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**PBL THROUGH THE LOOKING-GLASS:  
Comparing applications in Computer Engineering,  
Psychology and Physiotherapy**

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**BIOGRAPHICAL SKETCH**

Madeleine Abrandt Dahlgren is Associate Professor in Adult Education at the Department of Behavioural Sciences, Linköping University, Sweden. She has a background in the Health Sciences and long experience of teaching and consulting in problem-based learning in different academic settings. She was also keynote speaker and member of the organisation committee at the international conferences on PBL in Linköping 1995 and 2000. Her research areas are qualitative studies of students' learning in higher education and professional development. Presently, she is co-ordinating a web-based Master's programme in Adult Learning and Global Change, an intercontinental collaboration between four universities; LiU, Linköping, UWC, Cape Town, UTS, Sydney, and UBC, Vancouver.

## **SUMMARY**

The present investigation aims at describing and analysing aspects of students' experiences of PBL within three different academic contexts; computer engineering, psychology and physiotherapy respectively. A sociocultural perspective was outlined as a theoretical point of departure. Altogether 58 students participated in the study. Semi-structured interviews were used as the method of data collection. Data were analysed qualitatively. The results showed differences between how problem-based learning is realised and understood by the students in the three programmes. These differences are discussed in relation to the perspectives of knowledge and learning embedded in the programmes as reflected through the students' experiences.

## **INTRODUCTION**

The present article is a summary of a comprehensive research project aiming at comparing how problem-based learning is realised in three different professional educational programmes. The idea of PBL as an educational approach comprises certain key features that are described in the literature as general and important for student learning. On the part of the student, learning in context and social interaction is highly emphasised as well as the importance of developing metacognitive skills. It is often stressed that PBL, like any educational practice, is affected by its specific contextual factors and conditions. However, we have hitherto had limited empirical knowledge about how these contextual factors and conditions influence the educational practices, since very few analyses and comparisons of the particularistic outcomes of PBL have been conducted. The broad scope of this investigation was to study how students' experiences of PBL are moulded in three different academic contexts; computer engineering, psychology, and physiotherapy.

Data consist of interviews with students in different stages of their training. The focus is on curricular aims and students' study strategies in general [1], how the students experience the meaning of problem-based learning and the studies within problem-based programmes [2], as well as on students' strategies pertaining specifically to assessment [3].

### **The basic assumptions and characteristic features of PBL**

Today, Problem Based Learning is a well-known alternative approach to traditional disciplinary-based professional educational programmes in higher education. PBL has come to be regarded as representing a shift from the traditional perspective of higher education where much attention has been paid to the teacher and the teaching methods to a perspective that gives priority to students' learning [4]. This shift also means that the student's role changes in terms of increased responsibility for active commitment in his/her studies and learning [5, 6, 7, 8]. Three features of the learning environment in a problem-based curriculum stand out as typical in texts about PBL and are regarded as essential for enhancing student learning [4, 9, 10]. These core characteristics are learning in context, elaboration of knowledge through social interaction, and an emphasis on meta-cognitive reasoning and self-directed learning.

### **Learning in context**

In PBL, real-life scenarios are used as the point of departure for the learning. The rationale for this is to stimulate students' prior knowledge and to provide a meaningful context that also relates to the student's future professional work. Learning in a context resembling that of professional work is also considered important for the retention of knowledge when encountering similar situations

later on in practice. Working with real-life scenarios brings about some important consequences for the organisation of the syllabus and the educational process. In contrast to the traditional way of organising the syllabus, PBL curricula are usually thematically organised. This means that different fields of knowledge appear in the curriculum as real-life problems, events or phenomena, instead of in the form of traditional disciplines.

### **Elaboration of knowledge through social interaction**

The second basic characteristic of PBL is the emphasis on making the students elaborate on and verbalise their knowledge. The basic working form is the *tutorial*, where 5-7 students work together in a group with a tutor. In the group discussions, the learners themselves have to clarify their understanding and identify further learning needs. The emphasis on articulating knowledge and identifying learning needs, the synthesising of knowledge and the evaluating of the learning process are all considered important for enhancing learning. The teacher's role, it is claimed, changes from the traditional knowledge dispenser into the role of a tutor with the primary task of supporting student learning by monitoring and questioning all processes in which learning tasks are formulated or reported. This is regarded as a way of making the learning process public and thus accessible for meta-cognition and reflection.

### **Meta-cognitive reasoning and self-directed learning**

Meta-cognitive skills and self-directed learning are considered important for students' development into independent, life-long learners, responsible for their own learning. Schraw [11] describes two aspects of meta-cognition that he claims are necessary for self-directed learning; the knowledge of cognition and the regulation of cognition. These skills are teachable, he argues, and emphasises that instructional strategies should promote the construction and acquisition of meta-cognitive awareness. Self-directed learning comprises the ability to formulate learning goals, identify resources for learning, choose relevant and appropriate strategies for learning, and evaluate the learning outcomes [12, 13].

### **Academic cultures**

Descriptions of problem-based learning, thus, appear to share some common features as outlined previously in this paper. Does this mean that PBL as an educational practice will be the same regardless of subject matter or professional area?

From Kuhn's [14] writings, we know that different scientific disciplines have different paradigms for research and traditions as regards what counts as valid reasoning. Becher [15] claims that the attitudes, activities and cognitive style of a group of academics representing a particular discipline are closely connected to the characteristics and structures of this knowledge domain. Becher

characterises the nature of scientific disciplines as "academic tribes and territories" by describing two dimensions of their inherent culture, namely, the cognitive dimension and the social dimension. The cognitive dimension represents the epistemological aspects, the intellectual content or "territory" of the discipline. The social dimension describes the social features of academic communities or "tribes". Along the cognitive dimension Becher identifies disciplines as being hard or soft fields of knowledge. The hard fields are characterised by a well-developed theoretical structure embracing causal propositions, generalisable findings and universal laws. The knowledge is cumulative and focuses on quantitative issues and measurements. Soft fields of knowledge are characterised by unclear boundaries, unspecific theoretical structure, a concern with the qualitative and specific issues, and problems that are loosely defined and broad in scope. The cognitive dimension could also be described as the disciplines embracing pure knowledge, which is essentially self-regulating or applied knowledge that is open to external influence. Along the social dimension, disciplines could either be described as convergent or divergent fields. The convergent fields maintain a relatively stable elite and reasonable standards and procedures, while the divergent fields lack these features. The variation in research problems and methodological deviance is greater and more tolerated in divergent fields. Finally, the social dimension also comprises the distinction between an urban or rural approach to research. Urban researchers are described as having a narrow focus on their research problems, intense communication patterns, a high people-to-problem ratio. Problems are likely to have short-term solutions. Rural researchers embrace a broader perspective of the research problem that is not so sharply distinguished. The people-to-problem ratio is low, and the articulation of solutions takes considerably more time. Becher emphasises, however, that the classification is relative and not absolute, and that the attributions of the properties may change over time and space. The taxonomy could be regarded as an analytical framework for describing the variation in systematic differences between the epistemological properties of subjects and segments and the sociological properties of disciplinary communities and networks [p.154].

Similarly, every profession has its own frames of understanding, its own tacit rules for how arguments are constructed and with traditions for what counts as valid forms of reasoning [16, 17]. Students are gradually socialised into the academic culture they are entering and gradually also become carriers of the ways of thinking ruling these communities of practice. It is reasonable to assume that differences in academic cultures will also influence the ways of adopting PBL as an educational practice and, consequently, also students' experiences of their learning environment.

### **The aims of the study**

The aims of the investigation are to describe and analyse common features of students' experiences of PBL within three different academic contexts, computer engineering, psychology and physiotherapy. Three different themes that could be regarded as reflecting something of the collective, cultural knowledge that is conveyed to the students within the programmes. Three themes were chosen as the starting point of the interviews:

- I. The students' answers to the questions *What does PBL mean to you?* and *What is it like to be a student in a PBL programme?* aim at capturing the students' perspectives of the meaning of PBL.
- II. The questions *How do you know what to learn?* and *How do you use the study guides?* focus on the role of course objectives in the learning process.
- III. The third theme focuses on the impact of assessment on students' approach to studying and learning and was phrased as the question *How do you prepare yourself for the exam?*

### **MATERIALS AND METHODS**

The participating subjects are randomly chosen from three PBL programmes at Linköping University; a Master's programme in Computer Engineering, (180 credit points), a Master's programme in Psychology (200 credit points), and a Bachelor's programme in Physiotherapy (100 credit points). (In Sweden, one credit point corresponds to one week of full-time studies. Hence, a full academic year comprises 40 credit points). The programmes are all problem-based from the start and, according to the programme descriptions, they comprise all the key features of PBL as described above. All three programmes include tutorial groups as the basic working form. Lectures, resource events - i.e., sessions where students may use their teachers as resources by posing any questions they wish - and different kinds of skills training sessions or laboratory work are also included in all three programmes. The idea of tutors as indirect facilitators rather than being directive is generally applied, but the extent of tutor training varies between the programmes.

The Computer Engineering programme is organised in a number of interdisciplinary themes, each comprising from 2 to 10 weeks over the four years. The syllabus of the Psychology programme is organised in five overarching parts, each comprising from 7 to 56 weeks over the five years. The Physiotherapy programme at the time of the data collection was organised in six overarching themes, each comprising from 10 to 20 weeks of the two and a half year programme. For the Computer Engineering students, each theme has its separate assessment, carried out during allocated assessment periods, six per semester. In the Psychology programme, assessments normally occurred at the end of each block and at the end of each semester, respectively. In the Physiotherapy programme, assessments occurred at the end of each semester.

All three programmes applied a variety of assessment forms, oral as well as written examinations, with both individual and group assessments.

In Linköping, the PBL model has been used at the Faculty of Health Sciences since 1986 as the common pedagogical approach for all study programmes, including those for physiotherapists, occupational therapists, social care managers, medical biologists, nurses, and doctors [10]. The Computer Engineering programme at the Faculty of Technology and the Psychology programme at the Faculty of Arts and Sciences were initiated in 1995. Both programmes have designed their own implementation of PBL, although the Faculty of Health Sciences has functioned to some extent as a model and a source of inspiration.

### **The empirical study**

Sixty students, 20 from each of the three programmes, were randomly chosen from the cohorts in the third and fifth term respectively (for the physiotherapy group the second and fifth semester). Altogether 58 students agreed to participate in the study; 20 physiotherapy (age 21-42,  $m = 26$  years of age), 20 psychology (age 22-37,  $m = 26$  years of age), and 18 engineering students (age 20-29,  $m = 22$  years of age). Two students from the Computer Engineering programme initially agreed to participate, but did not turn up for the interview. They could not be reached for an explanation to why they chose not to participate in the study.

Data was gathered through a semi-structured interview with each student individually. The interviews were tape-recorded and lasted approximately 45 minutes. The transcribed interviews were analysed qualitatively with an interpretative phenomenological approach [18, 19], focusing on the individual's interpretations of his/her experiences. The process of the analysis can be described as an iterative and cyclical movement between the individual interviews within each group and the construction of an interpretative narrative, portraying the characteristic similarities of the answers within each group and between comparing the three group narratives with each other.

Each individual interview was thoroughly read and the most significant statements and meaningful units of the answers were marked. A cross-case, interpretative and preliminary narrative was constructed, based on the merged series of selected statements for the groups respectively. The preliminary narratives were then condensed for the purpose of expressing the typical and common features for each group. The individual interviews within each group were then checked again to see how the general condensation fitted. Further revisions were then made until the condensed narrative was considered sufficient. Excerpts from the interviews were used to exemplify the narratives. In the comparative analysis, common themes in the three groups' narratives were discerned and used as a structure for the comparison.

## RESULTS

### **Students' experiences of the typical characteristics of PBL**

The meaning of PBL is presented as the significant feature of PBL that the students expressed in their descriptions. It also incorporates their thoughts about the learning process and the emotional core expressions inherent in these descriptions.

The computer engineering students considered the fellowship and community in the tutorial groups to be of great value to them. They described how they used the group as an instrument for tuning their own understanding of concepts and/or strategies for problem solving. The tutorials seemed to fulfil a double function by giving opportunities for comparing one's own understanding with that of others, as well as providing opportunities for developing communication and co-operation skills, and was highly appreciated by the students.

*I think it's good, it's fun..the tutorial work gives you quite a lot...you get better at group work../ you have someone to turn to if there is a problem (Computer Engineering 217)*

The engineering students' descriptions of the learning process were typically characterised by confidence as regards the learning task. The question to deal with in the tutorial groups did not concern how the content should be delimited, but rather how it should be understood. In this respect, the tutorials played a significant role.

*It means a larger responsibility..you know what you are supposed to learn, but how, that is up to yourself to decide (Computer Engineering 207)*

The findings in the computer engineering group differ from the findings within the two other programmes in these respects. The psychology students' answers were instead characterised by firstly, an uncertainty regarding the delimitation of issues for learning, and secondly, the experienced authenticity of the learning task. A third theme was the function of the tutorials. The uncertainty regarding the delimitation of the learning task seemed primarily to be associated with the students' autonomy as regards choice of literature, which, in turn, required a commitment to a certain perspective of the problem at hand. The tutorials seemed to evoke ambiguous feelings among the psychology students. On the one hand, they valued the learning opportunities provided, on the other, they were confused since they seemed to have difficulties in distinguishing between what was happening in the group and what was accomplished by the group. In other words, the dynamics in small groups could

sometimes be the object of study but could also form the context of their learning.

When comparing the computer engineering students with the physiotherapy students, yet another difference was discernible. The physiotherapy group also emphasised the character of authenticity of the studies. The students described how they got a feeling of dealing with the kind of problems that they would later encounter as professionals. The authenticity also functioned as a tool for the students in managing the delimitation of the learning task. The focus on the treatment of a patient brought about a pragmatic frame for the formulating of questions for learning, even if they, as in the case of the psychology group, experienced uncertainty about how the learning task should be delimited. Typically, the computer engineering students related the learning task only to the demands of the educational programme and they did not relate to a future profession. They never pointed to the authenticity of the learning tasks as a typical feature of PBL. The data in the present study do not permit a satisfactory answer as to why this is the case. On the one hand, students may experience computer engineering programmes as being “immersed“ in authentic problem solving, which makes comments about this superfluous, i.e. the authenticity is taken for granted. On the other hand, there is still the possibility that most problems encountered in Computer Engineering education lack authenticity. Table 1 summarises the comparison between the three programmes.

**Table 1. Comparison of typical features of the students’ experiences of PBL**

	<b>Computer Engineering</b>	<b>Psychology</b>	<b>Physiotherapy</b>
<b>Core feature of PBL</b>	Co-operation	Authenticity	Authenticity
<b>Core expression</b>	Appreciation	Ambivalence	Activity
<b>Relation to learning task</b>	Confidence	Uncertainty	Uncertainty

### **The role of course objectives**

The course objectives indicate what learning outcomes the students are expected to achieve in relation to subject-matter content during the course. The students are supposed to formulate their own individual learning needs in relation to the course objectives. The students are required to take responsibility for their own learning, and this learning could take place in a variety of settings. In PBL, it is emphasised that goals of self-directed learning should be integrated with the content and made visible in the course objectives. Ryan [20] suggests that the

educational environments require certain characteristics for effective self-directed learning to occur. There should be an emphasis on the process of learning, as well as on the learning of course content; control of learning should be progressively turned over to students. Further, there should be a focus on the exploration of key concepts and principles, rather than on a detailed knowledge of every topic; and there should be integrated, 'active' learning, utilising the student's own experiences as part of this process [ibid. p. 56]. The role of the course objectives in the learning process is described as the analysis of the students' reflections over and answers to the questions *How do you know what to learn?* and *How do you use the study guides*. The comparison between the computer engineering programme and the psychology and physiotherapy programme is summarised in table 2.

**Table 2. Comparison of the role of course objectives in the learning process**

	<b>Computer Engineering</b>	<b>Psychology</b>	<b>Physiotherapy</b>
<b>Function</b>	Retroactive checklist: Objectives initially incomprehensible Content fixed	Integrated tool: Objectives problematised Content negotiable	Administrative schedule: Objectives ignored or abandoned
<b>Style of objectives</b>	A comprehensive, content specific and detailed list of goals	A few, overarching goals together with a list of central concepts	A comprehensive list of complex goals

The interpretation of the results is that the objectives in the study guides apparently played a differing role for the students in the three programmes. The different strategies for using the objectives in the learning process also in a way mirrored the ways the objectives were formulated in the different programmes.

In the Computer Engineering programme, the objectives of the courses were detailed and content-specific, clearly pointing to a mandatory body of knowledge which the students were supposed to acquire.

S: It is very clearly stated in the objectives; 'this is what you are supposed to achieve' So it is not that we decide what to learn, but rather how to learn it.(304).

The highly detailed goal formulations made the objectives initially incomprehensible to the students, and thus they were mainly used as a retroactive checklist.

S: Well, we get objectives for each theme, what it comprises and what it is all about..and we use them...we don't actually read them at all from the beginning, but when about half of the period is over, we check what we are supposed to have achieved at the end of the course...we usually make a list of what we don't know...and then we go through it again at the end to check that we have got everything..

I: How come you don't read the objectives until half of the course is over?

S: Because you don't understand at all what it means, there are so many new concepts and new things that you don't have a chance of understanding it..And even if you do understand, you don't know where begin, where to start, what is what...It is not until you have come halfway through it that you know roughly what it is all about, the difficulties and how things relate to each other...It is much easier to structure then...(207)

The computer engineering students' strategies for using objectives thus differed from the psychology students. In the Psychology programme, the objectives were formulated as expected learning outcomes. This meant a few, overarching sentences together with a list of concepts, considered central to the achievement of the learning outcome in question. Apparently, this gave the students an opportunity to use the objectives as an integrated tool in the learning process, to discuss and problematise their meaning. It is reasonable to assume, that when the objectives are problematised, the learning process becomes more student-directed. This would also mean that the content of the learning becomes negotiable, it is not self-evident what the students choose to study.

The computer engineering students also differed from the students in the Physiotherapy programme regarding the use of objectives.. In the physiotherapy programme, the objectives were formulated as an extensive list of overarching goals, more or less expressed as generic academic skills that the students were supposed to achieve, and with a less clear relationship to the content of the learning. The students obviously could not use the objectives, they were either unaware of them or felt that they were too abstract and unclear to play any decisive role in their learning process. Instead, the students used different strategies to define the learning tasks via the educational context, i.e. turning to

elementary textbooks, relying on other students or on hints from the tutors. The study guides were, thus, mainly used as an administrative schedule.

### Assessment and approaches to learning

Research in higher education has shown that assessment is one of the most powerful forces for influencing student learning. The influence of assessment on approaches to learning is not only exerted by the form of assessment *per se*, the students' anticipation of the examination and marking also influences how they go about their learning activities [21]. There was a variation between the three programmes regarding how the assessment was carried out. The Computer Engineering programme was organised in a number of interdisciplinary themes, each comprising from 2 to 10 weeks over the four and a half years. Each theme had its separate assessment, carried out during allocated assessment periods, six per semester. The syllabus of the Psychology programme was organised in five overarching parts, each comprising from 7 to 56 weeks over the five years. Assessments normally occurred at the end of each block and at the end of each semester, respectively. The Physiotherapy programme at the time of the data collection (it has since been extended to comprise three years) was organised in six overarching themes, each comprising from 10 to 20 weeks of the two and a half year programme. Assessments occurred at the end of each semester. All three programmes applied a variety of assessment forms, oral as well as written examinations, with both individual and group assessments. Still, the students' answers to the question *How do you prepare yourself for the exam?* revealed both a common and an idiosyncratic pattern of categories.

The analysis revealed a set of strategies of preparations for the examination that are almost unique to the three programmes. *A. Confrontation of perspectives*, is typically frequent among the Psychology students, *B. Reaching consensus*, is typical of the Engineering students and *C. Clinical contextualisation*, is characteristic of the Physiotherapy students. There is also a common variation within the three programmes, which is described in the three following categories *D. Reflecting*, *E. Memorising* and *F. Tactical planning*. The comparison between the programmes and the distribution of subjects over the categories is shown in table 3.

**Table 3. Comparison of the impact of assessment on approaches to learning. Distribution of subjects over the category system**

Approaches to learning	Computer Engineering	Psychology	Physiotherapy
A. Confrontation of perspectives	0	7	0

B. Reaching consensus	10	0	1
C. Clinical contextualisation	0	1	10
D. Reflecting	1	7	5
E. Memorising	1	2	2
F. Tactical planning	3	2	1
Non-categorised	3	1	1
Total	18	20	20

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The typical feature of the *reaching consensus* category, which was idiosyncratic for the Computer Engineering students, was that students helped each other to reach a consensus about how to understand and solve given problems that were considered essential to the course.

S: We often sit together and try to sort out the difficulties in some tricky problems, and we often check the course objectives and go through all the objectives to discuss exactly what they say and what they really mean. You kind of check, that everyone knows this (208).

Here, the tutorial group played an important role in the preparations for the exam. The students utilised each other as resources in working through the problem and they appeared to take a collective responsibility for the learning task. This was a strategy that was different compared to the psychology students.

The Psychology students described how the *confrontation of perspectives* was a necessary condition for learning, they arranged extra group discussions or studied together with a student colleague to accomplish this confrontation of perspectives. In these discussions, the students talked about what they had been reading and tried to see it from different angles to see connections between theories within a certain field. They also described how they tried to see the origin of the theories and their contemporary importance.

Comparing the computer engineering students' strategies with the physiotherapy students, differences in another aspect appear. The central theme in *clinical contextualisation* category, which was typical of the Physiotherapy students' preparations for the exam, was how concepts, theories and skills were contextualised into a clinical situation where a patient was present. This meant that the students, individually or in groups, prepared themselves by reasoning about fictive patient cases. The students went through the patient cases they had been working with in the tutorial groups during the semester, but a typical strategy was also to construct new cases and reason about these.

The common categories that appear across all three programmes, *Reflecting*, *Memorising* and *Tactical planning*, bear characteristic features that are similar to deep, surface and strategic approaches to learning that have been found in many studies of student learning [22]. What is also obvious from the results of this study is that the assessment does have a differential impact on the approaches to learning adopted by a majority of the students. The idiosyncratic categories *Confrontation of perspectives*, *Reaching consensus* and *Clinical contextualisation* clearly illustrate this. This means that strategic approaches to learning would be most commonly applied within all three programmes, if the realisation of strategic approaches causes students to adapt to the kind of assessment they are expecting and to adjust their studying. Paradoxically, these approaches bear features of a deep approach to learning, and are at the same time strategic. In table 4, all results are collated and compared between the programmes.

**Table 4. Summary of results – comparison between programmes**

	<b>Computer engineering</b>	<b>Psychology</b>	<b>Physiotherapy</b>
<b>Role of course objectives</b>	Retroactive checklist	Integrated tool	Administrative schedule
<b>Relation to learning task</b>	Confidence	Uncertainty	Uncertainty
<b>Approaches to learning</b>	Reaching consensus	Confrontation of perspectives	Clinical contextualisation
<b>Core feature of PBL</b>	Co-operation	Authenticity	Authenticity
<b>Core expression</b>	Appreciation	Ambivalence	Activity

## DISCUSSION

The results make it obvious that there are differences between how problem-based learning is realised and understood by the students in the three programmes included in this study. These differences could be described along the dimensions of *the reflected perspective of knowledge and learning* embedded in the programmes. If we return to the collated results of all the papers included, as displayed in table 4, we can discuss what kinds of embedded epistemological frameworks are reflected.

#### **Knowledge as indisputable – learning as mastery of content**

The typical traits of the results in the Computer Engineering programme reflect a perspective of *knowledge as indisputable*. It appears as if the discursive tools on a global level convey the message that the content is given. The interplay with the local level displays itself in the descriptions of how the course objectives function. To the students, it appears as if it can be checked whether the correct knowledge has been obtained. The reflected perspective of learning is typically *mastery of content*. Immersed in the reflected perspective of knowledge and learning is also the message that a consensus rules for how the content should be understood. The students' accounts of their participation in preparations for the assessment reflect how they transform and appropriate the notion of consensus through co-operation as an important trait within their discipline area.

The results in this group could also be connected to previous writings about characteristics of different cultures in academia. The clear criteria for sufficient reading and the lack of uncertainty in the case of the Computer Engineering students harmonise with Becher's [15] cognitive characteristics of a hard and applied field of knowledge, where the primary outcomes are products and techniques. The appreciation of group collaboration when working with the learning task could reflect the urban character of the social dimension of the field, with a high people-to-problem ratio.

An alternative way of viewing the results of the Computer Engineering programme is that they possibly reflect the concept of technical rationality brought into the educational situation, as suggested by Handal and collaborators [23]. The notion of an effective, instrumental action towards goals that are not disputed, involving mastery and control of the objective world is in several ways discernible in the accounts in this group. In Savin-Baden's [24] terminology, the results in the computer engineering group harmonise with a model of 'PBL for Epistemological competence'. The characteristic features of this model are that what counts as knowledge is determined in advance and that students are expected to know propositional knowledge to solve problems.

#### **Knowledge as relativistic – learning as discerning variation**

The descriptions in the Psychology programme reflect an embedded perspective of knowledge and learning that contrast with the perspective in the computer

engineering group and, as will be shown later, the physiotherapy group. The characteristic feature here is a perspective of *knowledge as relativistic*. On the global level, discursive tools are loosely sketched and students interpret this on the local level as if content is negotiable and that they are viewed as responsible and participating in the constitution of the body of knowledge in their discipline area. The students appropriate the relativistic perspective by their ways of participating in the tutorial groups and by their ways of preparing for the assessment. The uncertainty in relation to the learning task is resolved through the confrontation of different perspectives of a certain phenomenon, and *discerning variation* becomes their learning project.

In Becher's [15] terminology, these results could be seen as reflecting cultural traits pertaining to soft and applied fields of knowledge. These fields do not have a stable or common perspective of their body of knowledge like the hard fields of knowledge. The sense of what should count as progression within these fields is less evident, due to the fact that the soft and applied fields of knowledge are focused on understanding the complexity of human situations, according to the author.

If we compare the results with Savin-Baden's scheme of PBL models [24], they resemble the model 'PBL for Critical Contestability', in which knowledge is viewed as contingent, contextual and constructed. Here, learning is characterised as a flexible entity involving interrogations of frameworks. Handal and collaborators [23] reason along similar lines when describing the concept of critical rationality introduced into the educational situation. In such a case, the emphasis would be on emancipation through re-evaluation and scrutiny of the conditions that underlie and determine understanding and action.

The capability of discerning variation has been put forward as the primary mechanism of learning [25], and it appears to be particularly important within an epistemological framework as described here.

### **Knowledge as pragmatic performance – learning as contextualisation**

The third perspective of knowledge and learning discernible in the material resides within the physiotherapy group and comprises an emphasis on *pragmatic performance*. This notion is transformed and appropriated by the students through their emphasis on activity. The course objectives appear as less important as discursive tools reflecting a particular perspective of knowledge. As they appear abstract and incomprehensible to the students, they are themselves transformed into activity. The course objectives become the schedule for the administration of different activities and tasks and in this way play a secondary role in defining of the learning task. The emphasis on pragmatic performance is also transformed in the students' preparation for the assessment. Learning as *clinical contextualisation* resolves the uncertainty in defining the task, to know how to perform, act and do for the patient becomes their way of tackling the learning process. Similarly, Savin-Baden [24] has outlined a model

of 'PBL for Professional Action' that harmonises with the reflected perspective of knowledge and learning described here. In this model, the view of knowledge is practical and performative and learning is focused on knowledge and skills for the workplace, Savin-Baden argues.

One conclusion that could be drawn from this investigation is that PBL will not mean the same thing when implemented in different academic contexts. A positive interpretation of this feature is that PBL seems to be flexible enough to permit different traits of the academic or professional culture to exercise a decisive influence on the learning process. There are, thus, possibilities for different academic cultures to shape PBL according to their own needs and traditions and to their inherent perspective of learning. This conclusion brings, however, up several questions when scrutinising the reflected epistemologies above. The first question is whether there actually is a univocal notion of knowledge and learning that is expressed and realised through PBL. The results of this study apparently seem to contradict such a standpoint. The second question is whether it is desirable to aim for a common normative standpoint for what should count as PBL, or if a multiplicity of epistemologies associated to PBL would be preferable.

Margetson [26] argues that there is a widely held misconception of what PBL is that has distorted the understanding of the educational approach and limited its development. He claims that this misunderstanding historically goes back to a conception of a fundamental split between fact and value. Even today, this has consequences for teaching and learning as well as for PBL, the author argues, since the belief that facts and values are separated is deeply entrenched in our thinking. In education, the fact-value split may be represented by a matching dichotomy between two contrary views of teaching; *objectivist didacticism* and *subjective autonomy*.

Objectivist didacticism is based on the fact side of the fact-value split. Teaching is characterised by a strong belief in the objectivity of facts and the appropriateness of didactic teaching. Subject autonomy, on the other hand, emphasises the value side of the dichotomy and encompasses a strong belief in the idea of individual, subjective values held by the learner.

According to Margetson, there is also a mix of objectivist didactic and subjectivist autonomy assumptions in teaching that is reflected in various forms of education. He argues that there is a need to view PBL as transformative, both in conception and in practice in order to realise its full potential. In this process, the conception of what constitute a problem in PBL is central, as elaborated on earlier in this paper. Is the problem viewed as a 'convenient peg' on which to hang the coat of basic science, i.e. factual knowledge, or is the problem part of a 'growing web', an integrated whole that has no given answers or solutions and in which facts and values are inseparable [27]. In order to bridge the fact-value split, Margetson argues that there is a need to view problems in PBL in a wider context than the immediate educational frames. Educators need to look to the

macro-social, global level in order to prepare students to address major issues, Margetson claims.

Another important set of questions to be added and reflected on in this process is the reason for implementing PBL in the first place. What kinds of issues are there that a faculty expect to be resolved by choosing PBL as the educational approach? It is obvious from the results of this study that PBL resolves different issues in different academic cultures, as well as it creates different kinds of problems for the students to handle.

An alternative view of the results of the study is that PBL could be a tool in the reproduction and preservation of the prevailing academic and professional cultures, but perhaps not the universal vehicle for change and development as it is sometimes portrayed to be. The argument that PBL is more than a method, it also encompasses a certain way of viewing knowledge and learning, only holds true up to a certain point. The shift in method does not necessarily mean a shift in perspective of learning in a certain direction. Superficially, the procedures are the same, but the view of knowledge and learning varies between different academic contexts. The method brings about procedural changes in a direction that can support a shift in perspectives from teaching to learning. At face value, the procedures of PBL give the learner the responsibility for taking charge of the formation of the learning task and for the learning process. It is likely to assume that the discursive tools provided will, however, *support* or *counteract* this process according to how the notion of the autonomous learner fits into the overall regime of the academic field of knowledge as a community of practice.

The results of this study show that the specific contexts will influence how students take and give meaning to the learning process on the local level, which, in turn, will affect the kind of effects to be expected when implementing PBL in different fields of knowledge. A given community of practice may also be more or less reflective as regards the nature of its own practice. It is interesting also to note the kind of paradoxical finding that a centre of a community of practice could be the co-existence of a diversity of conceptions of what constitutes its core, as was the case within the Psychology programme.

Analyses like those performed in this study could contribute to portraying the perspectives of knowledge and learning and how they are communicated to the students through the formation of the educational practice. Knowledge about the nature and message of this communication could then constitute a basis for reflection about educational development within the programmes.

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Captions for tables:

- Table 1. Comparison of typical features of the students' experiences of PBL
- Table 2. Comparison of the role of course objectives in the learning process
- Table 3. Comparison of the impact of assessment on approaches to learning.  
Distribution of subjects over the category system
- Table 4. Summary of results – comparison between programmes

**Table 1. Comparison of typical features of the students' experiences of PBL**

	<b>Computer Engineering</b>	<b>Psychology</b>	<b>Physiotherapy</b>
<b>Core feature of PBL</b>	Co-operation	Authenticity	Authenticity
<b>Core expression</b>	Appreciation	Ambivalence	Activity
<b>Relation to learning task</b>	Confidence	Uncertainty	Uncertainty

**Table 2. Comparison of the role of course objectives in the learning process**

	<b>Computer Engineering</b>	<b>Psychology</b>	<b>Physiotherapy</b>
<b>Function</b>	Retroactive checklist:  Objectives initially incomprehensible  Content fixed	Integrated tool:  Objectives problematised  Content negotiable	Administrative schedule:  Objectives ignored or abandoned
<b>Style of objectives</b>	A comprehensive, content specific and detailed list of goals	A few, overarching goals together with a list of central concepts	A comprehensive list of complex goals

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**Table 3. Comparison of the impact of assessment on approaches to learning.  
Distribution of subjects over the category system**

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<b>Approaches to learning</b>	<b>Computer Engineering</b>	<b>Psychology</b>	<b>Physiotherapy</b>
A. Confrontation of perspectives	0	7	0
B. Reaching consensus	10	0	1
C. Clinical contextualisation	0	1	10
D. Reflecting	1	7	5
E. Memorising	1	2	2
F. Tactical planning	3	2	1
Non-categorised	3	1	1
Total	18	20	20

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**Table 4. Summary of results – comparison between programmes**

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	<b>Computer engineering</b>	<b>Psychology</b>	<b>Physiotherapy</b>
<b>Role of course objectives</b>	Retroactive checklist	Integrated tool	Administrative schedule
<b>Relation to learning task</b>	Confidence	Uncertainty	Uncertainty
<b>Approaches to learning</b>	Reaching consensus	Confrontation of perspectives	Clinical contextualisation
<b>Core feature of PBL</b>	Co-operation	Authenticity	Authenticity
<b>Core expression</b>	Appreciation	Ambivalence	Activity

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