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**PORTRAITS OF PBL: STUDENTS' EXPERIENCES OF THE
CHARACTERISTICS OF PROBLEM-BASED LEARNING IN PHYSIOTHERAPY,
COMPUTER ENGINEERING AND PSYCHOLOGY**

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ABSTRACT

The present study is part of a comprehensive research project with the general aims of comparing how problem-based learning is realised in three different professional educational programmes. The specific aims of this study are to describe and analyse how students in the three different programmes conceive of the meaning of problem-based learning and how they experience their studies within a problem-based learning programme. The PBL programmes are a Bachelor's programme in Physiotherapy, a Master's programme in Psychology, and a Master's programme in Computer Engineering. Data were analysed qualitatively. The results reveal differences in how the students in the three programmes conceive of their autonomy as learners, co-operation with their counterparts and the authenticity of the learning task. The findings possibly also reflect the taken-for-granted perspectives of knowledge, embedded in the cultures of the professional practices and the scientific disciplines to which the programmes pertain.

Key words: problem-based learning, comparative study, physiotherapy, computer engineering, psychology, student's perspective, academic cultures, qualitative analysis

INTRODUCTION

The present study is part of a comprehensive research project aiming at comparing how problem-based learning is realised in three different professional educational programmes in different academic departments. The incentives for the research project have their origins in a doctoral thesis (Abrandt, 1997) which focused on the outcomes of learning as regards physiotherapy students' conceptions of central concepts in physiotherapy. The physiotherapy programme was delivered within a problem-based curriculum, and the processes of problem-based learning (PBL) became the focus for a new project, focusing on students' experiences of their learning environment. The interest in comparing PBL in different programmes was aroused as the result of discussions about whether the preliminary results obtained in physiotherapy would be valid in a different academic context or whether PBL in such a case would be something else. This was the incentive to expand the project to comprise also students in computer engineering and psychology, in 1997 two relatively newly started PBL programmes at Linköping University.

Data consist of interviews with students in different stages of their training and focus on curricular aims and students' study strategies in general (Abrandt Dahlgren, 2000) as well as pertaining specifically to assessment (Abrandt Dahlgren, submitted). The specific aims of this particular study are to describe and analyse how the students experience the meaning of problem-based learning and the studies within problem-based programmes.

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 was first implemented in medical education at the McMaster University in Canada about thirty years ago. It 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 (Boud & Feletti, 1999). This shift could be regarded as a “figure-ground” reversal.² In a general sense, the figure-ground reversal between teaching and learning also means that the student's role changes in terms of increased responsibility for active commitment in his/her studies and learning (Barrows & Tamblyn, 1980, Barrows 1985, 1988; Albanese & Mitchell, 1993). Three features of the learning environment in a problem-based curriculum stand out as typical in normative texts about PBL and are regarded as essential for enhancing student learning (Boud & Feletti, 1999; Norman & Schmidt, 1992; Kjellgren et al, 1993). These core characteristics are learning in context, elaboration of knowledge through social interaction, and an emphasis on meta-cognitive reasoning and self-directed learning.

² The gestalt notion "figure-ground phenomenon" refers to the characteristic organization of perception into a figure that 'stands out' against an undifferentiated background. What is figural at any one moment depends on patterns of sensory stimulation and on the momentary interests of the perceiver.

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. There are, however, different ways of implementing PBL. Saarinen-Rahiika & Binkley (1998) discerned three approaches described in the literature; firstly, completely integrated curricula, where all content is problem-based throughout the programme. Secondly, transitional curricula, in which the earlier stages of the programme are subject-based or traditional, and the problem-based approach is applied later in the programme. The third variant discerned was single-course approaches, in which only a single course within a whole programme is problem based.

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. The group discussions, in which the learners

themselves have to clarify their understanding and identify further learning needs, are considered important for formulating, synthesising and evaluating knowledge. 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 (1998) 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 (Knowles, 1975; Zimmerman, 1990).

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 (1970) writings, we know that different scientific disciplines have different paradigms for research and traditions as regards what counts as valid reasoning. Becher (1989) 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. Similar findings have also been reported in studies focusing on policy implementation processes (McInnis, 1996) and leadership cultures in academic departments (Kekäle, 1997). Becher (1989) 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 pertaining to 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 (Säljö, 1994, 2000; Wenger, 1998). 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 specific aims of this particular study were to describe and analyse how the students experience the meaning of problem-based learning and the studies within problem-based programmes. The core questions on this issue in the interviews were formulated as follows: *What does problem-based learning mean to you?* and *What is it like to be a student in a problem-based programme?*

MATERIALS AND METHODS

The participating subjects are randomly chosen from three PBL programmes at Linköping University; a Master's programme in Psychology (200 credit points), a Bachelor's programme in Physiotherapy (100 credit points), and a Master's programme in Computer Engineering, (180 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 syllabus of the Psychology programme is organised in five overarching parts, each comprising from 7 to 56 weeks over the five years. The Computer Engineering programme is organised in a number of interdisciplinary themes, each comprising from 2 to 10 weeks over the four 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. 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. For the Computer Engineering students, each theme has its separate assessment, carried out during allocated assessment periods, six per semester. All three programmes applied a variety of assessment forms, oral as well as written examinations, with both individual and group assessments. The impact of the assessment on students' study strategies in the three programmes is investigated in a forthcoming article (Abrandt Dahlgren, submitted).

The Physiotherapy programme was introduced in 1986, when all the study programmes at the Faculty of Health Sciences were launched as the first full-scale PBL implementation in Scandinavia. The Computer Engineering programme and the Psychology programme were implemented in 1995.

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. The data collection was carried out on two separate occasions. The physiotherapy students were interviewed in 1993 and the psychology and computer engineering students in 1997 (table 1). The physiotherapy programme comprised 100 credit points at the time, but has since been extended to 120 credit points.

Data-collection	Program/group	Year/semester	N	n
1993	Physiotherapy I	1 (semester 2)	18	10
	Physiotherapy II	3 (semester 5)	17	10
1997	Psychology I	2 (semester 3)	30	10
	Psychology II	3 (semester 5)	26	10
	Computer engineering I	2 (semester 3)	24	10
	Computer engineering II	3 (semester 6)	21	8
Total			136	58

Legend to table 1. Data collection

Data was gathered through a semi-structured interview with each student individually. The interviews were tape-recorded and lasted approximately 45 minutes. The interviews had a typical duration of 45 minutes. The transcribed interviews were analysed qualitatively with an interpretative phenomenological approach (Huberman & Miles, 1994; Lawler, 1998), 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 traits 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

In the following, each of the three groups of students will be described separately. The descriptions are based on common and frequently mentioned experiences of their everyday life as students in a PBL-programme. For each group, the students' experiences of PBL are presented as the *typical features of PBL* that the students expressed in the interviews. It also incorporates how they described *their relationships to the learning task* and the *core expressions of feeling* inherent in these descriptions. These three themes incorporate statements from all students and together build up the essence of the common narrative for each group. The results for all three groups are collated and summarised in table 2.

Physiotherapy

I think it's great to study in a PBL programme, although it can be frustrating sometimes, when you don't get clear directives.. / but I think PBL is great, you develop terrifically..I have built up an identity all by myself, thanks to the school..and now, I actually feel like a nearly graduated physiotherapist (Physiotherapy 301)

In a nutshell, this quotation summarises the physiotherapy students' experiences of being students in a PBL programme. The latter part of the excerpt emphasises on the one hand the development of an active and independent learner on the threshold of being a full-fledged

professional. At the beginning of the statement, there is, on the other hand, a clear reference to the more frustrating experiences, i.e. the difficulties in delimiting the learning tasks that go with the role as an independent learner. Several of the senior students, as in the quotation above, report on a development throughout the course of studies in this respect, which gradually makes them feel more confident.

The autonomy as regards formulation of learning tasks and choice of texts for reading creates a dilemma for the students. This dilemma concerns the freedom to formulate learning tasks by themselves, and at the same time meet the expectations that they are studying the relevant content at the proper level. As illustrated by the quotation below, the difficulties experienced concern judging when reading is sufficiently profound and far-reaching.

Compared to upper-secondary school, this is much better...more discussions..you share the knowledge you acquire with others...What is most difficult is to know if you have studied enough, or if you have studied too little...(Physiotherapy 211)

Several students also stress the importance of themselves taking an active role in the learning process. In one of the interviews, this demand is phrased in the following way:

It means that the students have a great responsibility, to be more active, and to acquire knowledge and experience by themselves (Physiotherapy 203)

The emphasis on the activity of the individual student is a typical trait in this group. In some of the answers, the group environment is mentioned, but only as a background of the main theme about delimiting the learning tasks.

You work in a group most of the time..and you have cases to work with../great responsibility is given to the individual and the group to find the knowledge...and about group dynamics..to become aware of your own role in the group, and how a group functions..(Physiotherapy 354)

Another feature emphasised in this group is the character of authenticity of the studies, in the sense that the students get a feeling of dealing with the kind of problems that they will later encounter as professionals. The following excerpt is typical:

You work a bit closer to reality.. you work a bit closer to what you will be working with then / after the studies/ (Physiotherapy 204)

The authenticity also functions as a tool for the students in managing the delimitation of the learning task. The focus on the treatment of a patient brings about a pragmatic frame for the formulating of questions for learning, as expressed in the quotation below

You find the knowledge you need to treat the patient...you have a problem that you try to solve..(Physiotherapy 306)

Computer Engineering

It (PBL) is something that has developed, but it's not like the academic definition of PBL, that you start with a problem../There has been a real lot of the good old reading from page one to page 200../ there has been a lot more freedom to choose literature and the ways of learning../the tutorials have provided good opportunities to discuss concepts that you haven't come to grips with..(Computer Engineering 308)

This excerpt from the interviews gives a representative image of the computer engineering students' experiences of the tutorials as the significant learning environment. It is definitely the case that the students consider the fellowship and community in the groups to be of great value in themselves, but they also use the group as an instrument for tuning their own understanding of concepts and/or strategies for problem solving. Thus, the tutorials seem to fulfil a double function by giving opportunities for comparing one's own understanding with that of others. In addition, the tutorials also provide opportunities for developing communication and co-operation skills. Two of the students express this as follows:

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)

You get to know each other..and you are forced to work together with people you would otherwise not have chosen (Computer Engineering 208)

Typical of the answers in this group is also, as indicated in the introductory quotation as well as in the two following excerpts, the lack of uncertainty as regards which content to study.

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)

You get a problem that you are supposed to solve..and in order to solve it, you have to get knowledge...that's how I interpret it, literally speaking (Computer Engineering 305)

The fact that it seems as if the students are given problems by their teachers, rather than being required to formulate them by themselves, also leads some of the students to doubt whether their programme really complies with the traditional definition of PBL, as indicated in the introductory quotation.

Psychology

In general, I think it's good, I'm happy to be in a PBL programme. Still, it's associated with very much uncertainty, gradually diminishing, but still..I mean, you can always read more..sometimes the method can lock it all up because it dominates and yet it's not easy to grasp (Psychology 225).

Thinking about it, it's mostly the reality connection that strikes me. You get real problems and you try to solve them as you would have done for real..(Psychology 323).

The three main themes that appear to dominate the interviews with the psychology students are firstly, the delimitation problem and secondly, the authenticity of the learning task. A third theme is the function of the tutorials.

The delimitation aspect seems primarily to be associated with the students' autonomy as regards choice of literature, which, in turn, requires a commitment to a certain perspective of the problem at hand.

To me, it means freedom to choose literature..to appraise different theories...I can choose to study in a direction that suits my thinking best (Psychology 314)

When mentioning this, they very often talk about their uncertainty as regards the criteria for sufficient reading.

It's not self-evident what you're supposed to read. The literature is pretty optional and you can choose for yourself (Psychology 320).

..it's frustrating..and I'm worried about missing something..one is not sure about whether one reads enough...(Psychology 217)

The second characteristic trait of the experiences in this group is the feeling that they work with real problems.

You start with a problem that exists in reality...or is closely connected to reality..that's what I think about first..(Psychology 301)

The tutorials seem to evoke ambiguous feelings among the psychology students. On the one hand, they value the learning opportunities provided, on the other, they are confused since they seem to have difficulties in distinguishing between what is happening in the group and what is accomplished by the group. In other words, the dynamics in small groups may sometimes be the object of study but may also form the context of their learning.

.It can be rather tiresome with the never-ending tutorial groups..it is almost like in school, everything is mandatory...And it can also be tiresome that you constantly, discuss other things, emotional things..Maybe, that depends on what programme you're in..we are going to be psychologists, so it's kind of natural..(Psychology 313)

There is also a link between the tutorials and the delimiting issue in terms of commitment to a certain theoretical perspective. Thus, the students do not necessarily contribute to the construction of a totality, but may instead have different perspectives of an entire problem that may sometimes be integrated into something more complex than what they may have accomplished individually.

You get a complex perspective of the problem, since we all bring different knowledge to the group, that we somehow try to integrate..so you learn more than you would have done by yourself (Psychology 223)

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

Legend to table 2. Typical features of students' experiences of PBL in Computer Engineering, Psychology and Physiotherapy.

To summarise, the physiotherapy students' experiences of PBL is primarily characterised by the *authenticity* of the study method and the cases. There is also an emphasis on the need to be *active* in the learning process. The common denominator in the physiotherapy students' descriptions of their relation to the learning task is a gradually fading *uncertainty* regarding the formulation and delimiting of the learning task.

The computer engineering students' experiences of the typical feature of PBL is the emphasis on *co-operation*. Their descriptions are also entrenched by *appreciation* of the study method. The relationship to the learning task is characterised by *confidence*, to the computer engineering students, the dilemma is not uncertainty regarding how the learning task should be delimited, but rather how the content should be understood. In this respect, the tutorials play a significant role. Furthermore, there are no statements about the degree of authenticity of the learning tasks.

The psychology students share with the physiotherapy students the experience of the *authenticity* of learning tasks in PBL. They also share an *uncertainty* when delimiting the learning task, sometimes elaborated to also comprise which theoretical perspective to choose on a certain problem. They express a feeling of *ambivalence* in relationship to the tutorials, since these may form both the context of learning as well as exemplifying the learning content.

DISCUSSION

One of the main findings in the study concerns the students' experiences of formulating and delimiting the learning task. The Physiotherapy students and the Psychology students share an uncertainty as regards the criteria for sufficient reading. Such uncertainty is totally absent among the Computer Engineering students. We know from a previous study (Abrandt Dahlgren, 2000), comparing the same three programmes with regard to how students make use of goal documents in their learning process, that the Computer Engineering students differ from the others in this respect. The objectives of their courses are detailed and content-specific, clearly defining a mandatory body of knowledge, which the students are supposed to acquire. In the Psychology and Physiotherapy programmes, the objectives are less specific and thus permit the students to interpret and/or negotiate their meaning.

The tutorials play an important role for all the groups of students as regards dealing with the learning tasks, although in somewhat different ways. The Physiotherapy and Psychology students face a problem regarding what should be included in the learning task. The dominating problem for the Engineering students is, instead, how the content should be comprehended, particularly how procedures and algorithms for problem solving can be mastered.

These results may reflect some of the differences related to the programmes pertaining to different academic cultures. The clear criteria for sufficient reading and the lack of uncertainty in the case of the Computer engineering students harmonise with Becher's cognitive characteristics of a hard 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. The Computer Engineering students also differ from the other two groups of students in another respect. They never point 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. There is a possible paradox embedded in this, since engineering education programmes in general have the image of being problem-solving cultures and of emphasising mastering procedures for problem solving, not least mathematical algorithms. A focus on procedures and algorithms for problem solving may be assumed to guarantee that students develop general problem-solving skills, purposive for solving any problem, even if problems involving authentic construction and/or production are not always present.

The uncertainty as regards criteria for sufficient reading and what should be included in the learning task, which was found in the psychology and physiotherapy group, could also be

interpreted as reflecting cultural features of soft and applied fields of knowledge. These fields are not as stable and the sense of progression is less evident. The primary outcome for these fields is protocols and procedures whose functions are judged in pragmatic and utilitarian terms. They are focused on understanding the complexity of human situations.

The finding of uncertainty in students in PBL programmes has also been shown in other studies and often been described as a typical feature of PBL itself. Findings from previous research indicate that PBL in different ways creates psychological dilemmas or disjunctions in students' experiences of the learning context and in their lives (Stiwne, Abrandt & Holmqvist 1996; Savin-Baden 1996, 2000; Silén, 2000). The occurrence of disjunction is, however, often viewed as a prerequisite of learning. Dewey (1933) described this as the state of hesitation in the mind of the learner, which is the incentive to enquire into a situation .

Margetson (1998) outlines two variants of PBL, which he assumes to be generated from different perspectives of what counts as a problem and the role of the scenarios. In addition, the two variants outlined differ with respect to the view of the structure of learning appropriate for the education programme in question. He labels this view the 'Convenient peg' and the 'Growing web' conception, respectively. The former is characterised by learning being viewed as a two-stage process. The initial stage is the acquisition of a theoretical foundation of knowledge in what is referred to as 'basic sciences'. The second stage in which the students are to 'apply' their basic science knowledge to a professional problem appears later in the process. In this conception, the scenarios are regarded as small, atomistic, single difficulties. Hence, they are obvious and non-problematic and serve the purpose of

convenient pegs on which to “hang the coat of ’basic’ science knowledge” (p. 196). According to Margetson, it can be questioned whether the ’convenient peg’ conception meets the intentions of PBL. These intentions appear to be more truly met in the ’Growing web’ conception which is characterised by the scenarios themselves being dependent on the context in which they appear and not necessarily comprising a given solution. Problem and context are regarded as an inseparable, inter-related whole. The learning process required to become a professional is seen as a coherent whole from the beginning. Thus, information, concepts and reasoning, skills and attitudes are acquired in relation to each other in order to complement each other and no distinction between the acquisition of basic science knowledge and its application is made. An alternative interpretation of the two variants of PBL outlined could also be that PBL has been moulded within different academic cultures. Using Becher’s (1989) words, one could describe the ’convenient peg’ conception as pertaining to a hard and convergent field of knowledge, which is characterised by relatively stable, cumulative growth, and where criteria for establishing or refuting claims to new knowledge are clear. In our study, the realisation of PBL in the Computer Engineering programme resembles the ’convenient peg’ conception. The ’growing web’ conception would, instead, pertain to a soft and divergent field of knowledge, where the pattern of development is recursive or reiterative. In this field of knowledge, criteria are diverse and there is a lack of consensus about what constitutes a contribution of new knowledge to the field. In our study, the realisation of PBL in the Psychology programme and in the Physiotherapy programme shows features of the ’growing web’ conception.

To sum up, all the core characteristics usually emphasised in texts about PBL (Barrows, 1985; Boud & Feletti, 1991) are discernible in the empirical material. On a superficial level one could thus get the impression that PBL brings about almost identical educational practices, whatever the content of a study programme. Our further analyses of the meaning ascribed to these characteristics through the students' experiences, however, also reveal substantial variations between programmes. A possible conclusion is that since PBL being a flexible way of organizing teaching and learning, there are possibilities for different academic cultures to shape PBL according to their own needs and traditions and to their inherent perspective of learning. Thus, the implementation of PBL does not necessarily mean a new way of thinking about teaching or learning. The academic disciplines are powerful forces in the articulation, maintenance and reproduction of the perspectives, values and beliefs embedded in their cultures.

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