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Facilitating Reflection and Progression in PBL: A Content Analysis of Generic Competences in Formal PBL Curricula

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ABSTRACT

This paper proposes a systematic approach to the analysis of the prevalence of generic competences in formal problem-based learning (PBL) curricula at higher education institutions and universities in which generic competences are an integral and integrated part of the curriculum, with a particular focus on how the generic competences are specified explicitly in the curriculum. A case study on the implementation of PBL competences at Aalborg University (AAU) shows, that the dialectic relationship between knowledge and practice is limited after the first semester, with the risk that both knowledge, skills, and competences related to PBL become tacit and thus might be less easily expressed and related to the development of a professional identity. Based on this we argue that revision of the formal curricula must support students with theoretical knowledge on PBL, project management, and group collaboration throughout the study to accommodate a greater variety in types of problems, projects, and complexity. This calls for further elaboration of 'generic' competence frameworks and points to challenges and potentials for near-future and next practice curriculum development particularly with attention to the concept of progression, thus providing a benchmark for future research assessing the integration of PBL competences in formal curricula.

Keywords: Generic competences, Problem-based Learning, PBL, Curriculum Development

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INTRODUCTION

Since the 90's, there has been an emphasis on outcome and competency-based approaches to higher education, and generic competences have steadily been promoted as part of a new paradigm for structuring and organising education in an increasingly complex society (Adam, 2008; Bologna Working Group on Qualifications Frameworks, 2005; González & Wageneer, 2003). The rationale directing this motion are changes in society and economy where new skills and competences are required to contribute to emerging models of economic and social development where knowledge is the main asset for economic development (Ananiadou & Claro, 2009). These competences have many names: transferable skills, transversal skills, employability and 21st century skills or competences. However, they share a general focus on enabling students or learners to apply, share and contribute their knowledge in communicative and collaborative organisational settings (Young & Chapman, 2010). The Tuning Project identifies generic competences in terms of instrumental, interpersonal, and systemic competences that are general and shared attributes of any degree (González & Wageneer, 2003). In a selective review of national and international frameworks of generic competences, Young and Chapman (2010) found 58 competences grouped in six clusters of skills: basic skills, such as literacy and numeracy; conceptual skills such as creativity and pursuit of lifelong learning; personal skills; people skills; business skills such as financial planning and enterprise; other skills in health and safety, motor skills or freedom from substance abuse (p. 19). In line with this, the prospects of future employment are by students no longer perceived to be determined by disciplinary qualifications alone but by a complex of personal, social attributes, academic credentials, and students' ability to assess the market value of the intertwined experiences (Tomlinson, 2008).

Although no single definition exists, frameworks describing attributes needed for future success in the knowledge society are finding political endorsement and ways into the curriculum, albeit with different focus and implementation strategies depending on national policy (Voogt & Roblin, 2012). While policies may vary, Voogt and Roblin (2012) find that inquiry-based and experiential learning approaches are highlighted as viable pedagogical models to support the development of generic competences. This was also noted by Barrows and Tamblyn (1980), who describe how the personal and affective competences needed in medicine could be scaffolded and emulated in PBL.

This paper proposes a systematic approach to the analysis of the prevalence of generic competences in formal PBL curricula at higher education institutions and universities in which generic competences are an integral and integrated part of the curriculum, with a particular focus on how the generic competences are specified explicitly and integrated into the curriculum. PBL is a widely popular pedagogical approach to student-centred learning with a plethora of different applications (Chen et al., 2020; De Graaff & Kolmos,

2003). Rather than seeking to demarcate potential PBL practices, (2003) find similarities in theoretical underpinnings, learning principles, and models. In a similar vein, Savin-Baden and Major (2004) describe and outline eight different curricular models, ranging from a single module approach to a complex model transcending the traditional educational sphere to identity formation in domains of *knowledge*, *action*, and *being* described by Barnett and Coate (in Savin-Baden & Major, 2004, pp. 43-44). Both approaches point out the common theoretical ground and the diverse practice that are to be found under the umbrella of PBL, where rather few institutional models have applied specific principles for a systemic PBL practice institution wide. An identified and authentic problem is central in the students' learning as it is the point of departure for a learning process organised as project work running for weeks or throughout an entire semester (e.g. Chen et al., 2020). PBL then nurture a learning environment where students can develop competences in domains such as problem-solving skills, project management, communication, and collaboration (Du & Kolmos, 2006; Guerra, 2017).

GENERIC COMPETENCES IN HIGHER EDUCATION

The personal and social attributes are as we have seen part of most frameworks describing future competences, and can be supported by inquiry-based pedagogical approaches such as PBL (Barrows & Tamblyn, 1980; Voogt & Roblin, 2012). While PBL has the potential to support the development of generic competences (Hmelo-Silver, 2004), the competences needed in the 21st century ought to be integrated into the curriculum as part of the core of the taught subjects according to Marope (2017). Voogt and Roblin describe three different approaches for implementation into the curriculum:

- an addition to existing content or new subjects;
- as cross-curricular competences underpinning subjects while emphasising wider key competence development;
- as a transformation of existing subject structure rethinking schools as learning organisations (p. 3).

These three strategies corresponds to the three strategies for curriculum change identified by Kolmos et al. (2016) who have built up a framework for change based on Sterling: add-on strategy, integration strategy and the re-construction strategy. The add-on strategy is easy to implement in the formal curriculum as this is just a question about formulating another element. The cross curricular or integration strategy is much more advanced as the generic competences will have to be explicitly integrated into existing elements and integrated in the learning. The transforming or re-construction will require a whole new curriculum, which might be interesting but also will have special conditions such as a new value-set and totally new courses.

Both the PBL societies and the CDIO (Conceive-Design-Implement-Operate) society recommend an integration strategy where the generic competences are learned within the disciplinary and interdisciplinary frames by reflection on experiences (Crawley et al., 2014). However, if the generic competences are not spelled out in the formal curriculum – both in terms of learning outcomes and assessment, there might be few formal initiatives to help facilitate students' reflection and conceptualization of their experiences. Previous research has also found students often being left alone to reflect on their learning with little guidance (Boud et al., 1985), impeeding potential outcomes while Riis et al. (2017) notes that students in their study could reflect if 'properly encourage' (p. 409).

The outcome-based approach to curriculum design is further bolstered by the International Bureau of Education at UNESCO, who argue for a global paradigm shift for curricula. The paradigmatic shift outlines both political and technical elements for a curriculum design supporting and sustaining relevant competences within contexts of rapid change. Central to the paradigm is also a stricter alignment of the official and the taught curriculum, arguing that discrepancies between the two due to too much teacher autonomy can lead to teaching of what teachers know rather than what ought to be taught according to the curriculum (Marope, 2017). Management of education through the curriculum then changes the object of accountability and locus of control. According to Steiner-Khamsi (2009), recurring waves of educational reforms rotate who is responsible for the outcomes of learning: the teacher or the student. Central in this transition from teacher-centred teaching to student-centred learning is the move from content to outcome (Karseth, 2008), or towards 'marketable tokens of accomplishment' as noted by Labaree (2012).

RESEARCH DESIGN

To explore and examine the presence of generic competences in the formal curricula, we have conducted a case study using Aalborg University (AAU) as an extreme case of systemic PBL integration. PBL is an intergral part of all eduational programmes, thus making AAU a suitable case for researching the prevalence and progression of generic competences specifically in formal PBL curricula. We have identified ten bachelor programmes to constitute the basis for our data collection.

Different definitions and conceptions of the curriculum exist, some involving the entire educational system of curriculum, pedagogy, and evaluation, in short, the entirety of the educational experience (Bernstein, 2003; Pinar, 2008). Deng and Luke (2008) describe three levels of curriculum making: the institutional level, i.e. a public policy nexus of influential internal and external actors; the programmatic level of syllabus construction

to be transmitted during classroom use; and the mediated curriculum enacted in the classroom (p. 67). In this article we will only address the formal, or intended, curriculum.

PBL Competences

During the first semester of their study, most students at AAU will have one or more courses on study competences as well as introductions to PBL and its practice in their particular educational programme. These courses lay the theoretical foundation applied later in practice during group and project work. After the first semester, the dialectic relationship between theory and practice is completed, and the interpretation of PBL becomes that presented by supervisors and experienced tacitly in practice, where the practitioner may miss valuable insights to improve practice (Schön, 1983). Thus, in 2018 the AAU PBL Academy published an internal working paper identifying four domains of competence which characterize the practice at the first year program at engineering and science (Holgaard & Kolmos, 2019):

- Problem-oriented competence: the relation between students and the problem.
- Interpersonal competence: the relation between human actors involved in a project such as peers, supervisors and external collaborators.
- Organisational and leadership competence: the relation between students and the tools and methods supporting the process of PBL.
- Meta-cognitive competence: the relation between students and their learning process, supporting, connecting, and creating 'innovation' across the three former competences.

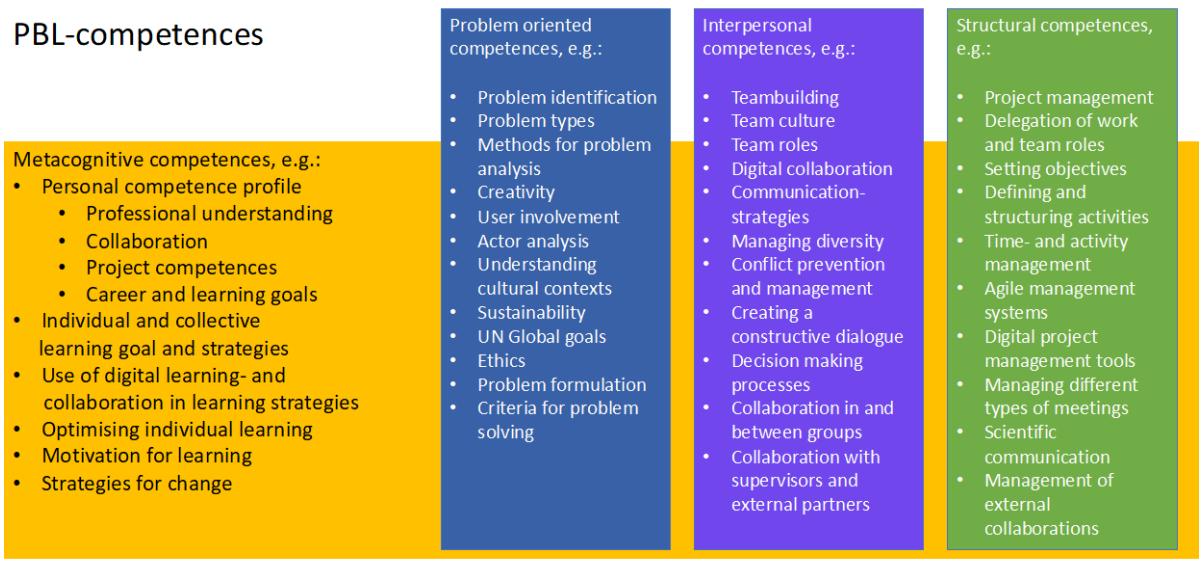

Figure 1. Categories of PBL competences (Holgaard & Kolmos, 2019).

The categories and competences visualized in figure 1 have been deduced from practice in an internal process akin to a delphi panel. These four competences are currently part of the practiced curriculum at the first year program at engineering and science, and has been formally structured in a conceptual framework for PBL competences to aide in integrating these as outcomes in existing curricula. In this study, the framework will serve as a basis for a directed content analysis of the formal curricula as they form a more coherent understanding of what PBL competences can reveal. The formal curricula used for the content analysis has not been structured according to the framework, but an application of the framework will provide a benchmark for future research assessing the integration of PBL competences in formal curricula.

Material Selected for Content Analysis

As mentioned, the selected material is formal curricula from ten different bachelor programmes at AAU. These are all included in subprojects of a larger institution-wide research project, PBL Future (www.pblfuture.aau.dk), of which this research is considered part of a baseline study. While the research in these subprojects addresses one or two semesters, initial readings of formal curricula suggested a limited reading and interpretation of a single semester would be insufficient when assessing the presence of PBL competences throughout an educational cycle. Because the generic descriptions mostly occur on the first and partly second semester, the scope was broadened to include the entire formal curriculum of the selected bachelor programmes. English Studies and Sociology were added to include two cases from each faculty.

Faculty	Educational programme (Acronym)	Additional information
Humanities	Communication and Digital Media (CDM) English Studies* (ES)	**Include electoral part of education, teacher training*
Social Sciences	Sociology (SC) Organisational Learning (OL)	
Health	Biomechanical Engineering and Informatics (BIOM) Sports Science (SP)	
Engineering	Nanotechnology (NT) Energy Engineering (EE)	
IT & Design	Medialogy (MED) Internet Technology and Computer Engineering (ITC)	

The formal curriculum is organised in learning outcomes (LOs) for each subject in domains of knowledge, skills, and competences, showcasing ranges of understanding, declarative university knowledge, or relevant professional knowledge described by certain closed or open-ended verbs (Biggs, 1999). The concrete subject matter is not readily available in every curriculum, meaning the normative selection of 'what-

knowledge-is-most-worth' characterising the selective tradition of the curriculum is only visible on a superficial level, at least from a non-disciplinary perspective. To qualify and justify the rationales for the actual selection of subject matter would require engagement from relevant staff and stakeholders considered outside the scope of this study.

The selected material can be considered as the institutional framing of the programmes. This points to a delimitation of the research, as it solely addresses the formal curriculum and intended LOs, and not how the formal curriculum is enacted.

The formal curricula are structured according to the Dublin Descriptors with disciplinary and generic statements of expected achievements in elements of knowledge and understanding, application of knowledge and understanding, making judgments, communication skills, and learning skills (Bologna Working Group on Qualifications Frameworks, 2005). These elements have in the Danish National Qualification Framework found a stricter and more vocational oriented translation (Sarauw, 2011), summarised in 'knowledge and understanding', 'skills', and 'competences.' Each is defined by specific qualifiers such as: a knowledge field, level of understanding and reflection, types of skills, levels of decision-making, communication, action space, and learning and metacognitive abilities.

Methodological Considerations for Content Analysis of Curricula

The direction of the analysis of formal curricula in this study is set by the aforementioned descriptions of PBL competences and analysed by applying a directed content analysis (Hsieh & Shannon, 2005) informed by the framework developed by Krippendorff (2004) depicted in figure 2. Thus, the content analysis, defined as *'a research technique for making replicable and valid inferences from texts (or other meaningful matter) to the contexts of their use'* (p. 18) is scaffolded with five elements aiming to add transparency to the research.

Figure 2. Outline of Krippendorff's (2004) methodological framework.

In this directed content analysis, the body of text has already been selected and described in the previous section, namely the formal curricula of ten bachelor programmes.

Selecting generic descriptions of PBL may result in coding excerpts where PBL is somewhat decontextualised and removed from the professional domain. This poses certain challenges of a directed content analysis, in particular since we anticipate that exemplary and authentic problems closely ties PBL to a professional practice, stressing

the importance of supervisors continuously making students aware of transversal competences obtained through the project work, a process that can prove difficult for some students (Kolmos et al., 2008). However, since knowledge transfer between courses and projects cannot be expected for all students, formulations of LOs relating to a specific professional domain are omitted for the purpose of this particular content analysis.

The context in which the documents are analysed follows the rationales of LOs, mainly the student-centred argument and change in locus of control (Bologna Working Group on Qualifications Frameworks, 2005; González & Wageneer, 2003). This situates the documents as 'actors' in a formal educational setting. At AAU, the practice of PBL is both one of canonical knowledge and theory and project-oriented group work. Students engage in group work for half of their study (Kjersdam & Enemark, 1994), meaning that many learning activities are constructed by students and thus hidden and not easily captured in a formal curriculum. How students interpret, translate and enact a formal curriculum during their study is unknown, thus the authority attributed to the documents by students is undetermined.

According to Krippendorff (2004) analytical constructs '*take the form of more or less complex "if-then" statements*' (p. 35). Practically this means that in this directed content analysis, *if* an LO addresses the development of one of the four PBL competences, *then* the LO is coded in NVivo in the corresponding category as illustrated in figure 3 visualising the coding tree. In some cases, more than one LO is stated in one string:

'*to design and reflect on problem-based project work*' (Communication and Digital Media (CDM), authors' translation).

The LO above contains both design and reflection. The student must be able to design project-based work, but it is not stated if the design addresses processes or content. Similarly, it is not clear whether 'reflection on project-based' work entails the work conducted in its totality or its constituting parts, or with what intention. For the sake of simplicity, an LO like the one presented above was coded as a structural and a meta-cognitive competence (reflection).

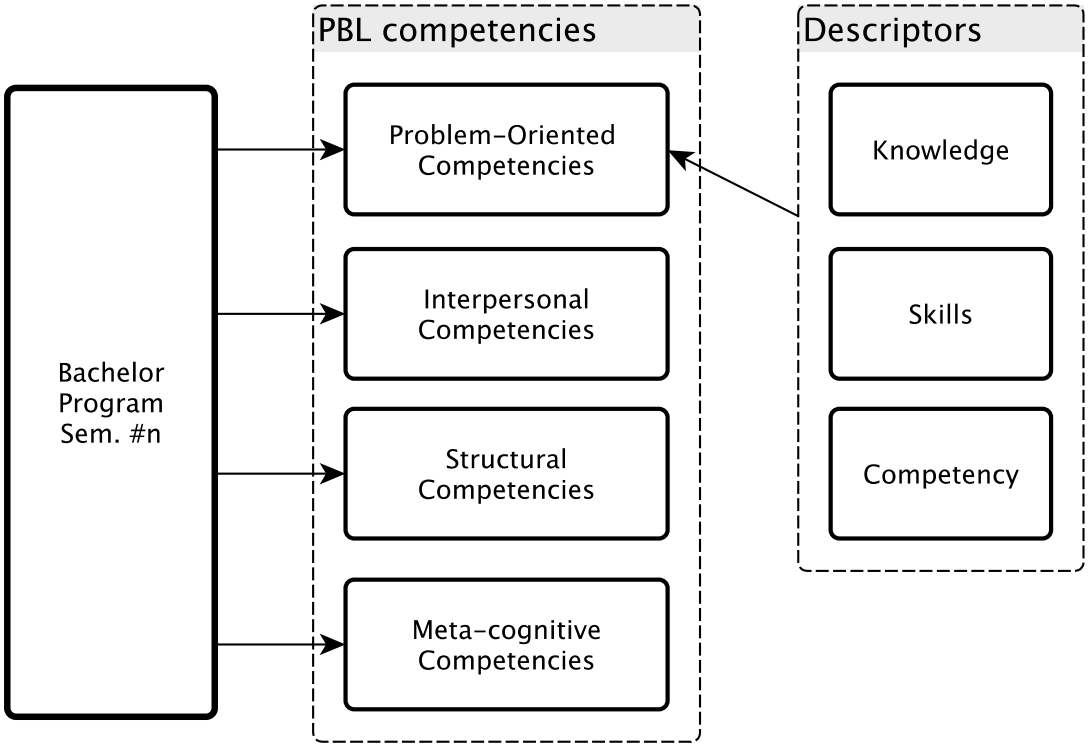

Figure 3. The coding tree for the coding and categorisation of LOs in NVivo informed by the 4 PBL competence domains and their descriptor knowledge, skills or competences.

Practically, if an LO is stated under the descriptor 'Skills' in the formal curriculum, it is coded in the competence domain related to the:

'*Explain problem-based study and the AAU model of PO PBL*' MED (2017)

The LO is stated under the descriptor 'Knowledge' and coded in 'Knowledge' (child node) ← 'Problem-Oriented Competences' (child node) ← '1. Semester' (parent node). This process has been repeated for all nodes.

FINDINGS

The content analysis of the formal curricula shows that the total presence of LOs addressing the development of PBL competences is present primarily in the first semester. This includes all four competence domains of PBL competences and descriptors. Consequently, the dialectic relation of theoretical knowledge and practice constituting PBL competences ends rather abruptly. While projects still account for roughly half of the time spent studying, students are dependent on researching on their own initiative or inputs from supervisors or other teaching staff to supply the theoretical dimensions of PBL to the more practice-oriented group work (Kolmos et al., 2008).

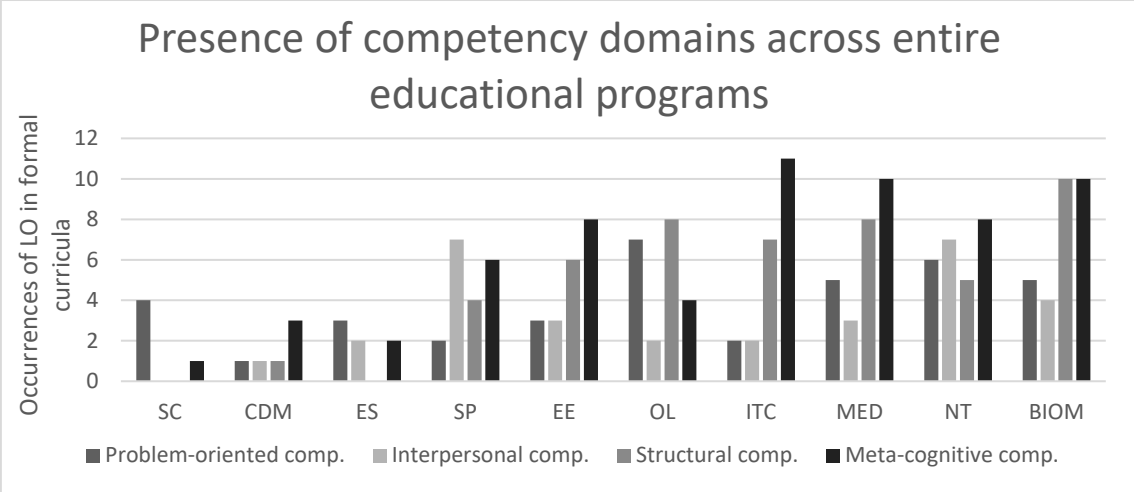

Figure 4. Presence of LOs supporting the development of PBL competences through entire educational programmes.

Figure 4 illustrates the frequency with which the four competence domains (problem-oriented, interpersonal, structural, and meta-cognitive competence) are included in the formal curricula through the entire programme of each selected case. This initial analysis shows great variations in prevalence of PBL competence-related LOs both across programmes and in between competence domains. The rationales behind this variation or the emphasis on one competence domain as opposed to others within individual programmes is not apparent from the formal curricula. There is great variation between educational programmes. Meta-cognitive competences are but one example of this, where they are mentioned two times in English Studies (ES) but eleven in Internet Technology and Computer Engineering (ITC). Another example is the problem-oriented competences, where ITC only mentions these twice in the curriculum, but seven times in the curriculum of Organisational Learning (OL).

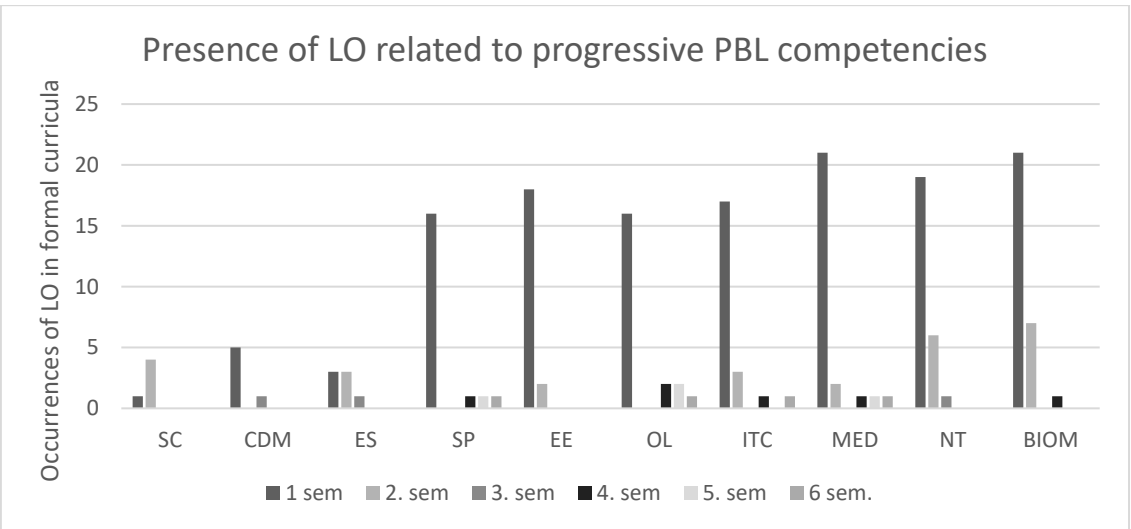

Figure 5. Presence of total LOs supporting the development of PBL competences through the semesters.

The chart presented in Figure 5 shows a rapid decrease in LOs supporting the development of PBL competences after the first semester. It also shows variation between some of the educational programmes, especially Sociology (SC), Communication and Digital Media (CDM), and ES (English Studies), compared to the rest. A possible explanation could be that in some programmes the introduction to PBL is part of introductory subjects of the particular academic discipline, meaning that the expected generic outcomes can be intertwined in existing courses in later semesters. Other educational programmes have a stand-alone subject introducing PBL to new students. These are also the programmes with the highest presence of LOs. However, Figure 4 shows little evidence of progression of the relevant LOs in any of the curricula.

Competence Domain	Descriptor	Themes of LO's from Formal Curricula
Problem-Oriented Competences	Knowledge	*Outline different approaches to problem-based learning, including the AAU PBL model and problem-oriented methodology (*BIOM, CDM, EE, ES, ITC, MED, NT, OL, SP)
	Skills	*Conduct a problem-analysis and compose a problem formulation* (BIOM, EE, MED, OL) *Define the goal of project work and develop a strategy for problem-solving* (NT, OL)
	Competence	*Formulate a problem formulation within a theme* (OL)
Interpersonal Competences	Skills	*Organise short term group work and collaboration with supervisor* (BIOM, MED, SP) *Analyse and reflect on causes and potential solutions to potential conflicts within the group* (BIOM, ITC, MED, NT, SP)
	Competence	*Participate in group-based project work* (BIOM, CDM, EE, ES, MED, NT, OL, SP)
Structural Competences	Knowledge	*Knowledge of work processes in problem-based project work* (BIOM, EE, ITC, MED, NT, OL, SP) *Explain techniques for planning and managing project work* (BIOM, EE, ITC, MED, NT, OL, SP)
	Skills	*Can organise group work* (BIOM, EE, MED, OL, SP) *Apply concrete tools and principles for management of problem-based project work* (SP) *Reflect over causes and solutions to potential conflicts within the group* (EE)

	Competence	*Design and manage problem-based and project-oriented work* (BIOM, CDM, NT, OL)
Meta-cognitive Competences	Knowledge	*Explain basic individual and organisational learning processes* (BIOM, MED, OL)
	Skills	*Analyse individual learning process* (BIOM, EE, ITC, MED, NT, SP) *Analyse and identify the strengths and weaknesses of the project group's collaboration and suggest potential improvements* (BIOM, EE, MED) *Apply theories and methods supporting learning processes in problem-based project work* (SP)
	Competence	*Participation and optimisation of collaborative learning processes* (BIOM, CDM, EE, ITC, MED, NT, SP) *Can consciously reflect on individual learning* (BIOM, EE, ITC, MED, NT) *Analyse and reflect on individual learning process and learning 'needs'* (BIOM, CDM, EE, ITC, MED, NT, SP) *Reflect and evaluate individual experience of group work* (BIOM, CDM, EE, ITC, NT, SP) *Use PBL as a methodology for individual and others' learning* (OL)

Table 1. LOs supporting development of PBL competences in first semester.

In all of the competence domains, the three descriptors shown in table 1 depict a relation between knowledge, skills, and competence; however, when focusing on a particular education, some variation in the dialectic relation of theory and knowledge, skills, and competence emerges.

For instance, in the meta-cognitive domain, only Biomechanical Engineering and Informatics (BIOM) and Medialogy (MED) have LOs in all three descriptors, e.g. in *knowledge*, the students must be able to 'explain basic individual and organisational learning processes' implying students must have been introduced to theoretical knowledge of basic learning theory. In *skills*, the students must demonstrate the skills to apply the knowledge to analyse individual learning processes and the group's collaborative processes. Furthermore, in *competences,* the students are expected to participate in group work competently and reflect on individual and collective learning processes. The same is the case for the structural domain, where students in Biomechanical Engineering and Informatics (BIOM), Organisational Learning (OL), and Nanotechnology (NT) are expected to demonstrate knowledge of work processes and

techniques for conducting group work, have the skills to organise group work, and the competences to design and manage problem-based project work.

Competence Domain	Descriptor	Themes of LOs from Formal Curricula
Problem-Oriented Competences	Skills	*Be able to critically evaluate knowledge, models, and theories used to analyse a problem* (EE, NT, SC) *Be able to break a problem in smaller constituents* (ITC)
	Competence	*Analyse the problem domain* (BIOM, MED) *Assess the relevance of collected information in relation to project* (BIOM)
Interpersonal Competences	Competence	*Be able to participate in collaborative group work* (ES, NT)
Structural Competences	Skills	*Plan and manage project work* (BIOM, NT) *Apply a method to organise the project work* (NT)
	Competence	*Independently manage lengthy project work* (BIOM) *Analyse the organisation of group work* (BIOM) *Plan, manage, and reflect on project work for future course of study* (EE, MED)
Meta-cognitive Competences	Skills	*Analyse individual learning process* (NT) *Analyse individual learning process using relevant analytical models and experiences from P0 and P1* (ITC)
	Competence	*Analyse individual learning process* (BIOM) *Independently develop competences* (ES) *Reflect on cause and potential solutions for problems in the project group* (BIOM) *Reflect on experiences of project work and problem-solving* (NT) *Generalise and reflect on experiences of project management and collaboration for future course of study* (ITC)

Table 2. LOs supporting development of PBL competences on the second semester.

Table 2 shows macro level LO for the second semester, and most notably the descriptor 'knowledge' is absent. This implies that students have not been presented with new theoretical knowledge on the four competence domains on this particular semester. The dialectic relation between theory and practice has thus become somewhat one-sided and completely dependent on the students' own research into this area or the supervisor's suggestion of resources in these domains. This is also seen in 'Skills' of the meta-cognitive domain where LOs e.g. from Internet Technology and Computer Engineering

(ITC) refers back to the project of the previous semester. However, ITC is also expecting the students to be able to use reflection of experience as a mean to anticipate possible directions for future project work.

Competence Domain	Descriptor	Themes of LOs from Formal Curricula
Interpersonal Competences	Competence	*Be able to participate in collaborative group work* (ES, NT)
Meta-cognitive Competences	Competence	*Independently develop competences* (ES)

Table 3. LOs supporting development of PBL competences on the third semester.

In table 3 summarising the third semester, only two categories were coded, both within a competence descriptor indicating that students are now expected to independently participate in group work and develop competences within a professional and disciplinary context, and, as with second semester, the knowledge descriptor remains absent.

Competence Domain	Descriptor	Themes of LOs from Formal Curricula
Interpersonal Competences	Competence	*Collaborate with others to develop and optimise situations for learning on an individual, group and organisational level* (BIOM, SP)
Structural Competences	Skills	*Apply methods for process- and project management* (OL) *Apply methods to transfer and implement knowledge* (OL)
Meta-cognitive Competences	Competence	*Recognise need and provide knowledge* (ITC)

Table 4. LOs supporting development of PBL competences on the fourth semester.

For the fourth semester, table 4 shows four educational programmes which have LOs relating to PBL competences, focusing particularly on the competence descriptor. Similar to the second and third semester, the dialectic relationship between knowledge and practice remains absent, with the risk that both knowledge, skills, and competences related to PBL become tacit and a-critical and might not be easily expressed and scrutinized potentially resulting in a-critical or habitual practice (Polanyi, 1972; Schön, 1983).

Similar patterns are observed for both the fifth (Table 5) and sixth (Table 6) semesters with fairly few explicated PBL-related LOs across the cases and although all four competence domains (problem-oriented, interpersonal, structural, and meta-cognitive) are represented by the competence descriptor, no new knowledge or skills are assessed in this final year of the bachelor programmes.

Competence Domain	Descriptor	Themes of LOs from Formal Curricula
Problem-Oriented Competences	Competence	*Reflect on the relation between research question and research design* (SP)
Interpersonal Competences	Competence	*Apply PBL as an approach for individual and others' learning* (OL)
Structural Competences	Competence	*Apply PBL as a method for planning and completion of scientific work* (OL)
Meta-cognitive Competences	Competence	*Independently continuously develop competences* (ES)

Table 5. LOs supporting development of PBL competences on the fifth semester.

Competence Domain	Descriptor	Themes of LOs from Formal Curricula
Problem-Oriented Competences	Competence	*Application of knowledge to real problems* (NT)
Interpersonal Competences	Competence	*Plan, structure, and manage a project* (ITC, MED)
Structural Competences	Competence	*Apply PBL as a method for planning and completion of scientific work* (OL)
Meta-cognitive Competences	Competence	*Identify individual learning gaps and structure learning in different learning environments* (OL)

Table 6. LOs supporting development of PBL competences on the sixth semester.

It is clear that the bulk of LOs addressing PBL competences are present in the first semester, limiting the temporal aspect in the descriptions of PBL competences and thus the possibilities of assessing progression throughout the educational stay at AAU. Furthermore, the knowledge dimension supporting particularly reflection on competence development quickly decreases after the first semester, with the risk that PBL practices and associated knowledge, skills, and competences become tacit. Based on this, Holgaard et al. (2019) suggest changing the traditional, standardised semester structure (15 ECTS project and three 5 ECTS courses) prevalent in most bachelor programmes and instead introduce variation with different types of problems, types of projects, and levels of complexity, supporting reflection through a greater diversity in the PBL learning experience (p. 7).

IMPLICATIONS AND FUTURE WORK

This paper presents findings from a cross-case curriculum study showing great variation in how and to which extent PBL competences are explicated in the formal curricula at AAU. The majority of learning objectives specifically addressing the development of

PBL competences are present in the first (and occasionally second) semester with only a few in the following semesters. This points to challenges and potentials for future curriculum development particularly with attention to domains and progression of 'generic' PBL competences throughout the educational stay at AAU. This article forms a baseline from which revised formal curricula can be compared to earlier renditions. Future research is needed to evaluate how the framework potentially can assist in integrating generic competences in formal PBL curricula.

The results showcase an issue in the dialectic relationship between theory and practice where the theoretical aspects of PBL are partly missing after the first semester. If the semester projects also follow a similar standard and structure throughout their educational stay, students may experience a stable practice without much variation. A consequence of this could be that PBL related knowledge, skills, and competences become un-reflected professional knowledge-in-action, where students are unable to describe and reflect upon the knowledge their actions reveal (Schön 1983). Following Polanyi (Polanyi, 1972, 1974), inarticulated knowledge is challenging to view from more than one perspective simultaneously, resulting in trial and error. Articulation allows us to assess, reflect and make inferences critically about what has come to as an 'external object' (1972, p. 16).

From a formal level, this means that the project supervisors are the primary resource for facilitating the theoretical reflection on variations in project work and group collaboration (Kolmos et al., 2008), unless group members initiate such a process on their own. With the lack of reciprocal exchange of theory and practice follows the risk that the PBL practice and obtained knowledge, skills, and competences become tacit, in which case experience alone determines actions during project work. Consequently, students are unable to explicitly communicate their PBL and project related competences. This is further buttressed by the traditional approach to projects supporting a stable practice for students with little variation in the semester projects, particularly at bachelor level. Based on this we argue that revision of the formal curricula must consider the practical turn after the first semester, supporting students with theoretical knowledge on PBL, project management, and group collaboration throughout the study to accommodate a greater variety in types of problems, projects, and complexity. This calls for further elaboration of the concept of progression in relation to problem-based learning and generic competence frameworks to ensure that progression is in fact integrated into the programme and not a mere matter of sprinkling learning outcomes scattered over the educational programme.

Furthermore, whereas a formal curriculum analysis at the programmatic level can inform the translation of a public policy nexus at an institutional level, the authoritative status of the curriculum remains uncertain, and research needs to be conducted on how students interpret and include PBL-related learning outcomes in their everyday PBL practice. If

faculty and teachers ascribe more authority to the documents than students, revisions may not bring about the change needed. This notion aligns with Brooman, Darwent, and Pimor (2015), who invited students to participate in focus group interviews during the redesigning of a curriculum, helping to clarify and challenge researchers' approaches to curriculum development. In learning environments such as PBL, an invitation to student participation in the development of a curriculum would reignite the participatory and emancipatory components central to student-centeredness rather than only by learning outcomes.

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