Knowledge formations in PBL - Extended paper draft ECER –conference, Istanbul 2013

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Abstract:

The paper presents some of the results from a recent completed Ph.D. program about disciplinarity and inter-disciplinarity in problem based learning (PBL). Disciplinary content in PBL-programs has been questioned during recent years, so stronger concepts of how knowledge is actually organized and structured in PBL are needed to qualify this discussion. This paper focuses on the research question: How has the structuring/organization of knowledge in curriculum changed over time and what kinds of connections and interrelations between disciplines/subjects can be identified in current PBL-courses?

The research has aimed to conceptualize how various knowledge areas blend in two educational contexts applying PBL. Interrelationships have often been referred to as inter-cross- or trans-disciplinarity. However, these terms are ambiguous. Thus I introduce the term transversality to suggests that knowledge organization are no longer based on relationships between strong independent disciplines, but rather on a number of ‘themes’ or ‘subject areas’ that should be combined and tied together during the students PBL-studies. As such, the curriculum organized knowledge, as well as student’s reflections of various types constitute certain ‘modalities’ of transversality. Two educational contexts, Nursing and Constructing Architect education, have been used as a case study research in order to demonstrate how institutional practices show different modalities of transversal knowledge in their PBL-courses. For the purpose of this paper Nursing Education will be abbreviated as NE and Constructing Architect as CAE.

Generally about theory and methodology

Legitimation code Theory (LCT)

Basil Bernstein’s code theory of classification and framing is known by many educational sociologists as a powerful analytical tool to examine how knowledge is transformed from primary practices outside education to the pedagogical practice and how control over content and form is exerted in such practices (Bernstein 1990). The so called Legitimation Code Theory (LCT)
developed by Karl Maton refers directly to Bernstein’s original code theory, but it also builds upon his later work of vertical and horizontal knowledge structures (Bernstein 2001) (Maton 2000, Maton 2006). Furthermore LCT also integrates insights from Bourdieu and Foucault. Where Bernstein’s analysis coded the epistemological aspects of educational knowledge structures the LCT also codes the educational knower structures.

The main argument by Maton is that knowledge is always claimed by someone about something. In other words: Every knowledge field has an ‘epistemic relation’ (ER) and a social relation’ (SR), but each with different strength. ER represents the statements, propositions, procedures and techniques that are distinct from the knower. SR concerns subjective dispositions…

“...whether these are described as innate or natural (such as notions of genius) inculcated (such as an artistic or literacy sensibility, cultivated through prolonged immersion in great works) or resulting from the knowers social position (such as standpoint theory based on class, gender, sexuality religion and so forth).” (Maton 2008)

Fig. 1. The epistemic relation and the social relation of knowledge.

LCT can apply for knowledge fields both outside and inside academia. In curriculum research the code concepts ER and SR are suitable to examine relations between knowledge fields and relations within such. The concepts are to be seen as moving in a continuum between strong to weak.

Strength in ER is defined by: a) the degree to which knowledge areas, in this case disciplines in curriculum, have strong boundaries and are insulated from each other (classification), and b) the degree to which control over the transmission of knowledge in its specific context such as content selection, sequencing pacing etc. (framing) is exercised.

Strength of SR is defined by: a) The degree to which learner’s biological and social dispositions are emphasized in the educational system (classification), and b) the degree to which learners are encouraged to develop their personal knowledge, experience, values etc. in the actual learning context (framing).
Using such continuum concepts as ER and SR it is the strengthening or weakening of ER and SR which are most interesting and such changes are noted with +/- . This results in four code orientations as shown in the figure below:

- **A knowledge code** (ER+/SR-) where possession of certain procedures, skills, techniques within the subject is emphasized.
- **A knower code** (ER-/SR+) where learner dispositions are emphasized
- **A relativist code** (ER-/SR-) where legitimate knowledge and identity is determined from neither of the above
- **An elite code** (ER+/SR+) where legitimate knowledge is based on both well-defined procedures and the development of a certain knower gaze or personal attitude/expression.

Crossing these two continua of ER and SR opens up for a variety of curriculum modalities, thus providing a strong tool for examining the structuring of knowledge, especially how this structuring has changed over time.

**Analytical model for curriculum changes**

To examine changes in knowledge structures over time I have developed a model with two analytical dimensions. Horizontally the model marks divisions of reform periods where curriculum documents replace new ones. Vertically the model is divided into three levels representing different
recontextualization fields (Bernstein) in order to trace the changes in knowledge structuring in each of the fields (Bernstein 2000) (see figure above).

For each of the two institutional cases a large number of relevant curriculum documents have been studied, i.e. directives at State/ministry level, syllabuses at institutional level and “semester plans” at team/lecturer level. Here the focus has been on changes in ER and SR, which means descriptions of disciplines, their objectives, content and assessment criteria, respectively on descriptions of student’s involvement in learning. A two dimensional scheme has then emerged with a differentiated picture of code changes, and it has also shown how the agents at lower levels of recontextualization have reacted – and compensated - for the changes on the upper level. See the below figure.

**Changes in curriculum disciplines**

The research result reveals significant changes in knowledge organization.

A gradual weakening of ER in the single disciplines over the period from approx. 1960 to 2009 and a strengthening of SR can be traced. This is evident for both of the two cases, CAE and NE, but most significantly in CAE. The data material shows that the content and assessment criterion for each discipline has become continuously less explicit in curriculum documents. Almost simultaneously descriptions of students’ involvement and their own subjective resources have become increasingly more explicit in the descriptions of learning goals and assessment criteria, which is not surprising, as learning discourses have generally become increasingly orientated towards the learning subject during 80s and 90s, i. e. discourses of constructivist pedagogy, competence, “student directed learning”, etc. (Hermann 2008)(Bjørgen 1991). In other words the curricula have changed from a knowledge code (ER+/SR-) towards a knower code (ER-/SR+).

However, the picture is a lot more differentiated. The code changes of the disciplines must be considered along with some “displacements” of recontextualization. Decisions about disciplines and their content which were previously made at a top level in the educational system (State/Ministry) have gradually been pushed down to the institutional levels. Such movements are due to modernization processes in the public sector through the 80s and 90s in general (Hjort 2002). It is what some sociologists have called a double ‘counter-movement’: Mutual decentralization and centralization (Sørensen 2001).
An important point here is that disciplines do not just disappear as ‘singulars’\(^1\), but the decisions about them are moved to lower recontextualization fields. In the CAE case a clear demarcation and description of disciplines can no longer be found in formal curriculum documents! Up to the late 1980\(^\text{th}\) disciplines where defined at the state/ministry level (directives). The main disciplines comprised: ”Building design”, “Statics”, “Building Services” and “Planning and management”. Today those disciplines are only made explicit in the student’s timetable, and subsequently they still operate as such in the classrooms. The point is however, that the disciplines have lost their “legal support” in terms of the resources previously laid down in directives such as teaching units, external exams etc. The materiality of a single disciplinarity-discourse has eroded (Neumann 2001).

Today knowledge areas are termed ‘subjects’ or ‘themes’ and are less explicit due to lack of explicit descriptions of aim and content of each subject (weakening ER). The model below indicates how decisions about the organization of knowledge have been pushed down through the recontextualization fields. The contemporary syllabuses made at the institutional level now describe the learning objectives and knowledge content in general terms and the cooperative planning of teaching in the various subjects is taken place at the lowest level (‘Teams and individual lectures’, see fig. above)

In the NE-case a division of disciplines still remains in formal documents, but also here the boundaries between them remain unclear. It is worth noting that NE includes disciplines from both human and science culture, and there is a difference. The human disciplines such as ‘Nursing’, ‘Ethics’, and ‘Sociology,’ are less demarcated than the science disciplines, such as ‘Anatomy and physiology’ and ‘Pharmacology’. The hard science disciplines are still independent course units, which have maintained their epidemic strength (ER+).

This corresponds to the insight about differences in human and science cultures developed by Bernstein and expanded upon more recently by K. Maton and J. Muller (Bernstein 2001) (Muller 2011a) (Maton 2011)(Snow 1993).

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\(^1\) Bernstein’s term for a disciplinary orientation towards a knowledge area, that is its own development and protection
From approx. 1960 – 2012

<table>
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<tr>
<th>Recontextualization fields</th>
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PBL-idea implemented around 2000

Fig. 3: Analytical model for curriculum analysis.

Notes: The period division marks new reforms. Analytical results from CAE are shown, but simplified. ‘Disciplines’ have lost power from top level because they are no longer defined as such. Learning goals are instead orientated towards ‘main topics’. Decisions about knowledge content are increasingly made on the lower levels.

The role of PBL

It is obvious that this decentralization of curriculum decisions have generated higher complexity in the educational sub systems, which must somehow be dealt with – one way or another (Gleerup 1997). However, the institutions themselves cannot simply regain the strength in the disciplines. The institutions lack the legal basis to do so. Other countermoves need to be made, and Problem Based Learning (PBL) seems to have been one of them.

An important point emerging from the historical research perspective is that PBL has entered the scene as something which should compensate for the loss of epistemic strength in the disciplines. No matter what reasons educators may have stated for the implementation of PBL, a historical necessity has risen for a pedagogical concept that should provide a legitimate framework for a new type of curriculum.

This curriculum change is a history of moving from collection to integration (Bernstein 1971). If not PBL had been introduced, another pedagogy with similar properties would have been needed to cope with the increasingly stronger knower code.

The problem orientation in PBL removes the focus from the disciplines to a ‘problem’ and makes the disciplines/subjects a function of the problem. Disciplines should no longer be learned by themselves from an introjective perspective (Bernstein 2001)(Sarakinoti, Tsatsaroni & Stamelos...
2011), but instead problems should direct what knowledge to be learned from which discipline in order to reach a solution. Very often the problems in PBL are projections of the external professional practice, whose rationality foregrounds disciplines in their own right.

Thus the analytical approach gives an understanding of the contemporary organization of knowledge in curriculum as a formation of eroded\(^2\) disciplines. This corresponds to what Bernstein termed as ‘\textit{regionalization}’, where disciplines and subjects get more orientated towards external fields of practice (Bernstein 2000 p. 55)(Stavrou 2009). Again this is mostly seen in CAE and less in NE.

With further inspiration form Johan Muller I have termed this ‘knowledge organization’ as a federal constellation, because the subjects can no longer stand alone (Muller 2011b, Muller 2006). They enter into a federation, in this case ruled by PBL founded on the principles of problem orientation and interdisciplinary. However, the federations in CAE and NE are not alike and quite different aspects of the student’s learning are privileged.

\begin{center}
\begin{tikzpicture}
    \node[ellipse,draw] (ER) at (0,0) {ER weakens and SR strengthens at macro level};
    \node[ellipse,draw] (SR) at (5,0) {Syllabuses at institutional level react and ‘compensate’};
    \node[ellipse,draw] (PBL) at (10,0) {PBL is implemented};
    \node[draw,fill=blue!20] at (5,0) {Regionalization};
    \draw[->] (ER) -- (SR); \draw[->] (SR) -- (PBL);
\end{tikzpicture}
\end{center}

\textbf{Fig. 4: Curriculum changes over time}

**Transversal knowledge formations**

**Constructing Architect Education: “A tight federation?”**

In CA-education the PBL- idea is linked to project-work. Each project runs for a semester (½ year) and is carried out in groups of 3-4 students. The projects relate to technical house design and have a

\footnote{It is the materiality of the disciplinary discourse which erodes, (i.e. physical, organizational and administrative resources)}
new theme each semester. Projects are introduced by a brief case description about client demands and site conditions, etc. The project work is the main curriculum unit which almost all other lecturing and tutoring activities relate to. Teachers both lecture and supervise in the same room where students work on projects. During the preparation of teaching, lecturers coordinate lessons from various subjects (Building Design, Statics, Technical installation, etc.) so that the knowledge content from the subjects fit well with the students housing design in the projects. Immediately this indicates that the lecturers try to re-inforce the weakening of epistemic relations (ER) on the levels above. My classroom analyses following the curriculum confirm that this is the case to some extent. However, there are still some spaces for the students to make priorities in their projects as further explained below.

As most of the subjects connected to the project work share common roots in the natural sciences, they are characterized by a hierarchical knowledge structure (Bernsteins 2000). This means that the subjects can easily integrate in a common language. This is not the case with human knowledge areas, as it will be seen from the NE case. Human areas are characterized by a segmented structure where each theory has its own perspective and language (Martin 2011). Adding a new theory is adding a new perspective. In the project work carried out in CAE the various subjects have instead strong inferential links and speak to one another (Lundquist 1998)(Brandom 1994). Thus they can be connected without deeper reflection about their relevance. The knowledge resources (theories, procedures, techniques etc.) are prepared and made available by the lecturers and it is up to the students to adapt those and apply them in their housing projects. It is almost like a jigsaw puzzle, where pieces are made available by the lecturers, but put together by the students. Some few pieces may not be necessary and others may need slightly modification, but completing the house design is to make the ‘knowledge pieces’ fit together.

Although problem orientation is supposed to be the main principle in the PBL-project work, theories and procedures are not selected on the basis of an ‘ill structured’ problem in this case. The task is identifying how the given theories can be applied in designing a house. This kind of reflection has to do with the application and modification of theories and methods for the actual context (Bateson 1964)(Hermansen 2005)(Qvortrup 2004).

A question now emerges: how is the stronger SR supposed to be enacted? The legitimate pedagogical text - represented by the project work - is not produced only by the student’s mastering
of methods, procedures and techniques. The project work also involves a biographic component. Students are supposed to define their learning priorities based on what will be beneficial to their study or career perspective. The students justify their choices in a portfolio.

“So I may write in my portfolio, that I will work more with ‘statics’ in advance of ‘technical installations’, but I cannot exclude this entirely. The most important things should be there – for the authorities etc. but I can focus more on one thing than another. In that way you direct yourself through the study how much weight to put on this and that and in what area to specialize” (student 3. semester l 269)

Reflection of higher order about the theories/methods used to analyze empirical problems is not stimulated in this PBL-model because the ‘Problem’ is not a wicked problem embedded in an ill structured societal context (Boradkar 2010)(Kolmos) The task of “designing a house” requires building a model of a house or a model of a technical reality and therefore certain techniques and methods must be applied. The PBL model is similar to what Graff and Kolmos has termed ‘Discipline project’ (se PDF –Characteristics of problem based learning).

To sum up transversality in CAE: The study of both formal and enacted curriculum has revealed important features of transversal knowledge in PBL- programs. Former disciplines have moved into a relatively tight federation of subjects enabling certain kinds of reflection. Two types of reflections are dominant; one about the application of theories, and the other about subjective meaning in a career perspective. Due to the lecturers’ extensive preparation of knowledge resources and the student’s reflections on applying those to their house project, strong inferential links emerges between the subject areas. This results in creating a synthesis represented by the product; that is the housing design itself. However this synthesis is not a new transcending and overarching theory (Klein 2010) as each contribution from the subjects remains identifiisable. Since the projects are discipline and product orientated and not especially dealing with wicked problems it also means that the projects do not include meta-reflections about the relevance of knowledge and its scientific paradigms etc.
SP-case: "A loose federation"

As in CAE the weakened ER and the Strengthened SR requires countermoves, and also in NE PBL is implemented, yet in a different way.

A typical PBL-unit in NE lasts for a few weeks. This unit is then followed by a similar new one. The PBL-units involve a cluster of disciplines/subjects with ‘Nursing’ being the central discipline. Humanist subjects such as ‘Ethics’, ‘Philosophy and religion’, ‘Sociology’ and others are supplementary subjects. In addition science subjects as ‘Anatomy and physiology’ are also included.

Each PBL-unit is introduced by the lecturers presenting a study plan and a case story about a patient. Groups of students then work with recommended texts and receive lessons in the various subject areas. Each case work finishes with an oral presentation for the tutor.

Explanation of learning goals and assessment criteria are currently aimed at the federation of subjects rather than to the single subject. The weakening of ER has not happened so extensively in NE as it has in CAE and it is worth noticing that the science disciplines have kept their strength. They have still explicit learning goals and assessment criteria. In the PBL-case work students are required to discuss various theories in relation to the case story, thereby challenging their own norms, feelings and experiences.
As previously mentioned, the humanist subjects have a more segmented structure than the science disciplines. This means that the theories chosen by the team of lecturers often have alternative views to the same problem and the theories do not necessarily “speak together”. Furthermore, theories in the nursing field are less instructive and more interpretive. As a consequence the federation of subjects in NE is more loosely associated than in CAE.

A PBL case story can be viewed as a ‘model of the world’ similar to how a project is viewed in CAE, but the relationship between theory and empirical referents is of a different kind. The PBL case stories calls for interpretations, problematizing and explanations, not a solution which represents a product of the profession like a house design does in CAE projects. The problem orientation in the PBL-cases and the federation of subjects from humanist areas allows for – and involves - other types of reasoning and reflection: Not only of how theory X can explain problem P1 in the case, but also in how theory X differs from theory Y in explaining P1. Thus there are reflections involved at a higher level than in the project work in CAE.

It is challenging for the students to understand and use many of the nursing theories, especially the more philosophical ones (Kirkevold 2000)(Martinsen 2001), and therefore it is even more challenging to offer “critical assessment” of different theories as some of the learning objectives state. The argumentation which the students build up comprises statements and propositions from several theoretical resources, not linked epistemologically, but tied together mainly by the students own norms, opinions, experiences etc. A ‘biographic reflection’ like in CAE does not seem to have any significant place in the student’s work with the PBL case stories.

To sum up transversality in NE: The PBL cases in NE establish a frame around a loose federation of subjects from the humanist areas whose relation to one other is up to the students to argue for or against when exploring the case problem. In most cases the students’ argumentation is a serial constellation of theories, methods and principles from various scientific perspectives and traditions supplemented with own views and experiences. Consequently the argumentations do not produce new theoretical syntheses even though the PBL-cases call for reflection of a higher order when theories are to be compared/contrasted. The research on student’s products and dialogues with tutors shows difficulties especially in comparing and contrasting the more general nursing theories.

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3 Termed ’meta-theories in the academic Nursing field
If no possible relationships are made explicit the form of transversality turns out in the most simple form, usually termed ‘multi-disciplinarity’ (Jantsch 1972).

![Diagram of transversality](image)

Fig. 6. Transversality in NE – meta theoretical perspective but no transcending synthesis

**Conclusions**

Transversality is the central theme of this paper and it has been discussed in relation to the special knowledge formations that develop in two institutional Cases, ‘Nursing’ and ‘Constructing Architect’ education.

I have introduced the term transversality as an alternative to disciplinarity-terms like multi, inter- and trans-disciplinarity. Our conception of ‘disciplinarity’ needs to change in cases where disciplines have lost their strength in epistemic relations (ER-). As the two cases demonstrate, the *regionalization processes* that have taken place over the past several years have weakened the epistemic relations in each discipline. At the same time ‘social relations’ have been strengthened and opened for the implementation of PBL as a ‘pedagogical ‘answer’ due to the more student centered learning discourses.

Through PBL-course units the disciplines are gathered in a ‘federation’. One important point to note is that PBL is not the main cause of this new pedagogical environment. In both institutional cases, PBL operates more or less under the conditions of the regionalization process which has already taken place. This leaves room open for new possibilities. Transversal knowledge
formations emerge from various connections made between the federal constellations of subjects in the PBL-courses. As such, understanding transversality requires an understanding of how those connections are established in both the fields of recontextualization and the field of acquiring and reproduction.

As I have argued, the recontextualization and reproduction processes are quite different in each of the two cases. The student’s project work in CAE is based on a ‘tight federation’ whereas in NE the subjects are more loosely related. This results in different reflection and abstraction processes for the students in each institutional case. These processes are the key to a deeper understanding of inter-relationships between disciplines/subjects.

The CAE-case shows that the subjects in the PBL-courses are recontextualised to fit together. It is up to the students to tie the subjects and prove the inference between them through the housing design project which can be considered as a synthesis of the subjects, but not as an independent transcending theory.

The NE case shows that the subjects in the PBL-courses have much lesser potential for being linked epistemologically and inferentially, mainly because of the dominance of humanist knowledge areas. The looser federation cannot result in a synthesis, because the so called meta-theories in nursing have different scientific approaches and views. Instead the argumentation is build up in a multi-disciplinary sense where theories are supplementing each other without explicit relationships. Further transversality could be constructed by students’ meta-theoretical analysis of the interrelationships between the theories, but such argumentation has been hard to identify from the generated data.

**Perspectives**

As I have argued the historical analysis of knowledge transformations in curriculum uncovers important relationships between knowledge areas which the terms multi-, cross-, and trans-disciplinarity do not capture sufficiently if the structuring of knowledge should be further conceptualized in PBL-contexts. The two cases show how extremely different the transversality occurs in PBL. Not only they show the large variety in PBL-concepts and models, but also how the different science cultures influences on their knowledge capacity of semantic inference, applicability, interpretation etc. Thus, new questions can be raised from this research part.
One important question is whether theoretical meta-reflections, like in NE, are relevant for the students to perform in professional bachelor education, or it reaches a too high academic level. If no, PBL cases should be focused more on the craft issues and the procedural knowledge of nursing where it is possible to establish stronger inferential links between theoretical resources.

If yes, the structures of meta theoretical argumentations should be further researched in order to develop assessment criteria for such. One aspect is to look at *semantic structures* of how epistemological and axiological reasoning is built up in the students’ work. The last part of my Ph.D.-project discusses this issue.

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The single disciplines (singulars) have lost their explicit content descriptions and assessment criteria and thereby lost their legitimacy. However, educational institutions might not be encouraged to try to maintain strong singulars. More costs could be involved such as for example more assessment procedures.