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Teaching Critical Thinking Within an Institutionalised Problem Based Learning Paradigm – Quite a Challenge

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ABSTRACT

This paper reviews the design of a 'Professional Inquiry' course taught for four years to Information Studies students at Aalborg University, Denmark, within the pedagogical paradigm of Problem Based Learning (PBL). The course teaches students how to formulate research questions and scientific problems, and determine what is worthwhile knowing within the field of informatics. Assuming critical thinking to be an integral part of PBL, and PBL being an integral part of our university's pedagogy, we did not anticipate the conflicts which surfaced from our four years of teaching this course, conflicts which are putting students' cultivation of critical reflection skills at risk: (1) while project work revolves around real-world problem-solving, critical thinking requires inquiries into what we already know, the ways we know, and why we know and not know, hence implying continuous reformulation of the problem under research; (2) while making critical thinking the subject of a course gives this skill focal attention in a fixed period, it by the same time may give students the impression that it is something to get over with; (3) while to think critically require time to review past accomplishments, the continuous pressure to deliver on time invite students to shortcut reflection time; and (4) while teaching hours allocated to curriculum keeps being cut, students' needs for being meet where they are, keeps growing.

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INTRODUCTION

This paper is a self-reflection of four years of designing and teaching a graduate course entitled 'Professional Inquiry", a 5 ECTS meta-course to students of the Information Studies master's programme at the Faculty of the Humanities at Aalborg University.

A review of our teaching experiences shows that the university students of today's occidental world, in our case Denmark, face considerable pressure to deliver, get good grades, do as told and become individual successes in all aspects of their life to the extent that it jeopardises the pattern which should connect their items of learning and cultivate their ability to tell what is worthwhile knowing. Hence, we bluntly ask whether the institutionalised Problem Based Learning (PBL) paradigm allows students to cultivate their critical thinking skills. We are aware that finding ways to develop critical thinking is neither a simple nor an easy task. It has been a concern for educators since Plato, and we remember Gregory Bateson's (2002) famous warning in a letter to his fellow regents of the University of California: 'Break the pattern which connects the items of learning and you necessarily destroy all quality' (p. 7). Nevertheless, even though our material for posing this statement is limited, we find that the question of how to best support students' cultivation of their critical thinking skills require more attention, not least within an institutionalized paradigm of PBL claiming to have critical thinking as its DNA.

Graduate education forms a doorstep from schooling to professional practice. At work, you bring what you learned in graduate school to problems in your professional practice, situation by situation and day by day, and you learn how to improvise. The journey from being a student in higher education to becoming a professional practitioner with an academic background has been described as a journey from being taught and examined in espoused theory at university to becoming a reflective practitioner (Schon, 1983), passing – while gaining situated experience – from the level of a novice, who exercises the rules of espoused theory rigidly, to higher levels of situational application of theoretical knowledge (Dreyfus & Dreyfus, 1986). Teachers involved in graduate education, who want to prepare students to become reflective practitioners in their work life, must engage in their teaching with both sides of the doorstep to help students to develop a sustainable ability to determine what is worthwhile knowing.

Aalborg University, which was inaugurated in 1974, was founded on the idea of putting academic knowledge into societal perspective. The founding mothers and fathers chose the paradigm of PBL and Project Organised Learning (Dirckinck-Holmfeld, 2002) as its pedagogical foundation. Over the years, however, efficiency policies, standardisation and quantitative measures have put pressure on the idea of contextualising theoretical knowledge through dealing with real-world problems. Nevertheless, Aalborg University continues to use PBL as not only *an institutional frame* for the students' study work, in

that all major exams take their point of departure in study groups' reports from problem-oriented project research, but also, and consequently, as *a social frame,* since students are required to collaborate on these projects.

There is an ongoing debate at Aalborg University regarding the potential discrepancy between teaching and learning espoused theory and the pedagogical paradigm of PBL, and regarding the teacher's role in helping students to situate the academic knowledge in real-world problems in ways that prepare them to become reflective practitioners. Such preparation is an endeavour to which cultivating critical thinking and critical reflection and developing the ability to repeatedly question problem formulations seems the obvious key. Teachers know that it takes time to develop these skills. Currently in Denmark, however, governmental initiatives push for increased productivity in the educational sector, the consequence being that teachers and students are forced to meet pre-set goals rather than to open up explorative and curiosity driven learning processes. Based on data from their teaching, and referring to De Graaf and Kolmos' (2003) distinction between 'task projects', 'discipline projects' and 'problem projects', Hüttel and Gnaur (2017) showed a drift towards the prioritisation of task and discipline projects over problem projects. Hüttel and Gnaur (2017) attributed this drift to the widespread use of teacher-formulated project catalogues, from which the student project groups prefer to choose their research problem when initiating their problem-oriented studies. In another empirical study, also in an Aalborg University context, Guerra and Holgaard (2016) discussed the lack of clarity of the role of competence for critical thinking in PBL. Within the engineering study programmes, Guerra and Holgaard (2016) proposed translating critical thinking into tangible elements to make critical thinking part of ongoing work incorporating problem identification, analysis and formulation, inquiry, and argumentation for the best solution(s). They translate critical thinking into a questioning model that can be applied throughout students' project work to support their critical thinking: **WHO** (teams of students, facilitators and stakeholders) is **THINKING CRITICALLY** (problem identification, analyisis, formulation and solving) and **OUT LOUD** (group discussions and scientific, motivational, and contextual argumentations) about **WHAT** (oneself, the team, a discipline or other social instiurions) with what **PURPOSE** (solving real life problems, independent learners and relating theory with practise)?

Guerra and Holgaard's (2016) model is meant to be instrumental for engineering students' critical thinking in the context of their project work – 'a scientific enterprise', as Arendt (1971, p. 5) put it in the quote that opens this paper. The situation within the Humanities is however somewhat different. Here "the human condition" is part of any inquiry one way or another, and hence a uniform characterisation of critical thinking is harder to give. We have chosen to emphasise that having 'the human condition' as an inevitable element of any study, requires philosophically and historically reflection. Given its subject of

information systems and digital technologies, the Information Studies programme is a crossover between a scientific constructive enterprise and a philosophically and historically analytical study. In the first year of designing and teaching 'Professional Inquiry', we chose the brothers Dreyfus' book 'Mind Over Machine' (Dreyfus & Dreyfus, 1986) as our point of departure, precisely because it deals with human thinking, information systems and digital technologies on philosophical and historical grounds.

When we accepted the invitation to develop and teach the course "Professional Inquiry", we knew that we were taking on a challenging task. A review of experiences from 30 years of deploying the PBL pedagogy at Maastricht University (Moust, Van Berkel, & Schmidt, 2005) showed already more than a decade ago that, over the years, key elements of the PBL study activities have changed in ways that undermine the original PBL pedagogical paradigm. For example, students' time spent on self-study, preparation for supervision and literature search have dropped, while in the same period, numbers of students per group have increased and students have been employed as supervisors; however, there is a growing fear among staff that the subject-matter is not sufficiently covered. Without conducting a similar investigation at Aalborg University, but drawing on many years of experience teaching PBL at Aalborg University (5 and 33 years), we have noticed that students' investment in PBL study time has decreased, while our attempts to teach-to-task to protect the level of academic knowledge have increased. Similarly, the material and immaterial facilities constituting the PBL learning environment have decreased, while the governmental push on students to shorten their study time has increased. Hence we in the outset acknowledged the cross-press of shortening resources and increased pressure to complete studies on time, but we were optimistic that our effort with the Professional Inquiry course would improve students' critical thinking within the PBL pedagogical paradigm.

Our self-reflection about the course experience is grounded on the work of Schon (1983) about the reflective practitioner, specifically on reflection on action (reflecting on past events and how practice can be developed to build professional knowledge and expertise). Reflection occurs on a cycle of action, reflection, and action. The last four years we have done this cycle of reflection: reflection in action during each course and reflection on action after each course. However, in this paper, we have gone through a longer process of reflection on action. This reflection on action is based on an analysis of a corpus of our lecture notes and the Moodle[1] material consisting in study regulation text, the course descriptions year by year, course activities year by year, student journals year by year, and notes on evaluation. We looked at the students' learning situation: the time slots for studying and the number of activities, and their social situation as newcomers to a foreign country or as Danes having to collaborate with newcomers, as well as the overall educational climate in Denmark: what is rewarded and what is ignored. We related our

aim of teaching critical thinking as part of PBL in a humanistic academic context to this corpus and performed a critical walk through.

We chose this way of looking at our material and experiences because we are doing reflection on our own practice with the aim of improving as teachers. Hence, we do not focus on the students learning, we focus on our reflection on action as teachers in order become better at designing learning environments where the students find themselves motivated and able to learn the competences of critical thinking.

In the next section, we describe the 'Professional Inquiry' course followed by an outline of our didactic considerations. Then, we review our lessons learnt from the four years of teaching the Professional Inquiry course in light of the issue of critical thinking and PBL. Based on which we discuss critical thinking and PBL. We end the paper with a conclusion regarding the question of whether the institutionalised Problem Based Learning (PBL) paradigm allows students to cultivate their critical thinking skills.

FOUR YEARS OF TEACHING THE 'PROFESSIONAL INQUIRY' COURSE

The Information Studies programme offered within the Humanities at Aalborg University is taught in English and admits students holding a bachelor's degree in communication or informatics from all over the world. Many of these master students have difficulty understanding PBL as an institutional frame for their study work, let alone as a motivator for studying. We know this, not only from years of teaching the 'Information Studies' programme, but also from empirical research within the engineering study programmes at Aalborg University, which has revealed that students have difficulty deploying theory in a self-directed learning environment based on real-life problems (Guerra & Holgaard, 2016). Students tell us that in their prior studies, they were told what knowledge to acquire to solve a given problem. Those coming with a bachelor's degree in informatics from a computer science department also have trouble understanding the Humanities' academic culture, because they are used to *solve* problems rather than go back and forth trying to define a research problem. Hence, it is quite a challenge for us as teachers to make the subjects we are teaching relevant and motivating for students, while also making the PBL study form relevant and motivating, and helping students account in scholarly ways for the theoretical knowledge of the curriculum. These difficulties motivated the development of a course specifically aimed to develop students' ability to formulate research questions and scientific problems within the field of informatics. The study regulation describes the 'Professional Inquiry' course as follows:

*'**The module** comprises the development and phrasing of empirical inquiry for enabling students to formulate research questions and examine scientific problems within the field*

of informatics. This development will form the basis of the problem-based project work and inquiries to be carried out during the informatics study programme. Objectives: In this module, students will acquire (1) ***knowledge of*** *the connections and differences between empirical inquiry and research questions based on informatics, the connection between research questions and the theory of science in the organisation of scientific research, and theory of science within the field of informatics; (2)* ***skills in*** *describing empirical inquiry, translating empirical inquiry into a scientific research question within the field of informatics, and combining a scientific research question with the theoretical basis of its investigation; and (3)* ***competences in*** *preparing scientific research based on personal enquiry, taking a reflective approach to the basis of scientific inquiry, and engaging in disciplinary collaboration on scientific problem formulation'. (Own emphasis).*

In 2014, we developed and taught the first edition of the course, which was well received by the students. We received positive student evaluations, and some students even approached us asking for a continuation of the course in the following semesters because they found that a continuing focus on the course topics was valuable to the development of their study practice, specifically in relation to 'academic writing', 'listening' and 'giving feedback'. However, the students made no mention of more abstract elements such as 'critical thinking', 'problem formulation', 'PBL' or 'professional inquiry'. The course evaluation is a pass or fail of a seven-day take-home assignment on a set topic, or students have to perform a specified set of activities to a satisfactory level and show active participation. Almost all students choose the second option.

Table 1 presents an overview of the design of the 'Professional Inquiry' course from 2014 to 2017. The overview shows that, over the years, our focus slid from espoused theory to professional identity development because we gradually became increasingly concerned with 'finding the students where they really are' (Kierkegaard[1]). Overall, the lectures were shortened and the learning-by-doing parts were given more time.

[1] The Danish philosopher Søren Kierkegaard is famous for the following dictum regarding what he calls 'the learning profession': *'This is the secret in the entire art of helping. Anyone who cannot do this is himself under a delusion if he thinks he is able to help someone else. In order truly to help someone else, I must understand more than he, but certainly first and foremost understand what he understands. If I do not do that, then my greater understanding does not help him at all. If I nevertheless want to assert my greater understanding, then it is because I am vain or proud, then basically instead of benefitting him, I really want to be admired by him. But all true helping begins with a humbling.'* (Kierkegaard, 2009, p. 45)

	2014	**2015**	**2016**	**2017**
Course announcement to the Information Studies students in AAU LMS Moodle ®	*'The goal of this "Professional Inquiry" course is for the students to become articulate and skilled in what PBL entails, how to study the PBL way and how to assess the quality of outcomes of PBL studies, all by being exposed to a PBL practice – a practice which encompasses a circle of steps from (a) identifying a self-chosen societally relevant problem – which in this case means competence in professional inquiry in and outside of Academia, (b) engaging in searching for literature and empirical facts, (c) problem delineation, (d) empirical and theoretical inquiry, (e) experiments, (f) production and (g) writing up a shared project report.'*	*'This Professional Inquiry course will teach students how to become professional inquirers. Two points are worth emphasising: professional inquiry is a craft, learned through practicing, and it is very much a collective, collaborative act of going back and forth over arguments in acts of listening and questioning. You do not become a professional inquirer by following this course, but you can learn how to become one. In each session we deal with one of the constituents of professional inquiry, the knowledge we present is "accumulative", the themes are linked, and you cannot skip participating actively.'*	The same announcement as in 2015	*'The module presents PBL as a pedagogical model and as a backbone of research practice. Students learn through hands-on exercises and critical reflection of how to make a problem formulate their driver of inquiry. The course highlights how to treat a "problem" theoretically, through empirical investigation, all within the field of Information Studies. The module will use a framework we call "Professional Inquirer in the PBL way" as a map of the landscape of knowledge and skills to be acquired through the course.'*

Teachers' focus and topics	**Focus:** PBL and how to become an academic scholar **Topics**: PBL, scale of professional competence development, search for literature, problem formulation, research methodologies and methods, writing	**Focus**: PBL and the ability to understand and discuss academic literature **Topics**: PBL, the concepts of epistemology and ontology, research methods, tools and methods for Professional Inquiry, problem formulation, fact checking	**Focus**: PBL and capability of critical thinking when performing as a professional inquirer **Topics**: PBL, identity of a professional inquirer, methods and tools for professional inquirers, fact checking, scholarly ways of reading and writing	**Focus**: PBL and how you organise theories, data and techniques around the problem **Topics:** PBL and the professional inquirer, scholarly ways of reading and writing, tools for problem identification, the process of problem formulation, fact checking
Teaching activities	Lectures. Asking questions the Action Learning way. Writing exercises and submissions to an online blog. Self-assessment of PBL competence using the Dreyfus & Dreyfus competence ladder. Training in identifying the research problem in academic articles. Problem formulation using Creswell's scheme. Reformulating the problem using the ten steps framework. Designing an experiment. Skilled performance through role play training, case: job interviewing.	Lectures. Reflective Journal: Between 1 and 2 pages per week about the theme of the week, with written teacher-feedback. Training in chairing a Professional Inquiry discussion of a teacher-chosen paper. Writing a paper: Each student is required to write a five-page academic article demonstrating skills as a professional inquirer, with written teacher feedback. Skilled performance through role play training, case: job interviewing.	The same as in 2015 with some literature changes	The same as in 2016, except that skilled performance was replaced by a LEGO® SERIOUS PLAY® workshop on problem formulation

Table 1: Course Design 2014–2017

DIDACTICS OF THE 'PROFESSIONAL INQUIRY' COURSE

As stated in the introduction, we consider cultivating critical thinking and critical reflection and developing the ability to repeatedly question problem formulations essential for developing students' ability to determine what is worthwhile knowing. In our teaching, we drew on three theoretical sources to help the students build their understanding of critical thinking. Schön's (1983) 'The Reflective Practitioner' outlines the concepts of reflection-in-action and reflection-upon-action with examples. Schön (1983) introduced the concept of 'repertoire', suggesting that students should have their own 'tool box' and noting that 'a practitioner's repertoire includes the whole of his experience insofar as it is accessible to him for understanding and action' (p. 138). This repertoire influences the capacity for critical thinking because it includes the experience itself, understood also as knowledge, the ability to determine the elements that are hindering the achievement of the expected outcome and the resources available to be used. How the person sees the situation and their capability to explore it depends on their repertoire.

We drew on the Action Learning approach (Revans, 1980) to help students conceptualise the process of integrating theoretical and situational capabilities by cultivating the skills of listening and asking questions. Revans (1980) emphasised how it feels to find oneself in a condition of ignorance, risk and confusion, and explained how to frame and ask uncomfortable questions and to listen and hear the answer – skills that also apply when reading the work of scholars.

In 2016, we introduced Hamby's (2013) account of the virtues of the critical thinker – charity, openmindedness to evaluate arguments, valuing fallacious-free reasoning and willingness to inquire – to improve the students' grip on critical thinking in academic and professional practices. Hamby (2013) described critical thinking as the ability to identify an argument, analyse and evaluate arguments, clarify terms and statements, evaluate authors and sources, make inferences, formulate conclusions and examine alternatives. Overall, we staged our teaching to make the students aware of the following activities to familiarise them with critical thinking:

Reading for learning: After an initial teacher-led paper discussion, where we tried to show the students what we were aiming to achieve, students worked individually or in pairs to pick from the mandatory readings and formulate a set of questions. All students had to read the literature and answer the questions; emphasis was placed on making the

discussion a professional inquiry experience. We also led a discussion to provoke the students to make reasoned arguments about their positions.

Professional inquiry performance: Over the first three years of the final course session, we attempted to encourage students to articulate their conceptualisation of the professional inquiry competences. We handed them a 'UX designer' job ad and asked them to prepare for a job interview. The questions during the interview revolved around the competence of a professional inquirer in ways relevant to the job position. We took turns playing the role of job-interviewer on a stage in the corner of the classroom, while the class followed and actively commented on the performances.

Reflective journal: To support students' personal engagement with the content of the course, they were invited to express their knowledge through a personal process of self-exploration and self-questioning. The journal comprised five entries, in which the author discussed and reflected, in writing, upon such things as their experiences, ideas, assumptions, theories, progress and positions of scholars. We called this journal, 'Becoming a Professional Inquirer'. The idea was that, at the end of the course, the journal would form the base for writing the final academic assignment.

Short paper: The last assignment was an academic paper, which combined the different pieces of knowledge from the course. For example, in 2015, based on a paper from the reading list (Chenail, 2011) which they said they found informative, put into perspective by their experiences during the course, the students were instructed to write a five page article developing the topic of 'The Ten Steps of Professional Inquiry'.

LEGO® SERIOUS PLAY® workshop: This workshop was introduced in 2017 to encourage students to externalise their understanding of professional inquiry using their hands, materials and storytelling to mediate the conceptualisation of what Professional Inquiry means. Working in two groups, the students' work was video-recorded, and they were required to watch and analyse the video tapes.

Reviewing problem formulation: Following a list of effective problem formulations and based on the paper "Ten Steps for Conceptualizing and Conducting Qualitative Research Studies in a Pragmatically Curious Manner" (Chenail, 2011), the students were asked to evaluate problem formulations written by former students.

PBL navigation map: In 2017, to improve students' overview of the PBL project work, we devised a checklist to remind students of the flow of the project work and the role of problem formulation.

LESSONS LEARNED FROM TEACHING THE 'PROFESSIONAL INQUIRY' COURSE

Despite the positive student feedback in 2014 (the first year of the course) we found that at least two aspects of the student performance deserved more attention in our teaching: students' general performance in academic writing and students' courage to face conflicting positions in oral academic discussion, for example, during the action learning sessions. Additionally, we did not find any spill over from the students' work on problem formulation in the Professional Inquiry course to the problem formulations they presented in their project work. Figure 1 shows an example presented by a group of three students.

Current problem area:

We would like to understand how and with what purpose Danish high school students use laptops in the classroom (and outside school for learning). Furthermore we would like to explore how this user practice adds to or interfere with learning in the classroom.

To answer this problem we would like to observe (preferably for a week) how high school students use their computers in class and how it affects the classroom and their learning. We want to explore what the role of the computer is, whether or not the computer is integrated in the classroom or it functions like a barrier between teacher and students. We also want to know what the intended use of the computers are and if those intended uses are the actual uses of the students. To gain knowledge about this we would besides the observation study also like to interview some of the students and one or more teachers.

We want to conduct our observation study without participation in class because we don't want to affect the dynamic between teacher and students. Also we cannot see what they're doing/notice it, if we participate in class. We have a cooperation with [redacted] Gymnasium and a teacher that has volunteered.

Figure 1: Problem formulation presented in 2014

This problem formulation is put into perspective by the self-evaluation of students' PBL skills presented in Table 2; students marked with an asterisk (*) wrote the problem formulation reproduced in Figure 1 (two Danes, one AAU bachelor in communication, one IT bachelor from a university college, and a French IT bachelor). This group considered themselves competent and proficient in PBL skills.

PBL Skill	**Level of competence**				
	Novice	Advanced Beginner	Competent	Proficient	Expert
Identify a self-chosen societally relevant problem	Z	G*	A*, D, P	L*	
Engage in search for literature and empirical facts		A*, G*, Z	L*	P	D
Engage in search for empirical facts	G*	Z,P	A*, L*	D	
Problem delineation		G*, D, Z	L*, P	A*	
Empirical and theoretical inquiry	Z	D	A*, G*	L*, P	
Experiments	Z	D	A, G	L, P	
Production	A*		L*, D, Z, P	G*	
Write up in a group of collaborating students a project report answering and critically discussing the problem initially formulated		Z	G*, L*, D	A*, P	

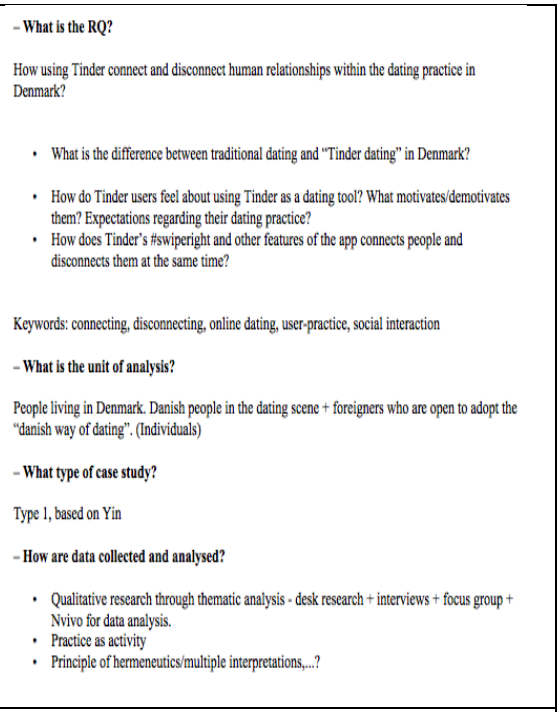
Table 2. Example of a Group's Self-evaluation of Their PBL Skills

We suspected that the lack of visible spill over was due to the course format, and we considered that we had not been sufficiently clear that the course was for their future academic and professional life. Looking in the rear-view mirror, we might have profited from using our observation of the lack of spill over in our 2015 course introduction as a critical reflection exercise in the beginning og next year's course work. Instead, we attempted to address more directly the academic and professional life perspective by emphasising the basics of communication by performing exercises involving asking questions and listening to answers. Regarding the reading for learning activity, we saw that students this year showed more control over the discussion and presented critical and reflective questions about the text and about fellow students' inputs. We detailed our feedback on the reflective journal entries and received positive feedback from the students as shown in the following example: *'I just want to say thank you for giving me feedback in this way. It is nice to try it, and actually, for me, it is easier to understand and it seems more manageable to approach the feedback and rewrite, e.g. the paper. It is nice to get feedback like this'*. Nevertheless, we were still not happy with the outcome. Students continued to narrate in their written entries rather than develop skills in academic critical writing. We discussed the clash between on the one hand finding students where they are and giving them a voice, and on the other, making students meet scholarly criteria for dealing with academic literature and expressing their personal experiences of deploying the taught espoused theory.

When we reviewed the students' final papers, we found that few included an introduction, research questions, methodology, use of theory, a conclusion, references and convincing argumentation. Nevertheless, the students' evaluations expressed satisfaction with the Professional Inquiry course, and for us, it was immediate gratification to follow the developments in the students' writing and see definite improvements, although few presented a satisfactory level of academic performance.

In 2016, we retained the 2015 design, modifying only the literature and focusing more on the aspect of critical thinking from the perspective of Schön (1983) and Hamby (2013). The outcome of the 'reading for learning' activity was weaker in 2016 than in 2015, and the journal was still the most relevant activity, seen from a training viewpoint for both critical reflection and problem formulation. The final paper quality and the positive feedback we received were the same as those in 2015.

In 2017, we introduced a LEGO® SERIOUS PLAY® workshop to help the students develop a deeper understanding of the problem formulation process by connecting hands and mind. The workshop fostered a rich activity of interaction and in-depth discussions. However, the quality of the journal entries were on a par with those of previous years: The students focused on following the instructions for the task of each entry, but they mentioned that this workshop was one of the most significant activities of the course. Regarding course spill over to project work, we saw the same problem as in previous years (figure 2). The students failed to reflect critically upon the problem formulation or exhibit critical thinking characteristics such as references to related work, reasoned arguments, and distinctions between analysis and judgement of outcomes of analysis.



Problem formulation group 1	Problem formulation group 2

Figure 2: Examples of problem formulations 2018

Our conclusion is that although students have always been willingly, almost enthusiastically, engaged in the course activities, the Professional Inquiry course has, over its four years, failed to instil critical thinking methods into the students' problem formulation practices.

CRITICAL THINKING AND PBL

We consider PBL, in the form of an institutionalised pedagogical paradigm, a learning structure for cultivating students' skills to integrate espoused theory and practical problem-solving in a scholarly fashion. Structures can support or prevent learning, or be ignored by the learner; if in line with the learner's activity goal, they provide support. It thus makes a difference whether the student's goal is to study to complete a task or to find out what is worthwhile knowing. Our teaching experience indicates that PBL is a learning structure that supports forward going, constructive and solution-oriented learning, and it thereby fits a learning goal of writing a project which meets the criteria of the study regulation. Critical thinking is, however, a process, which, when students engage with it, moves students' thinking in a backward-looking, problematising direction, asking about context and contribution. Ideally, the constructive and reflective movements of thought are complementary, as pointed out by all experiential learning theorists (Miettinen, 2000). However, as mentioned in the introduction, within PBL as the institutionalised

pedagogical paradigm, as is the case at Aalborg University, one project per semester leaves little room for reflecting upon action, let alone engaging in a process of critical reflection. As we see it, time pressure forces students to cut back on or ignore critical thinking and put their full effort into providing at least one – what they consider – good solution to their chosen problem. Dissolving the potential conflict will require a dispensation from the pressure for efficiency currently framing all university teaching and learning. Is this a too far-fetched conclusion? Perhaps the following student blog entry hints as to why the tools for critical thinking learned during the Professional Inquiry course were not used much: *'Considering all 10 steps is extremely time-consuming, and formulating my thoughts on some of the steps has been very hard. I do recognise the value of planning a study and am aware that it may save time later in the study. It may also help to keep the answering of the problem statement on track*'. When under time pressure, students rely on old habits of learning to task, rather than learning to inquire.

In the wider societal perspective on education, where, for example, the UNESCO announces critical thinking to be a 21st century skill for all citizens, and where critical thinking is considered the backbone of scholarly competence, there is a tendency to ignore the actual practical conditions for exercising critical thinking. We attribute this lack of practice focus to diverging understandings of how critical thinking is built through action as a skill in an experiential learning view. This view also applies to discussions of the relationship between critical thinking and PBL, where critical thinking is considered one of the core competences to develop.

In pedagogical research on PBL (Kamin, O'Sullivan, Younger, & Deterding, 2001; Kumar & Refaei, 2017; Masek & Yamin, 2011; Sada, Mohd, Adnan, & Yusri, 2016; Sendag & Ferhan, 2009; Ward & Lee, 2002; Yih Chyn & Huijser, 2011; Zabit, 2010), we find two different positions regarding how this relationship is to be understood: Some scholars see PBL as instrumental to their aim of teaching critical thinking (Kumar & Refaei, 2017), while others state that critical thinking skills develop through the students' way of working with inquiries into their chosen problem (Yih Chyn & Huijser, 2011). Kumar and Refaei (2017) conducted an exploratory study of the role of PBL pedagogy in promoting students' critical thinking, designed problems to support students' development of critical thinking in their writing and explored how the problems served to prompt students to apply critical thinking skills to their writing. The findings showed that PBL pedagogy supported the students' critical thinking, which became evident in the students' writing. Yih Chyn and Huijser (2011) considered PBL pedagogy as a way of studying, where students simultaneously acquire domain-specific content and learn critical thinking skills.

However, from our experience, students will not develop critical thinking skills by experiencing the process of PBL alone. We find that students do apply a certain level of

critical thinking in their project activities but without consciously dealing with scholarly critical thinking, which implies that they do not consciously put critical thinking in their toolbox as academics or make it part of their repertoire. Guerra and Holgaar (2016) identified this implication in their research, stating: *'Undoubtedly, problem analysis and formulation enhance students' critical and reflective thinking, but students might need to address these challenges step-by-step with clear learning objectives—and then develop their PBL skills to manage a comprehensive PBL process. However, there is also the risk that the PBL process in itself is not questioned. In the interviews, students recognised that during their three years of study in this particular PBL environment, they had developed a kind of mechanical way of formulating and solving problems' (Guerra & Holgaard, 2016, p. 434).*

A literature review developed by Masek and Yumin (2011) concluded that (a) the specific process in PBL pedagogy theoretically supports students' critical thinking, (b) the empirical evidence is inconclusive in explaining the effect of PBL on students' critical thinking ability, and (c) some evidence shows that PBL pedagogy requires long-term exposure to foster students' critical thinking ability.

Our teaching experiences support these findings, and we hope that the institutional frame around PBL will become adjusted to support the development of critical thinking progressively from one semester to the next. We consider that such adjustment will increase attention paid to conditions for the unfolding critical reflection on the course's project work for the students and for the teachers, and place greater emphasis on critical reflection in the system of grading and passing exams.

CONCLUSIONS

We have here described dilemmas involved in developing students' critical thinking within the pedagogical paradigm of PBL based on a case within an institutionalised PBL practice. We have addressed the conditions under which it might be possible to allow ourselves, as teachers, to experience surprise, puzzlement, or confusion *with the students*, and to reflect upon prior understandings.

Our work with designing and teaching the 'Professional Inquiry' course to graduate students has led us to reflect more deeply on how to help students acquire critical thinking skills. We have identified an apparent conflict between PBL and critical thinking in practice, which can be divided into the following four sub-conflicts:

- a conflict between project work to solve a real-world problem and critical thinking, which requires a process of reflection upon existing knowledge and a reformulation of the problem, perhaps several times;
- a conflict between teaching critical thinking in isolation in a single course and making critical thinking part of all scholarly thinking (as it should be);
- a conflict between the limited time students devote to their study work and the time they need to think critically; and
- a conflict between seeking to meet the study regulation demands within the hours allocated to us as teachers and meeting the students where they are.

To a large degree, these conflicts are shared by most university courses and are amplified by the governmental demands for student efficiency, including several incentives to make students graduate 'on time'. Rushing education, in Denmark and elsewhere, is detrimental to the cultivation of students critical thinking skills.

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