent responsible for defining this yourselves within a set though often very broad theme frame.

However, the ideal of student ownership of projects has seen a steady drift. At the start of the project, projects are often ‘owned’ by potential supervisors, partly because of the widespread use of *project catalogues* and in part because of the focus on the product of a project. The problem analysis may be a short one, and the focus may shift to that of solving the problem (or what is perceived as the problem) and creating a specific product.

The potential for choosing projects is extremely pre-defined to the extent that it may be 'closed'; students will tend to choose a project described in the catalogue. For students it is usually quite difficult to contribute to the project catalogue, since they obviously have little or no previous experience with the learning objectives of the project theme.

In this way, project proposals can become extremely well-defined off-the-shelf goods. For supervisors with little previous experience this may seem an advantage but there is also a danger of project supervision degenerating to guiding students through a well-defined routine. Moreover, as the supervisor will often 'own' the project initially, he or she may end up having a high degree of responsibility for the success of the project and for providing information concerning the problem solution itself.

There is nothing in problem-based learning that in itself contradicts the idea that the problem statement may have been put forward by someone else. De Graaf and Kolmos (2003) write

Who formulates the problem statement and who is responsible for the main decisions is dependent on the next principle, participant-directed learning processes, or 'self-directed learning', which has a far more individual-oriented focus. In the vast majority of cases, students have the opportunity to determine their own problem formulation within the given subject area guidelines. In other cases, the teacher defines the problem and the student uses this as a starting-point.

In this respect, it is interesting to note that project catalogues are particularly widespread at AAU within the early semesters of undergraduate programmes, even though the learning objectives of these semesters very often involve that of obtaining competences aimed specially at problem analysis and problem statement.

MODES OF LEARNING

The ways in which students perceive the ownership and nature of a project relate to different modes of learning (Ellström et al. 2008).

The *reproductive mode* of learning corresponds to conditioning models of learning, resulting in routinized actions that are performed without much conscious attention and control (Andersen, 1982). Thus tasks and methods are connected on the basis of routine connections rather than on the basis of analysis and inference. This level of learning is sufficient and necessary in many circumstances but has its role primarily building skills for handling routine problems that occur frequently.

Other modes of learning that go beyond the reproductive are *developmental*. The mode of *productive learning* is characterized by a higher degree of discretion with respect to the evaluation of results (Type I) or with respect also to the choice and use of methods (Type II). In the former type of learning, the learner has to evaluate the outcomes and make minor corrections in the way the methods were used to solve the problem at hand.

By contrast, in productive learning of Type II, the learner has to engage in a more active process of knowledge-based problem solving through experimentation, that is, the learner has to invent and test a solution to the given problem based on knowledge about the task and about possible alternative solutions (Engestrom, 1987). This mode of learning becomes necessary when we encounter novel or unfamiliar situations for which no rules or procedural knowledge are available from previous experience. At this level of learning, performance is assumed to be controlled by goals and based on explicit knowledge; that is, knowledge that can be reported verbally.

The "highest" mode of developmental learning is *creative learning*. Here the learner has to use his or her own authority not only to evaluate outcomes or choose methods but to define the task and the conditions at hand; the learner must diagnose a situation that may be unclear or puzzling. One of the crucial elements in this process is to make those premises explicit that are often implicit and taken for granted. This requires the learner to be able to see an action and its consequences in perspective, to be able to consider alternatives and to give a critical analysis of the underlying assumptions and other conditions of action. Thus creative learning occurs when learners start to question established definitions of problems or objectives and to act to transform institutionalized ideologies, routines, structures, or practices.

One can identify at least five groups of factors that are critical for facilitating or constraining creative learning: (1) the learning potential of the activity in terms of its complexity, variety, and control; (2) opportunities for feedback, evaluation, and reflection; (3) the type and degree of formalisation of the processes; (4) organisational arrangements for participation in problem handling and developmental activities; and (5) objective learning resources in terms of, for example, time for analysis, interaction, and reflection.

Even if these conditions are right, a learner may still not be able to take advantage of them if he or she lacks the knowledge or self-confidence to do so. The presence of certain "subjective" factors seems to be required, and they include the subject's knowledge and understanding of the task and the overall process, skills in performing the task, previous experiences with similar tasks, acceptance of the task and its requirements, self-confidence, and motivation (Ellström et al. 2008)

More specifically, there is a distinction between *enabling* environments and *constraining* learning environments. In an enabling environment the conditions and practices are likely to promote a balance between reproductive and developmental learning, that is, an environment where individuals are able to alternate between these two modes of learning. In contrast, a constraining environment refers to conditions and practices that are likely to constrain both reproductive and developmental learning, or to promote reproductive learning at the expense of developmental learning. In practice many learning environments are a mix of the two.

One of the dangers of routinization of project work is precisely that the routines may lead to a constraining environment. An environment in which the project is seen as not owned by the students can also be constraining. More specifically: Why would one be creative within a project environment that is not seen as owned by the participants? This is precisely the observation that Illeris has made.

EXPERIENCE WITH ADDRESSING ROUTINIZATION

We now describe an alternative approach that has been tried out in the undergraduate programmes in computer science and software development at Aalborg University. The first two years of these degree programmes are identical but starting with the 4th semester, there are separate semester coordinators for the two groups of students.

In the 3rd semester project in the degree programmes in computer science and in software development the project catalogue was replaced by an explicit theme description that describes the learning goals of the semester. One of these learning goals is to come up with a problem statement. This approach was continued for the 4th semester project, but *only for the computer science degree programme*.

The theme of the 4th semester is *Design, definition and implementation of programming languages* and the specific learning goals are that the student obtains competencies in designing, defining and implementing a programming language. In this way the goals of the project are very specific as to the requirements of a solution. The difference lay in how the theme was presented. Students following the degree programme in software development were provided with a project catalogue by the semester coordinator for this particular programme; students in the computer science degree programme – for which the second author served as semester coordinator – were not. Instead students were given the description of the project module from the study regulation together with a concrete interpretation of the project theme provided by the supervisors in the form of a four-page description. The students were specifically asked *not* to look at project reports from previous runs of the 4th semester and *not* to look at the project catalogue from the 4th semester of the software development programme.

A central aspect of the supervision was that the role of the supervisor would be to facilitate the problem analysis. Throughout the project, the coordinator and the other supervisors would meet and discuss how the problem analysis was proceeding. At the end of the semester, the semester coordinator asked for comments from the supervisors about their impression of the project experience as a whole. In the following we present some quotes from supervisors.

The second author of the presented paper served as semester coordinator of the computer science undergraduate programme for the spring semester of 2015. As part of this, he devised a structure in which there was to be a status seminar after the first five weeks of the project. Each student group was asked to provide the following deliverables for the status seminar:

- A problem statement
- Program examples in the programming language that was to be developed as part of the solution

Each status seminar involved two or three groups and their supervisors. Each group was to give a short presentation at the seminar; this presentation must present their problem analysis and ensuing problem statement. Following this, all participants would discuss the problem analysis, the problem statement and other content found in the presentation and in the deliverables. Status seminars of this kind are common practice in projects of the first two semesters of the undergraduate programmes at Aalborg University but are not commonly used later.

Overall, the introduction of a status seminar was a positive experience. A supervisor wrote:

For both groups the status seminar was time well spent. It helped the groups see their projects from another angle and exposed substantial deficiencies in both projects. I think it addressed some concerns in the process at an early stage for both groups. The way the groups handled the feedback was substantially different: afterwards, group A had many questions about the consequences of the choices that they had made [in their project], whereas group B was more interested in my opinions as to what the right choices would be. [*Supervisor A*, translated from Danish]

On the other hand, some groups appeared to be more dependent on their supervisor than others, and this made ownership a challenge. A supervisor in charge of supervising two groups wrote:

At the start I had the experience that both groups were a bit confused as to the format. Group A were relatively quick to find their “own” project and the rest of their analysis was to a large extent characterized by them carrying the project by themselves – my role was to help them with delimiting the problem and with the search for information. Group B found the format very difficult and sought a lot of inspiration in the examples

of projects that I had. This also meant that the groups did not end up “owning” the project, and the analysis phase was characterized by an expectation that I would contribute with the essential insights. [*Supervisor B*, translated from Danish]

Another supervisor in charge of two groups had a similar experience:

I supervised two groups and they were quite different in their outset. One group was very quick to think of an interesting problem (that of supporting parallel computing by means of graphics processors) and much of the problem analysis consisted in discussing the thoughts that the group had concerning the delimitation of the problem. The other group told me that they had looked at old project reports and wanted to choose a project topic from one of these even though they had been told not to do this! This was fairly frustrating; I told them that this was not acceptable and eventually they chose a problem setting that I had mentioned. I ended up playing a much greater part in the development of the problem analysis and parts of the eventual solution than I had hoped for. I am unfortunately still not sure if this group “owned” their project the way they should have. [*Supervisor C*, translated from Danish]

Interestingly, another supervisor also supervised two groups that behaved very differently along the same lines:

I was positively surprised as to how well they reacted [to there not being a project catalogue]. I do not recall that they were confused as to what we expected from them, which is what one might have feared.

I had some rather different experiences with my groups.

One group (...) was quick to find an interesting project and had few doubts.

The other (...) had more doubts and my feeling is that they chose a project based on the ideas that the semester coordinator put forward during the introduction to the semester. [*Supervisor D*, translated from Danish]

Overall, this seems to indicate that the issue of project ownership was not clear to all students. Another supervisor said

Personally, I think that the problem analysis phase is the most difficult task the students are asked to do. The analysis is not hard in itself, but it becomes problematic if you are not aware of what you have to do to accomplish the goals of the project. Supervisors should explain very clearly to the students what we are expecting from them and give strong guidance at this level of the project. ...

Overall I think this was a positive experience for me as a supervisor, and for the group as well because they have faced the problems regarding a project proposal that should be both interesting and doable within the time constraints. [*Supervisor E*, translated from Danish]

STUDENT PERCEPTIONS OF PROJECT WORK

The authors have conducted a survey among all 4th semester students in the software development and computer science degree programmes at Aalborg University in 2015. The intent was to not only highlight student opinions of project work but also indicate if there were differences in the perceptions between the students from the two degree programmes.

The survey consisted of 13 multiple choice questions scored on a Likert scale together with open-ended questions. A total of 46 students responded – 20 were computer science students, 26 were software students. In the following we highlight some of the qualitative and quantitative responses that were obtained in the survey.

The role of the product

Here is a very telling student quote.

Concerning the project report it can sometimes appear as if it is the only purpose of the project. Since this is what one is assessed on the basis of eventually. [*Student 1*, translated from Danish]

This student is not alone in observing that there is focus on the product of the project. Figure 1 shows the student opinions; only 9 students disagree that writing the report is an important objective.

Writing a project report is an important objective of project work

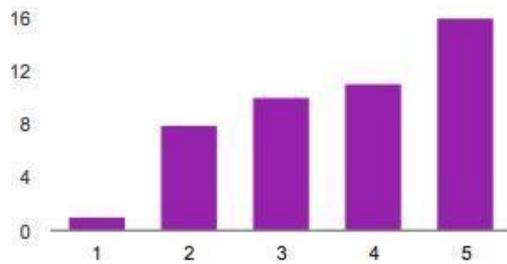


Figure 1. Student opinions of the importance of a project report. 1 = Disagrees completely. 5 = Agrees completely.

The role of the problem

Here is another interesting student quote.

Project work should first and foremost have real tasks in industry as their outset. PBL and its approaches to solving a problem are often well-suited for this but it can also be hindrance for a theme-oriented project. For instance: “Compilers and languages”. [Student 2, translated from Danish]

Trying to solve a problem is an important goal of project work.

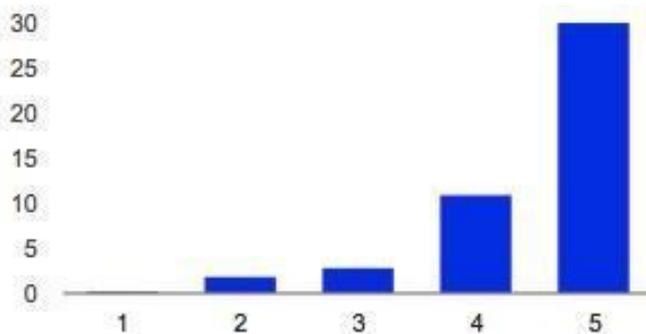
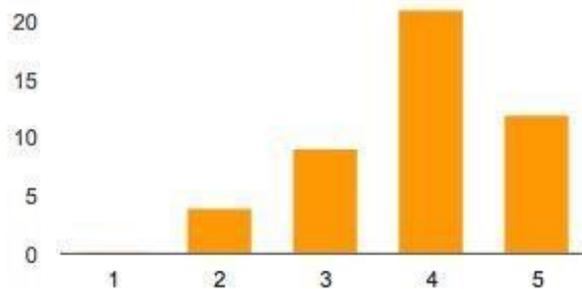


Figure 2. Student opinions concerning the importance of a problem. 1 = Disagrees completely. 5 = Agrees completely.

Carrying out specific activities is an important goal of project work.



This is in line with the results of the survey; Figure 2 shows that 40 out of 46 students regard it as important that a project solves a problem but Figure 3 then also indicates that students also find it important that certain specific activities are carried out as part of a project. This need not be controversial in itself, since every project module will have specific learning goals.

Figure 3. Student opinions concerning the importance of carrying out specific activities. 1 = Disagrees completely. 5 = Agrees completely.

WAYS AHEAD

Institutional support

At present the espoused ideals of problem-oriented project work are not in agreement with actual practice. If this is to change, the ideal of problem orientation must be directly supported in the project process at institutional level. At present, the bulk of the effort is carried out during the 1st semester of all undergraduate degree programmes in the form of specific course activities, project-related reflections (including status seminars) and learning goals that relate to the specific competencies involved with problem-based projects. As the degree programme progresses, these requirements are pushed towards the background. This is not necessarily a good idea, as the present paper indicates.

Semester descriptions appear unavoidable as part of the administrative reality of Danish higher education. However, it is important to remember that such descriptions can also be useful in developing a best practice for teaching by making requirements explicit. But if routinisation is to be dealt with, semester descriptions need to stress the role of the problem and the problem analysis competencies in the theme of the project module to a larger extent.

Moreover, it is necessary to explicitly create a teaching culture that fosters reflection both at the level of students, at the level of individual project supervisors and among the project supervisors involved with a given project module.

There is at present no requirement that project supervisors discuss their supervision practice, nor do members of the teaching staff get any credit for doing this in form of allocated teaching hours. Collaborative approaches to teaching that involve peer discussions have been advocated for more than 20 years by Shulman (1993) and Handal (1999) but are yet to become formal practice.

The issue of project ownership requires particular attention, as statements from the supervisors involved indicate. Our survey indicates that students well into the second year of a PBL-based degree programme still appear to have attitudes to project ownership that will be counterproductive to their learning.

Introducing PBL at other institutions

Several institutions of higher education are currently thinking of introducing PBL-based curricula based on the experiences at Aalborg and Roskilde Universities, often in collaboration with these institutions. In these settings it is important to be aware of the dangers of ritualisation and for the institutions that already use PBL-based curricula to point out this problem and develop approaches to avoid it. The institutions that adopt PBL should not simply copy the format but should develop the PBL principles and contextualise them to the local setting. It is particularly important to understand the degrees of freedom and uncertainties in more open-ended problem analyses versus the well-definedness and restrictions that pre-defined problems imply.

CONCLUSIONS

In this paper we have considered the current paradox of the emphasis laid on increasing innovative and creative capabilities on one hand and the increasingly bureaucratic environment defined by demands for accountability in higher education on the other. The routinisation of project work in institutions of higher education whose self-described pedagogical model is one of PBL is in part a result of these bureaucratic demands, and in part a result of the widespread use of project catalogues. The result of the routinisation is that the project work shifts its emphasis away from problem analysis towards solutions that have already been proposed in the project catalogue.

If this is to change – and we believe it should – there needs to be an explicit emphasis on moving the structural requirements from the product of the project towards the problem analysis and problem solving aspects of PBL projects. Firstly, the institutions will need to re-discover the probe-based nature of project work. Secondly, this must be supported by a commitment

from the institutions to counter routinisation by means of specific activities. The crucial aspect is to identify the conditions that must hold in order for a learning environment to be enabling as far as developmental learning is concerned.

In order to continue this process, further experiments carried out as action research are necessary. This paper points towards other ways of organizing problem-oriented projects and toward the need to identify another approach to writing semester descriptions to be used in an accreditation context. It is our belief that further experience of this kind is essential in the quest for creating and sustaining enabling learning environments in problem-based project work.

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