



Sharing is Caring

Building PBL Coherence Supported by IT to Integrate Semester Courses and Projects

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**Sharing is Caring:
Building PBL Coherence Supported by IT to Integrate Semester Courses
and Projects**

*Nanna Svarre Kristensen, Jon Ram Bruun-Pedersen, Lise Busk Kofoed,
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ABSTRACT

Organizing a coherent PBL semester where courses and project work are integrated and supporting the development of both disciplinary and generic competences is difficult. In this study we investigate how integration can be supported by different IT initiatives. Applying a practice theoretical approach, inspired by Stephen Kemmis, this article analyses how the practice activities and the resources within the practice are constituting challenges and possibilities for an integrated PBL practice. The findings of the study illuminate possibilities in reorganizing a semester structure with focus on creating a shared language to support communication and establishing solidary ways of relating. An important issue is also to have focus on the dispositions to act within the actual IT based materiality.

Keywords: Semester structure, Course and project integration, Practice theory, It-supported education, Problem-based learning (PBL)

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INTRODUCTION AND BACKGROUND

Teaching and studying in PBL environments in the higher education system, implies several constellations of PBL, and different foci for near future dilemmas. In this research study, the *near future* is seen from the binocular of a) framing future digital influences and by b) framing future digitalization strategies. This represents both a need and an opportunity to optimize the enactment of PBL, where digitalization becomes a solution. A dilemma within PBL in general is the balancing act between disciplinary and generic competences. PBL in its widest sense, builds on pedagogical theories of e.g. social and active learning theory, and is known to support the development of more generic and transversal competences. Aalborg University has developed and applied its PBL-oriented, pedagogical *AAU Model* since 1974, which relies partly on its *AAU PBL principles*. These include the principle of how “*the project work is supported by courses*”, as a structural part of a semester’s inherent coherence design, by how courses should feed tools into the project (Askehave et al., 2015). Some generic disciplinary competences from courses are ideally included as learning objectives in the project modules study plan, as a way to integrate course and project work. In the organization of the different educations, the generic competences support the development of disciplinary competences of the specific education to a variable degree.

In the latest reform of the AAU PBL organization, semester projects have become increasingly detached from the disciplinary learning objectives of courses, and removed focus on integration between semester modules. It is a belittling strategic move on the PBL-centric application of disciplinary knowledge in semester projects. An identity which AAU used to treasure, and would promote itself in the past - to a current PBL structure, which has suddenly become the basis for critique (Hüttel & Gnaur, 2017; Busk Kofoed et al., 2018).

In pursuit of creating more coherence and PBL-centric thinking to the semester structure, a research project was launched in 2017 (PBL Future, 2017), partly studying how the digital agenda may become an asset in context. The result was an initiative to test a reorganization of the semester structure, by the philosophical and practical construction of an “Integrated and IT-supported semester”, abbreviated here as ‘IITS’. In short, the IITS concept builds on an increased focus on initiating digital tools into the teaching, using a flipped classroom approach to integrate these into courses as lecture activities, as well as different initiatives for integration and coherence across the semester. An example of a digital approach is introducing digital umbrella platforms such as Jupyter Notebook, which is able to combine utilities and utilization of several different programming languages and softwares, practices or tasks, into one. Such initiatives should aid the creation of PBL practices, where generic and disciplinary competences should

complement each other to a higher degree, and introduce a higher degree of coherence within the semester modules and activities.

Based on that the research question of this paper is:

What are the possibilities and challenges for supporting a PBL teaching and studying practice when reorganizing an AAU PBL-based semester towards an integrated and IT-supported semester structure?

The reorganized, integrated and IT-supported semester is studied from a practice-theoretical perspective inspired by Theodore Schatzki (2005) and Stephen Kemmis (Kemmis et al., 2014). By studying the inherent *practices, practice architectures* and *practice activities* that constitute the *Integrated and IT-supported semester* concept, we look at how the IT-supported practice influences the integration, and which possibilities and limitations that are constituted in the concrete site. As detailed below, the analysis is based on student survey data, teacher interviews, teaching observations, meeting minutes, semester evaluations, and earlier work within the PBL Future research.

INTEGRATION AND COHERENCE OF A SEMESTER

Focus of the study is creating a level of integration and coherence across the organization of a semester. University-based educational programs often consist of a set of disconnected individual courses. Creating better coherence may thus be seen as a way to support students' learning (Hammerness 2006). Coherence can be understood "in terms of shared understandings among faculty and in the manner in which opportunities to learn have been arranged (organizationally, logistically) to achieve a common goal" (Tattoo 1996, p. 176). In short, coherence refers to a confluence, where several entities align into a shared direction, or where they individually contribute towards a common goal.

In a semester, coherence can play different roles on different levels, from low-level aspects such as organizational routines, to higher level aspects, such as e.g. theoretical or methodological transfer between different academic learning processes. For AAU semesters, coherence as the aim to achieve a common goal can be achieved through a shared understanding, and an arrangement where different courses, student projects, workshops or seminars of a semester can aid and guide students' learning.

In a PBL-based educational system, three types of coherence can be considered: developmental coherence of productive learning across time; horizontal coherence across curriculum, instruction, and assessment; and vertical coherence between classroom assessments and large-scale assessments. Developmental coherence is about the nature of

learning and teaching, addressing the structure of science disciplines, students' prior knowledge and experiences, and the integration of knowledge and practices. Horizontal and vertical coherence are about the approaches used to promote productive learning for all students (Fulmer, Tanas, & Weiss, 2018).

Considering the degree of coherency between different curricula within a semester may affect and balance how students learn and familiarize themselves with the field. It may also affect how they understand the value of certain knowledge, or how they are able to anchor their learning. Facilitators of PBL practices should consider whether and how the construction of the semester, the application of the learning goals, or the project proposals and supervision of a semester project, are representing a combined coherency.

Coherence should however not necessarily lead to uniformity. Hammerness points out a concern whether creating a fully coherent program could lead to students not coming to terms with alternative perspectives, and concludes that coherence is not so much an outcome as it is a constant process of adjustment (Hammerness 2006).

One of the initiatives of the teachers at MED4 in relation to creating coherence was for all courses to apply a flipped classroom approach as a shared way of organizing the course modules of the semester. A flipped classroom is generally understood as a reversal of the traditional didactic face-to-face lecture, which is pre-recorded and used as a pre-class activity, thereby instead leaving room in-class for further teacher-student dialogues, student activities and active learning strategies to support student learning (Bishop & Verleger, 2013; Jenkins et al., 2017; Lee & Choi, 2019; Triantafyllou et al., 2016). Flipped learning is not a one-size-fits-all solution, but a continuum of various combinations of teaching, scaffolding, technology use etc. (Tomas et al., 2019).

THE CASE STUDY

The initiative to study the Integrated and IT-supported semester concept was carried out at the Medialogy programme, at AAU. Medialogy is an education within media-technology that combines problem-solving, human-computer interaction, design, and media technology engineering to create specific solutions for specific users, often in collaboration with stakeholders. The specific case took place at the 4th semester of the bachelor (BSc) programme and ran from 2017 to 2020.

The study plan for the 4th semester of Medialogy (MED4) consists of three 5-ECTS courses and a 15-ECTS semester project. The general semester theme is '*Sound Computing and Sensor Technology*'. The MED4 semester relies more on math and programming than previous MED semesters, which makes many students rate it a difficult semester. It also shows by the number of students failing the ordinary MED4

course exams (Busk Kofoed et al., 2018). For years, this trend has frustrated the MED4 teacher team, which made them susceptible to alternative approaches, and agreed to initiate a new semester design.

DESIGN: THE INTEGRATED AND IT SUPPORTED SEMESTER CONCEPT

The *Integrated and IT-supported semester concept* is designed by the following premises:

A) Supporting the PBL model at AAU. This is done by ‘creating time’ to support a wider range of possible PBL-oriented activities during in-class sessions (ex. problem-based, group-based, project-orientated, student-led learning). This includes increased student-teacher-interaction, as a benefit of a flipped classroom approach.

B) Supporting a better integration between disciplinary and generic competences. This is done by the use of participatory action research and the collaboration of researchers and teachers. Initiatives have been based on scheduled meetings where all teachers are present and in collaboration have outlined the aim and concept for the integration.

The aim is framed by:

- Create a ‘room for communication on integration’, both between course teachers and between teachers and students.
- Create a practice with activities and exercises that cross-connect courses and consolidate their link to the semester project.
- Create a practice, in which IT, courses and semester work is connected and accessed across courses and semester work.

PARTICIPATORY ACTION RESEARCH APPROACH

The intervention into and investigation of the MED4 teaching and learning practices, followed a *Participatory Action Research* (PAR) inspired approach. This is best represented as a self-reflective spiral of planning, acting, observing, reflecting and re-planning, enacted in iterative cycles of improvement (Kemmis, McTaggart & Nixon, 2014). Improvements are sought from the knowledge and understanding of participants involved, from discussions and reflections on actions, which leads to new understandings (Greenwood & Levin, 2007). As researchers, we have been very aware of our facilitator

roles in the developmental process, as we respond to problems in the field rather than administer a prescribed strategy (Altrichter et al., 2002).

To transform MED4 teaching and learning practices, the PAR approach involved the teacher-team in the pursuit of a pedagogical and organizational change. This organization included teachers and students as active parts of the change process, supporting both planning and implementation with experiences and expertise (Svarre Kristensen et al., 2019).

PAR applies established research techniques - surveys, interviews, observations, project documentation, meeting minutes, etc. - and theories. Meanwhile, inherent to PAR is a dynamic and improvisation-oriented methodology, which can be very dependent on situational or emergent aspects to the phenomena investigated. The action plan for PAR is ideally based on the available contextual evidence, at the time of need (Hammerness, 2006).

The empirical data acquisition for the research project unfolded over a two year period, with the year prior being spent collecting data on past student experiences. The first iteration of the IITS concept took place in spring 2019 at MED4. During this time, the research team conducted observations at teaching sessions, workshops, and semester meetings. Empirical data on students' perspectives was collected during the semester through three online questionnaires with MED4 students, containing both closed and open-ended questions. The teacher perspective was investigated through five individual interviews with the MED4 team, combined with regular status, planning and evaluating meetings for both teachers and research teams, facilitated by the researchers, with teachers as the main contributors to the conversation. In autumn 2019, the research team carried out an additional student questionnaire with the 4th semester students, and held a number of follow-up meetings with the team of teachers at Medialogy 4th semester.

A second iteration of the IITS intervention was initiated in spring 2020, also at MED4, for the subsequent student generation. Here, two student questionnaires were distributed to students, and observations were made at teaching sessions, workshops, and semester meetings. Researcher/teacher team meetings were also upheld, including follow-up meetings with the teacher team after semester completion, autumn 2020. Data used in this research is detailed in Table 1:

Interview 2018	Interview with teachers of courses and project work	One video recorded interview with each of the 5 teachers covering all courses and project work activities. Duration 30-45 minutes
Observations 2019	In-class observations of teaching activities	20-45 minutes observations in classes covering all courses
Interview 2019	Interview with teachers of courses and project work	Video recorded interviews with 4 teachers-covering all courses and project work activities. Duration 30-45 minutes
Survey 2019	Student survey performed in October. Evaluating the semester by quantitative and qualitative questions	40 out of 59 students answered the survey. The questionnaire had 44 quantitative items and 17 open-ended (qualitative) items. This survey was the last evaluating survey out of 4 surveys done in 2019
Meeting Minutes 2019	Minutes from meetings with teachers. The research team set the agenda of discussion	Minutes from 2 meetings. One in March and one in May. Both one hour of duration. All teachers and researchers attended
Survey 2020	Student survey performed in august. Evaluating the semester by quantitative and qualitative questions	36 out of 47 students answered the full survey. The questionnaire had 36 quantitative items and 27 open-ended (qualitative) items. This survey was the second and last evaluating survey out of two surveys done in 2020
Grade statistic 2020	Grading statistics from the administration. Containing statistic on this semester's gradings	Full semester statistics for the 47 students course and project gradings

Table 1. Overview of empirical dataset for this paper.

A PRACTICE THEORETICAL APPROACH

Studying the reorganization of a PBL practice implies not only e.g. a structural analysis of a new semester concept, nor a monoscopic focus on the teachers' individual facilitation of a new (Integrated and IT-supported) semester concept. We apply a practice-theoretical approach that focuses on the analysis of social phenomena, such as a) the support of PBL in a teaching and studying practice and b) the transition of how to collaborate and c) bring disciplinary and generic studying activities together.

The philosopher and practice theorist Theodore Schatzki presents a holistic, theoretical perspective on practices (Schatzki, 2005). This theory is further developed by the educational researcher Stephen Kemmis, who presents a theory of both practices and practice architectures (Kemmis et al., 2014), both of which we benefit from in the analysis of the MED4 intervention. Understanding social phenomena such as MED4 as a practice is done by exploring the context (also referred to as a *site*) where the practice unfolds (Kemmis et al., 2014). According to Kemmis et al., the *Practice* (activities of practitioners) within a site is defined by the *Sayings*, *Doings* and *Relatings* enacted (Kemmis et al., 2014). *Practice Architectures* form the contextual *arrangements* of the practice. Kemmis et al. identifies three types of arrangements: the *cultural-discursive* arrangements (the facilitating context for *sayings*), the *material-economic* arrangements (the facilitating context for *doings*), and the *social-political* arrangements (the facilitating context for *relatings*). The *Practice* and *Practice Architectures* are mutually interdependent. Exploring how they are constituted at MED4 should make it possible to look at how the full organization of IITS is supporting the PBL practice, in its context. The elements of practice and practice architecture, when analysing a site as presented in figure 1, will be used to understand, structure and present our analysis and findings.

Individual side ← Practice → Extra-individual side		
<i>Projects/teleoaffective structures</i> How purposes and intentions expressed by practitioners direct activity		<i>Practice landscapes</i> How practitioners and objects are enmeshed and entangled in activity and how materiality, rules, and procedures prefigure actions by infrastructural sedimentations
Practitioners' characteristic ' <i>sayings</i> '	← How ' <i>sayings</i> ' performatively enacts a practice in semantic space through <i>language</i> →	<i>Cultural-discursive</i> arrangements
Practitioners' characteristic ' <i>doings</i> '	← How ' <i>doings</i> ' enacts a practice through the medium of <i>activity</i> and <i>work</i> →	<i>Material-economic</i> arrangements
Practitioners' characteristic ' <i>relatings</i> '	← How ' <i>relatings</i> ' enact <i>power</i> and <i>solidarity</i> →	<i>Social-political</i> arrangements
<i>Dispositions/practical understandings</i> How actors are attuned to participate in practices, how they have a 'feel for the game', and how they know how to 'go-on': practical knowledge, skillfulness, and appraisal of specific values.		<i>Practice traditions/general understandings</i> How current practice is enacted to reproduce or transform the traditions and history of the local practice or—more broadly—in relation to the traditions and history of practices that span multiple sites.

Figure 1. Elements of practice and practice architecture in a site (Buch & Andersen, 2015, p. 30; adaptation from Kemmis et al., 2014, pp. 38-39).

In the analysis, we do not only pay attention to the teachers' and students' individual sayings, doings and relatings, but also look at how their activities are framed by the arrangements constituted in that context. We look at what Kemmis et al. call *practice traditions* or general understandings (see lower right corner of figure 1) (Kemmis et al., 2014). When analysing the practice of MED4, the analytical focus on practice traditions

is an acknowledgement of how the practice is constituted by its historical entanglements. The PBL practice and the integration of courses and project work is constituted and (re)produced within the MED4 site. Thereby, both are made possible, but also limited by this site of practice activities and practice architecture. The historically embedded constellations of arrangements on the site will be investigated to see how certain aspects in the practice architecture (such as found limitations) may support the PBL practice. Further we will look at how the organization of practice makes it possible for teachers and students to contribute within their *dispositions* (lower left corner of figure 1) (Kemmis et al. 2014). New IT material is entangled in the reorganisation of the 4th semester, and this might change teachers' and students' opportunities for action. This will be a focus of our practice theoretical analysis using Kemmis et al.'s concepts. A third focus of the analysis is the concept of *practice landscapes* (upper right corner of figure 1). Looking at the practice landscape within the IITS concept puts focus on how rules and procedures of activities within the practice constitute and support PBL activities.

By using the practice-based lens by Kemmis et al. (2014) we aim for an understanding of the organizational *transformation* of social phenomena such as change in the PBL-supported teaching and studying practice. The practice-based theory presented by Kemmis et al. (2014) draws our analytic attention to a duality of individual and social phenomena, which constitutes both the individual's agency and the structures in social activities, and requires reflection on both when investigating social phenomena. We use Kemmis et al.'s conceptualization of practices to investigate the constitutions of the 4th semester, not just from the perspective of a leader, teacher or student, but from that of a dynamic and holistic site.

ANALYSIS: PRACTICE TRADITIONS FEEDING INTO THE REORGANIZED PBL PRACTICE

The revisions made to the AAU PBL model have followed developments in society and latest in 2010 a bigger reform changed the constitution of the AAU PBL model. Harmonization of university accreditation, adjustments to the Bologna Directive and a new grading scale put pressure on the PBL organization, and a new PBL model was developed. Before the changes, courses and semester projects were much closer connected and often examined together, and disciplinary course knowledge was naturally supported in the more generic competences developed in the project work. After the changes to a new PBL model, courses and semester projects are largely assessed separately (Dahl & Hüttel, 2015) and the focus on practicing the PBL principles has been criticized for being diluted (Hüttel & Gnaur, 2017). Problems with routinisation of the project work has been pointed out (Hüttel & Gnaur, 2017), along with problems integrating course content to project work (Busk Kofoed et al., 2019). Due to courses

working in isolation from both other courses and project work, the possibility for applying knowledge in a transversal fashion, and building those competences in general has weakened in the historically anchored practice architecture. A survey study done in 2019 covering the entire Aalborg University, showed that the most important issue with practicing PBL, as rated by teachers across all faculties, was creating better connections between projects and courses (Clausen & Kolmos, 2019).

As such, the social-political arrangements from this have constituted a number of problems in the practice landscape of PBL at 4th semester Medialogy. Rules and procedures rooted in the practice tradition of regulations done in 2010 are limiting a coherent PBL practice. At the 4th semester Medialogy site, interviews with teachers describe an historically anchored silo-organized practice between courses and project work (Interview 2018). This practice tradition is one that has fed the 4th semester for years, where teachers from each course have worked in complete segregation from teachers of other courses (Interview 2018).

Looking at the present re-organized practice of 4th semester we see how practice traditions are still feeding in the IT-supported and integrated concept and still constitute limitations in the practice and practice architecture.

SAYINGS AND THE CULTURAL-DISCURSIVE ARRANGEMENTS

Before starting the integrating and IT-supported intervention (spring 2019), MED4 teachers' communication level was generally low, and especially concerning discourses relating to integration prospects, or other holistic approaches to the semester's coordination. As a result, teachers of the same semester had very little knowledge on the teaching experiences or content material of the other courses (Interview 2018) (Svarre Kristensen et al., 2020b).

To implement an IITS teaching practice, researchers arranged meetings with teachers, with agendas on IT and semester integration (Meeting Minutes 2019) (Busk Kofoed et al., 2018). A shared language was established with two distinct discourses; a language on teaching subjects, and a language on programming approaches (Meeting Minutes 2019). To enable integration of course content and project work in a teaching practice, teachers directed the practice towards what can be called "a common third", as the 'third' (often interdisciplinary) space, besides their two individual perspectives or disciplines, where parties are able to share and combine impressions, knowledge, experiences or plans. This space can work as a common starting point. The academic theme of MED4 focuses on audio processing, but this common starting point was in practice not very prominent. Lectures, exercises, practical examples, homework and work with IT-applications needed

a shared trait, as a centerpoint that was commonplace, and applicable across all courses and project work (Observations 2019; Interview 2019). The ‘common language of the subject’ was narrowed down to only concerning a language of audio (Meeting Minutes 2019). A common language of audio thereby became legitimate for teachers, as a focal point in the teaching practice. More so than otherwise common academic areas for Medialogy, such as languages of game design, film theory, or virtual reality. In practice, this meant that certain course activities, which would previously be legitimized through different discursive subject foci, would now focus on only one. For example, a workshop in electronic systems, which in previous generations asked students to design a game, as the thematic vehicle for the electronics workshop, now focused the workshop on instrument design, while maintaining the overall learning objectives of the workshop (Observations 2019).

The legitimation of audio as the core and shared subject, as a transcending theme and language, made it possible to integrate and transfer knowledge, e.g. from the electronics course to the audio course. At the audio course, students were now able to create sound datasets, relate it to their experiences from the electronics course, and relay it into their own creation (the instrument) from the workshop (Observations 2019). So while learning about audio processing, students would need to revisit and contextualize the electronics course theory and application. The legitimation of an audio discourse at the semester level, makes the application between different courses and project work possible. Thereby, it actively represents the classic AAU PBL principle of *courses supporting project work*.

A common language to facilitate integration thereby works as a supportive arrangement. Thus the legitimation of audio also allows the audio discourse a specific privilege, for instance in the constitution of the teaching practice. This had a mixed impact on studying practices. From not experiencing any connection between courses and project work in 2018 (Busk Kofoed et al., 2019), students now understood and explicitly stated how suddenly ‘there was a clear connection between courses and project work’ (Survey 2020). A student survey from august 2020 showed that, on average across all courses, 19 out of 25 students rated the integration between courses and semester project as *good* (Survey 2020) (Bruun-Pedersen et al., 2020). However, motivation was becoming an issue among some students (Survey 2019). Medialogy works with media technology from a holistic point of view, so audio is only a part of the academic profile. MED4 students who did not study Medialogy based on interests in audio, now criticized the IITS approach for its narrower practice, leaving these students with a perceived loss of flexibility for projects and courses (Bruun-Pedersen et al., 2020). This reaction is logical. The freedom of self-chosen problems for learning is one of the most prominent promoters of students’ intrinsic motivation. When a semester organization changes the culture midway into the

undergraduate program, by introducing a highly privileged discursive subject (here, audio) to direct both teaching and studying practices, it can logically affect self-direction and student-centered learning, and create barriers for individual students' intrinsic motivation.

Another common language discourse, legitimized by the intervention of the MED4 teaching practice, was a uniformed programming language. In media technology engineering, many different programming languages can be used for various purposes. To the uninitiated, a 'programming language' is the method and bricks of how an IT-engineer builds a software program. It's called a language, because it is written 'to the computer' as text-like sequences (lines), which to the programmer forms a construction, of structures, areas, actions, patterns, rules, cross-referential pointers, libraries of information, etc. Individual programming languages differ by their specific practical commands, or specific structural methods. A programming language therefore constitutes the way in which practitioners talk about- or around the subject of programming.

Through the Medialogy education, students are often taught a programming language in one course, and another programming language in a different course, depending on the needs of the course and the strengths of the particular programming style. To support the concept of integration and coherence, MED4 teachers chose to introduce a uniform programming portfolio, which was applicable across courses and project work at the semester (Meeting Minutes 2019). Special electronic equipment was bought and implemented, which was able to receive and process the uniform programming approach for audio work.

This transformation also gave transitional dilemmas. Not all teachers were competent within the new programming language, and needed additional dispositions. The resources (time) for this were not available, and would have to be taken from a null pool of work hours. As such, optimizing the semester through a transformation to new systems and routines - in this case IT and programming language updates - showed costly. It placed pressure on the teachers' overhead and available competences, which undoubtedly affected the overall execution and subsequent experience and evaluation of the transformation (Svarre Kristensen et al., 2020b).

DOINGS AND THE MATERIAL-ECONOMIC ARRANGEMENTS

Despite a common subject- and programming-language, teaching and studying practice is characterised by diversity, concerning how to act within a certain practice. Practice traditions and landscapes constitute the method of *doing* the integrated and IT-supported semester. It depends on several aspects, including course curricula and study regulations,

teachers' experience with IT and different pedagogical strategies eg. experience with the flipped classroom approach which was used to a different degree at all courses. As well as teachers' and students' experience with PBL as an active learning approach.

Recent work has applied Bernstein's concept of classification and framing, as an interpretive framework for the formal curriculum of this specific MED4 semester (Melbye Boelt et al., 2020). Here, it was suggested that boundaries of subject and content classifications appeared blurry, making the MED4 study plan generally appear dynamic and adaptive to certain integration changes, by design. Meanwhile, the classifications differed between some aspects of course and project coherence, and some of the pedagogical framing appeared to hinder some integration opportunities (Melbye Boelt et al., 2020). This underlines how the formal curriculum is part of the recipe, as potentially both an enabler and a limiter on the extent to which integration between curricula is possible.

At the 4th semester Medialogy, different material arrangements are constituting the options and limits to what teachers and students can do within the practice. The flipped classroom approach provides teachers with access to new types of teaching material, and new mediation methods for those materials. Different types of flipped learning material was chosen by individual MED4 teachers (Meeting Minutes 2019; Observations 2019). For example, the *electronics* course (PID) teacher chose exclusively to use open access online resources for his out-of-class teaching, while the *experiment design* course (DAE) teacher produced her own videos (Meeting Minutes 2019). The differences in teaching materials gave students diverse course experiences (Observations 2019), and showed both teachers and students diverging ways of interacting with the material.

The DAE teacher had several years of experience with the flipped classroom approach, and had produced and refined her course material over time (Interview 2018). Student survey responses suggest the experience and teachers dispositions within the approach affected students' perception of the learning material accessibility (Survey 1019). Students also rated the online homework resources as well-balanced, and rated both the in-class exercises, and the proportions between workload and learning material difficulty, as very positive (Survey 2019) (Svarre Kristensen et al., 2020a).

For integration initiatives, students responded that DAE activities were successfully pointing to- and supporting the project work well (Survey 2019) (Bruun-Pedersen et al., 2020). In contrast, the use of open access resources for the two other courses, created issues for the appropriation of learning material, to properly address the learning objectives (Bruun-Pedersen et al., 2020). Student responses considered the learning material too difficult, the workload too large, and only a low degree of cross-cutting

activities supporting the course material integration into students' project work (Survey 2019), (Svarre Kristensen et al., 2020a).

Doing teaching and studying practices within the material arrangement of videos have implied a list of challenges when not experienced and having the right dispositions.

1) Using open access learning material includes the risk of information overload. Students don't know what and how to interact within a too big pile of learning material. Student responses in our survey data (survey 2019) asked for clear and sequential guidance to material, to correctly understand a) learning material purposes, and b) connection between readings and tasks (Bruun-Pedersen et al., 2020).

2) The IT-based material creates new possibilities for interacting with the students, but new ways have to be learned. The quality of in-class activities when having video-mediated learning before the in-class interaction is dependent on the students' preparation. Teachers find it difficult to monitor the level of this understanding among students at a given time (Meeting Minutes 2019). Not doing traditional lecturing creates a different process for teachers, e.g. when sensing students' state of understanding towards in-class exercises. Quizzes and summative testing of students' understanding adds insight, but only to a degree. In an interview, a teacher explained how a student group appeared to make good exercise progress, but actually had fundamental issues: *"when you start to discuss with them, you realize that they don't really have the concepts in place"* (MED4 teacher interview, 2019).

3) The flipped learning material may create better learning possibilities for some students, while creating limitations for other groups of students. In this 4th semester, few students obtained an 'average' grade (Grade statistic 2020). Teachers comment that the flipped learning approach created a clear divide between students performing very well and students performing poorly. This was evident in both in-class activities and assignments, as well as exams (Observations 2019; Interview 2019). When required to work with online video material from home, the students that struggle with tasks based on self-discipline and individual work will be challenged. Student responses show that a portion of students don't watch videos or other learning material, and arrive unprepared at in-class activities (Survey 2019, Survey 2020). Teacher reports mirror this, stating how the transition to the flipped learning material has explicated the learning gap for students who arrive unprepared for lectures. To circumvent the issue, in-class introduction sessions were introduced as small meta-lectures at the in-class session openings, going through some basics before doing exercises to kick-start students (Meeting Minutes 2020). These meta-lectures can be a possible way around the challenges when engaging with PBL exercises heavily depending on homework. Important to add is that a big group of students did respond very positively, and found the pre-class video material directly motivating, and consider the intervened 4th semester as the best coordinated and

integrated semester they have yet experienced (Survey 2019) (Bruun-Pedersen et al., 2020).

RELATINGS AND SOCIAL-POLITICAL ARRANGEMENTS

Relations and interaction in the teacher group was affected by the integration process. Teachers had to increase communication frequency to align teaching content (interview 2019), and gain greater mutual insight into each other's work and teaching content. This consolidated their team and increased the possibility of well-informed, assistive discussions between teachers. During their planning of course approaches or improvements, teachers were able to look at not only the individual courses, but also their alignment (e.g. progression or workloads). As one teacher highlights in an interview: *“thinking about what type of knowledge they should have, and see how you can support that in different stages... Like, at what point does it make sense that we push them more in one course, and at what point do we need to step back, and have a little bit of ease in the other.”* (MED4 teacher interview, 2019). Their communications thereby include planned touch-points, course progression, content developments, and cross-cutting activities (Meeting Minutes 2019). The relations when working with integration, thereby have to be organized in high degree by solidarity and work tasks organized in a shared practice understanding. Subsequent to the reorganization, the teacher group experiences a higher degree of dependency on a) each other, and on b) central coordination (Interview 2019). The semester coordinator especially needed a redefinition to adhere to and lead the additional integration requirements. Responsibility areas include initiating integration activities (for example initiating teacher team meetings), facilitation of cross-course activities (such as workshops), joint project supervisions (including both course teachers and project supervisors), and all semester-level communications on integration activities for students.

While constructive for integration and coherence, a full semester overhaul is time demanding, especially due to the cross-coordination of activities and progressions (Svarre Kristensen et al., 2020b). Therefore it has also been important, while working with a bigger shared practice: more crosscutting communication and shared work tasks, to (re)define and make clearer divisions in teacher roels (interview 2019). This to make the teaching obligations and the integration work tasks manageable.

Relations and interactions between students and teachers were also affected by the integrated and IT-supported semester model, during in-class exercise interactions. Interviews with teachers highlighted some intricate details of this dynamic, for example, how it opens the possibility to relate coursework to project work. However, the prolonged space for interactions during in-class sessions surprised teachers with its foreign dynamic, which they found ‘needs to be properly understood to be used effectively’. One

teacher explained the process as “*When you try to check up on what they have had to read, or if they have understood those important points, and have them try out a little bit. And then somewhere after there, you should still have time to actually relate to their semester project and have some useful discussions. I think there's room for improvement there, because it was difficult to know when to do this in a good way*” (MED4 Teacher interview, 2019). In the discussion space, the *relatings* between students and teachers are activated, especially compared to conventional classroom teaching. The in-class lecture space is a central, strategic social space, where integration can be strengthened tremendously. But only if the teacher’s semester team is well organized and well informed about the integration points of the semester. Either by touch-points between courses themselves, or their expected applications into the projects.

Acknowledging the need for extra resources towards the semester transformation and integration-oriented approach, a teaching assistant was hired to work on two of the courses, and to supervise project work (Meeting Minutes 2019). This was important for establishing coherence, because it built cross-course experience, and strengthened the relation between the teachers. The teaching assistant further supported the semester communication and the semester coordination, likely being the person with most knowledge about students’ practical and learning progression (interview 2019). Another effective priority was to organize supervision to only include course teachers (Meeting Minutes 2019). This provided closer relations to students’ knowledge progression in courses according to the expected project progression, and ability to support course integration into project work (as a supervisor) (Observations 2019). Finally, the coordinator asked students to formally deliver a written documentation, which lists how each course was used to support the project.

Defining the rules in the practice of how to work with both disciplinary knowledge and more interdisciplinary IT-based knowledge, has brought up discussions and new ways of relating to the professional work of teaching. Among the questions raised by the teacher team to plan the semester, are the following: *When is basic disciplinary knowledge needed to support cross-cutting activities? When is specific knowledge of how to use IT supporting and integrating tools and learning material needed?* (Meeting Minutes, 2020). These reach into the practice landscape of how power and solidarity has been constituted between teachers and their professional work. The MED4 students have been introduced to a range of new IT tools (e.g. the new programming tool, and other technical and mathematical tools). Teachers explain how students have had to develop domain specific competences on how to use the IT tools, to accomplish the disciplinary work tasks, while relying on the IT tools. This should be done at a time where students also need to build basic disciplinary competences, to know why/when/how to work with specific IT tools. Students’ IT dispositions within specific tools can not be seen in

isolation, but have to relate to the disciplinary competences. Teachers have to plan for this, and spend teaching hours to connect domain specific knowledge to needed IT-specific competences, and acknowledge that the IT-specific competences cannot be an explicit part of the course assessment, as it is not part of the learning objectives.

Teachers at MED4 have always used IT-tools in relation to teaching disciplinary competences, but have had fair freedom of choice. Now that the choice of IT tools need to be supported and applied by the entire teacher team, used for flipped processes and interdisciplinary integration, their role is very different, and so is the time needed for ongoing investments into proper application, procedure management and communication for experience sharing and modification. Teachers have needed to balance the disciplinary and IT domain specific knowledge in new ways under the integrated semester concept, and even ask for institutional guidelines in this manner. When the study plan doesn't accredit the more heavy work with interdisciplinary IT-based knowledge, it is hard to give it focus and power in practice.

DISCUSSION AND CONCLUSIONS

In this paper, we have investigated the research question: *What are the possibilities and challenges for supporting a PBL teaching and studying practice when reorganizing an AAU PBL-based semester towards an integrated and IT-supported semester structure?* Using digital tools to support integration has in many ways supported a more PBL-enacted and PBL-coherent practice. Initiative such as using a uniform, shared and cross-cutting programming language has increased integration between courses and project work. However, using the programming language with this intent, is a demanding initiation, challenging teachers' dispositions with the tool. Programming and IT tools for integration have also shown to be rather time demanding in use, as students may need to learn the IT tool, to enable themselves access to an actual study plan learning objective. Discussions on how to balance the power relations of disciplinary competences and IT domain-specific competences, have occurred in the teaching practice of the 4th semester at Medialogy. It shows a clear need for time to introduce IT-supported, domain-specific competences. This is complicated, as the Medialogy study plan does not accredit IT domain-specific competences.

Flipped learning material has also shown challenges within teaching and studying practices. A risk of information overload when using open access resources, as open access learning material demands a strict control of tasks and exercises. To reach the group of students that infrequently prepare from home, it was necessary for the teachers to introduce in-class intro-sessions, as short meta-lectures before proceeding to in-class exercises. We also see how students who arrive prepared, benefit extensively from the

flipped classroom approach. The flipped classroom approach has also shown to be increasingly useful, as teachers become increasingly experienced, and when the learning material is self-produced, or otherwise focused and well produced. When balance is found between out-of-class homework and in-class activities, including successful teacher-student interactions that lead to transversal discussions, the flipped learning approach has shown to enhance the possibility for supporting PBL processes, and supporting integration between courses as well as course-to-project.

Integration initiatives for coherence across the semester has also been done from a perspective outside the digital domain. Creating a discursive legitimation of how to interlink the courses and project work through the semester theme, has made communication across the teacher team possible and valuable. Making 'audio' become the privileged discourse at MED4, even at the expense of other subjects, such as game design, has given the teachers and students a common language to direct integration. The narrowed discursive legitimation has made it possible to coordinate activities across the course- and project work. And hiring a teaching assistant that works in the crossfield, also helped the integration. The increased, cross-going communication and coordination between courses and towards the project, has however demanded clearer definition of roles and responsibilities. An improved structured planning, and aim for communication and coordination has also become extra important. The semester coordinator role is now even more vital, and structural support for the semester coordinator work is necessary. We have also seen how initiatives ensuring that supervision for project work is kept within the course teacher-team, has shown great supportation of coherency. Initiatives making students reflect on the integration by direct mention of courses' role in projects, while framing their self-directed problem statement for their project, has also supported the integration.

All in all, we have seen how historical and political arrangements, concerning how course and project work are integrated, have fed into teaching and student practice for years. It has constituted a practice of silo thinking, and missing coherence in the organization of a semester structure. Change initiatives focusing on reorganizing IT engagement can support a better integration, but the practice architecture needs to constitute possibilities for this transformation. Organizing the teaching and studying practice, at e.g. this 4th semester at Medialogy, to support better coherence, has required the establishment of a common, legitimized discursive language, where engagement in interdisciplinary communication and coordination is possible. Organizing courses and project work, under a semester theme that goes across the entire semester, is a help to create a common language, but it also needs to be actively used and supported by the practice landscape, to actually support an integrated semester organization.

Organizing the learning material within an IT and Flipped Classroom approach, has shown to be most possible, if teachers are experienced and have had time to adjust the learning material to students' need for interaction. Reorganizing the learning material is demanding, and IT-dependent issues have filled a lot at 4th semester Medialogy. But more time for student-teacher interaction, discussion, exercises and active learning has also been found. Organizing more time for active learning in the classroom, if facilitated according to the PBL principles, can support a PBL organized practice. However if too much time is spent on finding solutions for IT-dependent issues, the aim of supporting PBL may fade noticeably. Creating supportive rules and procedures for how to engage and prioritise the use of IT-supported integration, is therefore of great importance. Supporting an organization of communication and coordination across a semester, giving time and economic support to develop integration planning, as well as new learning material - this should be accredited. A coherent semester structure is important, especially when the aim is a transformation into coherent PBL practice, which is supported by IT-organized processes, for a stronger semester coherence, with integration across courses and project work.

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