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Madeleine Abrandt Dahlgren

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The original publication is available at www.springerlink.com:

Madeleine Abrandt Dahlgren, Portraits of PBL: Course objectives and students' study strategies in computer engineering, psychology and physiotherapy, 2000, Instructional science, (28), 4, 309-329.

<http://dx.doi.org/10.1023/A:1003961222303>

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Postprint available at: Linköping University Electronic Press

<http://urn.kb.se/resolve?urn=urn:nbn:se:liu:diva-39166>

**PORTRAITS OF PBL:
Course objectives and students' study strategies in
computer engineering, psychology and physiotherapy**

Madeleine Abrandt Dahlgren, PhD*

Publicerad som

**Abrandt Dahlgren M. Portraits of PBL : Course objectives and
students' study strategies in computer engineering, psychology and
physiotherapy. *Instructional science*. 2000;28(4):309-329.**

*Department of Behavioural Science

Linköpings Universitet

S-581 83 Linköping

SWEDEN

e-mail: madab@ibv.liu.se

fax +46 13 28 21 45

ABSTRACT

The central theme of the investigation concerns the role of goal documents in relation to students' study strategies in problem-based learning (PBL). The results comprise data from three different PBL programmes at Linköpings Universitet; a Bachelor's programme in physiotherapy, a Master's programme in psychology, and a Master's programme in information technology, respectively. In all three programmes, goal documents are provided by the faculty with the intention that these should function as a supportive structure and guide for the students' independent studies. The results show that the objectives were used differently in the different programmes; as an *integrated tool* in the learning process, as an *administrative schedule* or as a *retroactive checklist*, respectively. The students' use of the goal documents in the learning process varied according to how the objectives were formulated and conceived. The relationship between the format of objectives provided by the faculty and how students deal with them in the learning process could also denote fragments of the different educational cultures within the three programmes and how the meaning of problem-based learning is interpreted.

INTRODUCTION

'Cheshire Puss', Alice said, 'Would you tell me, please, which way I ought to go from here?'

'That depends a good deal on where you want to go, said the Cat.

'I don't much care where', - said Alice,

'Then it doesn't matter which way you go', said the Cat.

'-so long as I get *somewhere* ,' Alice added as an explanation.

'Oh, you're sure to do that', said the Cat, 'if you only walk long enough...'

Lewis Carroll

The idea of Problem Based Learning (PBL) was launched some thirty years ago as an alternative approach for professional education in medicine. Since then, the problem-based approach has spread all over the world and is implemented in programmes for professional education in various domains of knowledge. PBL is regarded as representing a shift from the traditional perspective of higher education, focusing on the teacher and the teaching methods, to a perspective that gives priority to the students' learning. The student's role changes in terms of increased responsibility for active commitment in his/her studies and learning (Barrows, 1980, 1985, 1988; Boud & Feletti, 1991; Albanese & Mitchell, 1993).

One of the overarching objectives of problem-based learning (PBL) is to foster the students to become independent and life-long learners. The students are required to take a large degree of responsibility for the learning by formulating their questions and learning needs in relation to a given problem. At the same time, self-directed learning creates a dilemma that could be illustrated by the quotation above from Alice's Adventures in Wonderland. For the students, the dilemma is about how to be self-directed

in their studies when they do not know anything about the field of knowledge they are about to enter. For the faculty, the dilemma concerns how to clarify the objectives of the course and how to tutor the students, while still allowing them to formulate their own learning needs, and without interfering with the students' autonomy as independent learners. In several problem-based programmes, the faculty also provides the students with goal documents with the intention that these goal documents should function in similar ways as guides in the students' learning process.

The traditions of defining educational intentions in the literature of curricula design are somewhat ambiguous. The debate regarding the concepts of intention, such as objectives, goals, learning outcomes, etc., and the terminology used to describe them, is still in progress. In an article on the traditions of expressing educational intention and curricular design, Allan (1996) shows how the behaviourist tradition has dominated the field until recently (Tyler, 1949; Mager, 1962; McDonald Ross, 1973). According to this tradition, educational objectives should be formulated as *behaviour*, indicating the students' performance after having completed a course, under what conditions the performance should be observed, and what criteria the performance should meet to fulfil the course requirements. In recent decades, there has been criticism of the behaviorist tradition of defining objectives in higher education. Instead, *non-behavioural* objectives have been emphasised. Rather than indicating behaviour, the course objectives should emphasise understanding of concepts, critical thinking and personal outcomes (Cohen & Manion, 1977; Eisner, 1979; cited in Allen 1996). The use of taxonomies, e.g. according to Bloom (1956), for defining levels of knowledge, has also been criticised on similar grounds. Bloom's taxonomy was originally developed to categorise assessment tasks in relation to course objectives, but has come to be applied as a means of defining the course objectives *per se*. Rolf (1993)

argues that taxonomies are based on a naive application of the rationality of natural science, presupposing that human knowledge and understanding is reducible into measurable parts and abstract models, whatever the domain of knowledge. Allan (ibid.) argues strongly that the behaviourist tradition should be repudiated and that educational intent should, rather, be formulated as the desired learning outcome. Learning outcomes should include *personal transferable skills*, like critical thinking, metacognitive skills and self-directed learning; *generic academic skills*, a balance of knowledge, skills, creative thought and motivation; and *subject-based outcomes*, expressed as complex skills, and without conditions or standards attached to them. The reason for this is that learning within higher education has no intention that the outcome should seek the unity of response which necessarily characterises behavioural objectives. Secondly, there is no intention that the outcomes derive uniquely from the teaching or the course content (Allan, 1996). In the following, the characteristic features of problem-based learning and the role of course objectives within this context will be described.

The characteristic features of problem-based learning

The idea of problem-based learning can be described in the form of three distinctive features. Firstly, *real life situations* constitute the starting point for the learning; secondly, the learning is *self-directed*; and, thirdly, the basic work form is the *tutorials*, where 5-7 students work together in a group with a tutor. There is no mandatory literature, the students are free to choose texts to study which are relevant to the problems formulated in the tutorials. The intended learning outcomes of the course, together with a comprehensive list of relevant literature, are provided as guidelines for the students' learning.

The *real life situations* as the point of departure for the learning are considered to provide a meaningful context for the concepts and principles that also relate to future professional work. Traditionally, the identity of an area of teaching is disciplinary; that is, the established borders between disciplines of research are also maintained in teaching (Dahlgren, 1989). In PBL, real life situations are taken as a point of departure for the learning. This requires an organisation of the curriculum, where different fields of knowledge appear as problems, events or phenomena which, as in real life, are thematically organised. The principle of thematic organisation of the curriculum is also implemented in all three programmes included in this study.

In PBL, the students are supposed to learn how to address problems, i.e. how to identify what they know in relation to a problem, what they need to learn additionally, in order to deal with it, and how best to acquire the relevant knowledge. It is assumed that the students hereby become engaged in an active dialogue around their own learning process which constitutes a viable approach for bringing about holistic and educative learning among the students (Margetson, 1997). According to this view, educative learning is not only about gaining knowledge of the solutions or content of the problem, but also about learning the process, i.e. how to generate the content from a situation and also how content and process may interact (ibid).

Self-directed learning skills and critical thinking are considered necessary for development as an independent learner. Rapid change and proliferation of new important knowledge within the professions requires that the students acquire competence in self-directed learning. Competence in self-directed learning is defined by several authors as the ability to formulate

learning goals, identify resources for learning, choose relevant and appropriate strategies for learning how to evaluate the learning outcomes (Knowles, 1975; Zimmerman, 1990). These abilities could also be regarded as metacognitive skills. Schraw (1998) describes two aspects of metacognition, the knowledge of cognition and the regulation of cognition. He argues that metacognitive knowledge is multi-dimensional, domain-general in nature and teachable. He also argues that instructional strategies that promote the construction and acquisition of metacognitive awareness include the promoting of general awareness, improving self-knowledge and regulatory skills, and promoting learning environments that are conducive to the construction and use of metacognition.

In PBL, it is emphasised that the goals of self-directed learning should be integrated with the content and made visible in the course objectives. Ryan (1993) suggests that the educational environments require the following characteristics for effective self-directed learning to occur:

- emphasis on the process of learning, as well as on the learning of course content;
- control of learning progressively turned over to students;
- a focus on the exploration of key concepts and principles, rather than on a detailed knowledge of every topic; and
- integrated, 'active' learning, utilising the student's own experiences as part of this process (ibid. p.56)

The course objectives indicate what learning outcomes the students are expected to achieve in relation to subject-matter content during the course. Course objectives should also be overt in their expectations that students become successful self-directed learners as well as requiring students to demonstrate successful self-directedness in their learning (Knowles, 1975;

Ryan, 1993). The design of learning outcomes within PBL is not tantamount to the idea of expressing educational goals as unambiguous statements of predicted behavioural objectives which are derived from a given learning experience. 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 felt that the work together in *tutorials* leads to richer, more integrated and holistic learning (Margetson, 1997). This is brought about by active discussion, reference to authoritative texts to settle points, arguing, questioning, etc. Cooperative learning methods, such as tutorials, are also considered to be an effective motivator for the student. The arguments put forward are that when students in a group share responsibility for achievement there is less risk of personal failure and increased support for individual persistence (Nicol, 1997). Work in tutorials is also viewed as an opportunity to learn about group processes and group dynamics, which could be of special interest to most professional programmes. The teacher's role in the tutorials is to function as a facilitator of the learning process by encouraging active participation and dialogue in the group. Barrows (1988) suggested that the control of the learning process should be progressively turned over to the students, from a role-modelling function of the tutor in the inexperienced PBL group towards a coaching function and a gradual phasing out of the tutor's role in the more mature PBL group. By commenting on the discussions in the group in a way that challenges the students and stimulates reflection, the tutor encourages the students to explore their own thinking so that they learn about their own learning. These metacognitive strategies are regarded

as helping the students to develop critical thinking and skills for life-long learning.

THE AIMS OF THE STUDY

The general aims of the study are to describe and analyse how the formal intentions of PBL are transformed into informal meanings and strategies which are utilised by the students in their studies within different PBL programmes belonging to different academic cultures. The students' experiences, constituted in a particular organisation or setting, may take on the general qualities promoted by the organisation or setting, but the students' interpretations will also affect what is available and circumstantial. Holstein and Gubrium (1994) claim that this is an ongoing and reflexive process in which culture orients and equips the process, but where the students' interpretations intervene (ibid. p. 268). In the following, the relationship between goal documents and learning from the students' perspective will be focused on, i.e. how one of the intended tools provided to facilitate self-directed learning is conceived and functions in the learning process.

MATERIALS AND METHODS

The PBL programmes

The results presented in this paper comprise data from three different PBL programmes at Linköpings Universitet; a Master's programme in Psychology (200 credits), a Bachelor's programme in Physiotherapy (100 credits), and a Master's programme in Information Technology, (180 credits). (In Sweden, one credit point corresponds to one week of full-time

studies. Hence, a full academic year comprises 40 credit points). The three programmes are all problem-based from the very beginning, comprising all the key features of PBL as described above. 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 Information Technology programme and the Psychology programme were implemented 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 source of inspiration.

Design of course objectives

The three programmes all use study guides or goal documents, distributed to the students with the intention that they should function as a support and guide for the students' independent learning. The ways in which these objectives are formulated and distributed varies, although some similarities as regards the preferred styles are discernible within each programme.

Characteristic of the objectives within the Psychology Programme is that the objectives of each theme are formulated in a few overarching sentences that express the learning outcome the student is supposed to achieve during the course, followed by a list of concepts considered central to the theme in question. The goal documents are distributed at the start of a study period, comprising several themes.

The objectives within the Physiotherapy programme are presented as a list of overarching learning outcomes that the student should achieve during the course. The goal documents are distributed at the start of the term and contain the objectives for all the themes included in that period.

The Information Technology programme, finally, provides overarching teaching objectives for the whole academic year, together with a specified

list of course contents in the student handbook, distributed to all students in the programmes at the technical faculty. In addition, the students are given a comprehensive, detailed and content-specific list of learning outcomes when each new theme is introduced.

To illustrate the variation between the programmes, some examples of how objectives are formulated are provided (appendix 1). The objectives chosen all come from themes included in the first or second year of the three programmes.

The empirical study

Sixty students, 20 from each of the three programmes, were randomly chosen. Altogether 58 students agreed to participate in the study; 20 physiotherapy, 20 psychology and 18 engineering students. Two students from the Information Technology programme chose not to participate. They did not respond despite several attempts to contact them. The data collection was carried out on two separate occasions. The physiotherapy students were interviewed in 1993 and the psychology and information technology students in 1997 (table I).

(insert table I about here)

The physiotherapy programme comprised 100 credit points at the time, but has since been extended to 120 credit points. Data was gathered via semi-structured interviews which were tape-recorded and later transcribed. The interviews lasted approximately 45 minutes. The overarching theme of the interviews was students' experiences of being students within a study programme where PBL had been adopted as the educational approach, and dealt with topics such as the learning process, the use of goal documents, the role of the examination and so forth. The transcripts were analysed

qualitatively with an interpretative phenomenological approach (Huberman & Miles, 1994; Lawler, 1998), focusing on the individual's interpretations of his/her experiences, and how he/she arrived at some meaning on the basis of those experiences. The researcher, in turn, makes interpretations which are theorised from the data set as a whole. This means that the interpretations presented in the study occur on two levels; first, the interpretations that individuals make of their experiences, and second, the interpretations that the researcher makes of the experiences of the study participants (Lawler, *ibid.* p. 51) The procedure of the analysis in this study can be schematically described as follows:

- Each individual interview within each group was thoroughly read and the most significant statements and meaningful units of the answers were marked.
- A cross-case, interpretative narrative, based on the merged series of selected statements were written for each group.
- A general condensation of the narrative, depicting its essential meaning was sketched for each group.
- The individual interviews within each group were checked again to see how the general condensation was exemplified, looking for negative cases.
- Finally, the general structure of the results, focusing on what seems essential in the relationship between goal documents and the learning process in PBL was described and the differences between the three groups discussed.

Article published in *Instructional Science*, 28: 309-329, 2000.

The scope of the analysis was to describe the characteristic similarities of the answers within each group in order to make possible comparisons between the different programmes.

RESULTS

Psychology

The psychology students' answers are characterised by an awareness of the study guides as a frame of reference for the work in the tutorials. The common learning goals decided on by the tutorial groups determine what they choose to study, but the objectives of the theme in the study guide are present as a loosely sketched background for that work. Two students describe this as follows:

The study guides set the external frames, that is very important..././ You check before you start on a new theme...I think that even if we don't refer to the study guide in the discussions for each vignette, personally, I still have it at the back of my mind, and I think that the others do too...I think it is necessary to have those external frames...(203)

The central concepts are usually quite clear, but the objectives are sometimes very wide and loose, I think..././ It is more like getting an overview...not that you go into everything in detail..././ But sometimes, I wonder... about the central concepts...sometimes it's seems like just a bunch of concepts, thrown in haphazardly...it sometimes makes you wonder how the teachers have been thinking...(221)

Several students describe that knowing what to focus their studies on is dependent on the relationship between the vignettes, the work in the tutorial groups, the study guides and the independent learning process. The student's own responsibility and critical engagement are emphasised. The

question of knowing what to study is described by the following student's comments:

Well, the vignettes...and the brainstorming, where you get support from other associations than your own...and then the question that we formulate.. You can use that for a library search, for instance...And for me, it is valuable to discuss with the others what they think of, any particular author or area where you can find something interesting.. And..Well, of course, you also have to search your mind whether you are really covering the central concepts and the learning objectives, that you really answer the question that you formulated in the tutorial..(225)

You don't know what to study, really, at first...But when you ask a good question, I mean in the tutorials, it's quite easy to get a picture of your own of what it is you ought to find out about..But it is difficult, in the beginning, to be critical about the literature...I think it is good to learn , like 'this may not be relevant, a whole book and no references...where did they get that from, who says so'..You learn to read a lot more critically with PBL, but it is difficult in the beginning...(211)

We have the objectives, and we have the central concepts...and the problem formulation that we make together in the tutorial..That kind of delimits it...But within those frames, you're free to choose...no one tells you that you always have to read, for instance, psychoanalytic theory...you're free to choose social learning or whatever perspective you would like to illuminate the problem within...that is were the freedom lies...(314)

The second year students and the third year students seem to use the study guides in similar ways. Data show that the study guides are often used at the end of a theme, as a support for the objectives formulated by the students; that they are relevant and within the frames of the themes.

We often..when we have completed a theme..we discuss..whether we have included everything ..Sometimes we use it when we are uncertain about how to focus our questions..or if we are uncertain about what to read...(211)

I sometimes check.../.. like a security measure, to know that the vignettes lead in the right direction.../.. It gets more important towards the end of a theme...to check that you know all the central concepts and that you have been dealing with all the learning objectives.../.. (320)

In summary, the overall impressions of the students in the Psychology programme are that they speak in a conscious and critical way of their studies and of PBL. The study guides are *integrated* into the work of the tutorials and the objectives are subjected to discussion and are *problematized*.

Physiotherapy

The analysis of the interviews with the students in the Physiotherapy programme revealed that the students had severe difficulties in using the study guides during their first year of study. The difficulties appeared to be of different kinds. Several students were *ignorant* of the purpose and meaning of study guides. They had not thought about or reflected on the fact that the objectives could be used in the learning process. One of the students comments as follows:

"I know I read it in the first term...we got some kind of booklet..I think it was blue...and then we got a yellow one, I think..I looked through it the first time, but I haven't looked at it since...(216).

In other cases, the students had discovered the study guides during their preparation for the examination, as one student expresses it:

"It is not until lately, that I have started to look at that.. when I study for the exam...so I really must say, that I hadn't thought that much about the study guides previously...(213)".

About half of the group had tried to use the study guides in their learning process, but had failed. They found the objectives too abstract, difficult or unclear to function as a guide for their learning and, thus, *abandoned* the study guides. The dialogue between the interviewer and one of the students exemplifies this:

I: How do you use the study guides?

S: I just look through them sometimes, but I think they only consist of overarching objectives..I don't think it is enough...It's not sufficient help..

I: How do you mean?

S: It is so abstract in a way when you read the study guides.. It sort of lacks connection with reality..when you read it, it is hard to understand what it really means, I think I mean...

I: It lacks connection with reality?

S: Yes...

I: What are you thinking of..?

S: I can't really give an answer to that..It says that the students should orient themselves....I don't know...No, I can't answer any better than that..

I: Is it hard to understand what the text means?

S: No, it isn't that.. It is not hard to understand...but it simply feels abstract to read them..

I: The meaning is not self-evident?

S: Well, it is actually...It is clearly written and it is not hard to understand...but still....you can't get it, in some way..(217)

The students' statements could be interpreted to mean that the difficulties in understanding the objectives is really due to something beyond the language in the documents. The students describe that they understand the objectives from a linguistic point of view, but they cannot understand what they mean. A relevant question is, then, what informal strategies the students use to find out what to focus on in the learning process and what texts to read, if they cannot understand the formal intentions expressed as objectives in the study guides. The answers reveal that a common strategy is to *rely on others*, i.e. to listen to what the other students talk about and what they read, in order to find out what to study. The tutor also insures that the students keep on track. One student describes:

"In a way, you notice what the other students read...I mean, your friends in the tutorial group..what they read...so you kind of check with them..and you think 'maybe I should read some of that'..'I haven't been into that..maybe I should'...And you get some hints from the tutor as well, so that you don't ask questions that are totally weird..(207)

Another way to deal with the problem of knowing what to study, is to rely on an *advance organiser* of the content by reading an elementary textbook. The aim is to get a grasp of what the current study theme is about, before

trying to formulate questions for further studies. One student puts it like this:

"You kind of check with a textbook which is not too difficult, so that you kind of see...how should I put it...It is almost like cramming, but still..I think, when you have learnt how to formulate problems, well..then I think...it is very exciting to choose some interesting questions to study..but first, I still think that you want to go to a textbook and go through it, and then see, 'alright, you need this and this'...(201)"

The overarching impression of the interviews with the third-year students is that the objectives in the study guides are not so important to the learning process. The study guides are mainly used in an *administrative* way, as a device to obtain an overview of the content of the term. It is used as a schedule to obtain knowledge from, e.g. dates for practice or examination periods, deadlines for assignments, etc. One student comments on this issue as follows:

"You look in the study guide to get an overview of the term for your own planning and which books you need, perhaps...and..well, you look at the examinations.. and assignments...when they are scheduled...to get an overview ...what I don't look so much at is...it says something about interaction..and health.. about different...I don't have that much grasp of that.."(503)

Several students state that the reading list and list of other resources provided are useful to them when it comes to finding relevant texts to study. The meaning of the objectives seems hard to understand, even if there are also clear signs that the students have learnt during the programme how they can use the objectives. One student describes this:

"Well, I must say, that the last two terms...I didn't use the study guides at all during the first two terms, because I kind of forgot to...but what I realise now, in term 5 and 4 and partially in term 3, is that I use the study guides very much..I have them on my desk so that I have them in sight, and I have looked in them now and then to keep myself updated and to remind myself...I mean, it says what it is you're supposed to achieve..so that you have something to follow../.. but at the beginning , I know I didn't look in them very often...but the recent terms../.. I think that I didn't use them because I couldn't understand the importance of them../.. I didn't really understand then, that 'maybe I should use this in my work'...it came later...but why...I guess I didn't think that far..."(513)

At the same time, there are signs of a trend in the opposite direction. A group of students state that they felt more uncertain at the beginning of the programme and that they tried to use the objectives in the study guides. During the course of the programme they have, however, realised how they can manage their studies without bothering so much about what the objectives are. The following dialogue between the interviewer and one of the students illustrates this:

I: How do you use the study guides?

S: I used them very much at the beginning of the programme..I used to read them thoroughly...but now, during the last two terms, I've hardly ...I have read through them swiftly, but I haven't used them very much..

I: You said that you used them very much at the beginning of the programme?

S: Yes, I did, because I was so unsure about what you were supposed to achieve...and what the goals were...well, yes...more insecure..so I read them very much..

I: What did you read in them?

S: It was...what do you call it...these objectives...what you were supposed to achieve when the term was over...

I: But you haven't used them much in the recent terms?

S: No, I haven't..

I: Why not?

S: I don't know why I haven't...It has been so self-evident, what you're supposed to achieve anyway...Of course, I have looked in them once or twice, but not that thoroughly..

I: How do you know, then, what to achieve?

S: Well, probably the teachers and tutors have told us in some way so that we understand what it is they are looking for...or maybe that I myself in some way have...well, I don't know, I haven't thought much about it, really...

To summarise, the results from the students in the Physiotherapy programme reveal that the study guides have little importance when it comes to directing their studies. To the freshmen, the study guides seem incomprehensible and they are, thus, ignored or abandoned. The senior

students use them mostly as an ordinary schedule for administrative planning. There are some differences between first-year and third-year students, indicating that the students learn to use the study guides over time. The overall impression is, though, that the objectives are not problematised by the students and dealt with only on a superficial level. In some way, the learning tasks seem evident without the objectives.

Information Technology

The interviews with the students in the Information Technology programme reveal yet another variant of how the objectives function in the learning process. Several answers clearly indicate that the objectives are incomprehensible to the students from the beginning. It is impossible at this time to know how to proceed with the objectives as guidelines. Instead, they seem to function as a *retroactive checklist*. The students return to the objectives after a couple of weeks' work with the new theme, to make sure that they are focusing on the right content. The students check that they have dealt with all the objectives on the list.

Another important function of the objectives is during preparation for the examination. The students tick off the objectives one by one to check that they have learnt what the course aimed for. One student expresses this as follows:

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 objectives also play an important role for the third-year students. Their answers indicate that they have learnt how to use them in order to meet the requirements laid down by the faculty. The content is more or less fixed and the objectives are directive in a very decisive way, as expressed by some of the students:

S: We usually use the goal documents during the tutorials. After we have discussed the vignette and asked our questions /../ we take out the goal documents and check to see if we can identify some of the goals , if they fit in with our questions../.. We try to do that at every tutorial ..In case there was more that the vignette was supposed to cover, although we couldn't find out in the first place...(320)

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)

S: Well..you have kind of learnt how to look through the vague formulations to see what they are asking for...(309)

Besides the goal documents themselves, the lectures play an important role in directing the students' studies by clarifying the objectives of the course.

The students say that the lectures make sure that the right content is dealt with in the tutorials.

You are usually pointed in a certain direction, the right direction, by the lectures...It never happens that you start to study the wrong thing completely..(208)

There is usually a presentation of the theme at first.. And then they usually read the objectives, they take their goal description and read it to the students..That doesn't make you understand anymore, of course...but then when there are lectures, and you read the textbooks, you can read through the goals and compare, 'well, this was in the objectives, so it is kind of important'(210)

Sometimes, the lecturers also point out the relevant literature to the students, the lecture is based on a certain textbook, and it is evident to the students which texts to choose for their studies, even if the teachers are reluctant to provide that kind of information. One student describes this as follows;

Sometimes the teachers give us some hints..there was one..it was obvious that he considered one textbook as the best..but then he..well, he kind of..he didn't want everyone to pick that one without thinking...but at last he told us, like, well, there is one textbook that is kind of better.(205)

What stands out as the results from this group is that the syllabus is basically determined *a priori* by the faculty. The students need the teachers' clarification of the objectives before they can check whether they understand them or not. This means that the possibilities of self-directed learning is limited, and that the objectives can only be understood

Article published in *Instructional Science*, 28: 309-329, 2000.

retroactively. A similar pattern appears in the answers given by both second-year and third-year students.

DISCUSSION

The interpretation of the results is that the objectives in the study guides apparently play differing role for the students in the three programmes.

The different strategies for using the objectives in the learning process in a way mirror the ways the objectives are formulated in the different programmes. In the Psychology programme, the objectives were formulated as expected learning outcomes. A few, overarching sentences together with a list of concepts, considered central to the achievement of the learning outcome in question. This apparently gives the students an opportunity to discuss and problematise the meaning of the objectives. 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. 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 for administrative planning.

Finally, the results in the Information Technology programme show yet another picture. The objectives of the courses are detailed and content-specific, clearly pointing to a mandatory body of knowledge which the students are supposed to acquire. The highly detailed goal formulations

make the objectives initially incomprehensible to the students, and thus, they are mainly used as a retroactive checklist.

The relationship between the format of objectives provided by the faculty and how students deal with them in the learning process could also indicate fragments of the different educational and professional cultures within the three programmes and how the meaning of problem-based learning is produced and reproduced within them. Students are gradually socialised into the academic culture they are entering and gradually also becoming carriers of the ways of thinking ruling the professional practices of the discipline.

From Kuhn's (1962, 1970) writings, we know that different scientific disciplines have different paradigms for research and traditions for what counts as valid reasoning. This would also include conceptions of what content is necessary to convey to the next generation of scholars, and thus not be negotiable as objectives of the undergraduate curriculum.

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). Handal et. al (1990) suggest that scholars in scientific disciplines approach teaching with the same type of thinking and reasoning as when confronted with research problems in their own disciplines. The authors draw on Habermas' writings (1974), when describing how technical rationality shapes faculties' thinking about learning and teaching in the natural sciences. Habermas distinguishes between three forms of rationality; *technical rationality*, *communicative rationality*, and *critical rationality*. Handal and collaborators (ibid), suggest that the concept of technical rationality brought into educational situations will mean effective, instrumental action towards goals which are not disputed, involving mastery and control of the objective world. Communicative rationality in teaching and learning involves meaningful

action and development of shared, agreed-upon norms and standards. In the third form, critical rationality, the emphasis is on emancipation through re-evaluation and scrutiny of the conditions which underlie and determine understanding and action.

A question to discuss is whether PBL really means self-directedness in learning, when the learning outcomes are clearly defined, and the choice of starting-points for the learning in terms of cases, or vignettes, are determined in advance by the faculty. In the light of the empirical results of this study and the reasoning according to Handal et al (1990) above, it is reasonable to assume that the relationship between the goal documents and the learning process cannot solely be ascribed to the pedagogical idea or methodological instrumentation of PBL. The ways of adopting PBL may look different from the taken-for-granted perspectives of knowledge, embedded in the scientific disciplines and their professional practices. Accordingly, the free scope for self-directedness in learning in relationship to the course objectives will be differently limited, and the students will use the goal documents in their learning process in different ways. The characteristics of an academic or professional culture are not always discernible to its members. Kuhn (1962, 1970), referring to the writings of Polanyi (1958), has pointed to the difficulties in describing and articulating values and beliefs of a certain paradigm, which often function tacitly. The results of this study may illustrate some aspects, which can be subjected to reflection and discussion among faculties, when defining learning outcomes for PBL programmes within different professional educational programmes.

Acknowledgement

This project has been financed by the Centre for Learning and Teaching, University of Linköping, Sweden.

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Appendix 1.

PSYCHOLOGY

Course: Developmental Psychology and Educational Psychology

Theme 3: Learning, cognition and language, 6 credit points

The student should be able to

- acquire extensive knowledge about different theories concerning learning, cognition and language
- critically scrutinise different perspectives of knowledge
- analyse the impact of the different theories on education and teaching in pre-school and school
- analyse and compare different cultural and socio-economic prerequisites of learning, cognition and language
- analyse and appraise the individual's intellectual, cognitive and linguistic ability via different methods and suggest measures

Central concepts:

- | | |
|--------------------------------------|---|
| • teaching | • social group |
| • deep/ surface approach to learning | • conditions in childhood and adolescence |
| • knowledge | • attribution |
| • pre-school | • intelligence |
| • school | • test |
| • language | • reliability |
| • gender | • correlation |
| • self-knowledge | • validity |

PHYSIOTHERAPY

Course: Body and Movement. Declined function. Physiotherapy in hospital care, 20 credit points.

Students should

MOVEMENT:

- acquire basic knowledge and skills as regards prevention and rehabilitation of musculo-skeletal, neuro-muscular, respiratory, circulatory and psychiatric dysfunctions
- deepen their knowledge and skills as regards analysis and evaluation of movement with respect to different prerequisites and abilities of movement

HEALTH

- acquire knowledge of illness and dysfunction -aetiology, their symptoms, course and epidemiology as a basis of physiotherapeutic interventions
- deepen their knowledge of how environment, life style and living conditions affect the health of the individual as a basis of physiotherapeutic intervention

INTERACTION

- acquire further knowledge of communication
- understand and apply the physiotherapy process. Practice the ability to see and evaluate the clients' needs, resources and goals. Become aware of their own resources and goals and evaluate whether these goals are in concordance with those of the patient and possible to realise.
- develop empathy and a therapeutic relationship

INFORMATION TECHNOLOGY

Course: Electrical circuits (IT1), 3 credit points.

After completing the course you should be able to:

DIRECT CURRENT THEORY

- Define and understand the concepts of current, voltage, potential and effect.
- Master the concepts of graph, node, branch, and closed loop.
- Understand the difference between current sources and voltage sources and know the properties of ideal as well as non-ideal sources
- Understand the difference between circuit elements and components.
- Set up relationships between currents and voltages in a direct current circuit, using Kirchhoff's current law, Kirchhoff's voltage law, and Ohm's law.
- Calculate the equivalent resistance for an arbitrary number of resistors connected in series or in parallel.
- Apply the voltage divider rule for an arbitrary number of resistors connected in series.
- Apply the current divider rule for an arbitrary number of resistors connected in parallel.
- Eliminate current sources and voltage sources in a branch, and eliminate circuit elements that are redundant in a branch.
- Set up the equations needed for calculating currents or voltages in two-dimensional direct current circuits using mesh analysis and nodal analysis, respectively. The "long way", originating from Kirchhoff's laws has to be mastered. The "short way", using formal methodology does not have to be mastered, but may very well be used.

Article published in *Instructional Science*, 28: 309-329, 2000.

- Determine, from the circuit graph, the number of equations needed using each analysis method.
- Apply node analysis in calculations on a three dimensional direct current circuit.
- Calculate the input resistance for a given two-terminal direct current network by setting all sources within the network to zero, and then finding the resultant resistance between the two input terminals, and as the quotient between the open-circuit voltage between the input terminals and the short-circuit current between the terminals.
- Calculate a ThÈvenin equivalent circuit and the Norton equivalent circuit to a two-terminal direct current network.
- Formulate and apply the superposition theorem, ThÈvenin's theorem, and Norton's theorem for electrical circuits.
- Calculate the effect in direct current circuits.
- Understand the meaning of the concept maximum power transfer and derive the conditions for maximum power transfer.

ALTERNATING CURRENT THEORY:

- Be well familiar with properties and functions of the capacitor and the inductor and their corresponding ideal circuit elements.
- Set up and solve the differential equations obtained when charging and discharging capacitors and inductors.
- Understand what happens when fast and slowly varying currents or voltages is connected to a capacitor or to an inductor in series with a resistance.

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- Master and understand the difference between different models of stationary sinusoidal alternating current (wave diagram, sinusoid function, phasor diagram, and complex form).
- Draw a phasor diagram for an arbitrary two-dimensional alternating current circuit.
- Calculate currents and voltages in an alternating current network, representing sinusoidal signals on complex form.
- Define the concepts and calculate impedance, resistance, conductance, admittance, reactance and susceptance for an alternating current two-dimensional network.
- Understand the meaning of series resonance and parallel resonance respectively.
- Define the concepts of LP, HP, BP, and BS filters; both their ideal versions and their practical versions, and what is meant by cut-off frequency and bandwidth.
- Decide the main filter characteristics of a given circuit.
- Understand the meaning of the concepts amplitude response and phase response.
- Calculate and sketch the amplitude response and the phase for an electrical filter.

Table I. Data collection

Data-collection	Programme/ group	Year/ semester	n
1. (1993)	Physiotherapy I	1 (term 2)	10
	Physiotherapy II	3 (term 5)	10
2. (1997)	Psychology I	2 (term 3)	10
	Psychology II	3 (term 5)	10
	Information	2 (term 3)	10
	Technology I		
	Information	3 (term 6)	8
	Technology II		