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INFLUENCE OF REDESIGNING A LEARNING ENVIRONMENT ON STUDENT PERCEPTIONS AND LEARNING STRATEGIES

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ABSTRACT. In society, there is a growing need for graduates who possess competencies consistent with deep learning. This means that, amongst other competencies, graduates should be capable of dealing with the complexity of the tasks in which they will engage in professional situations. We tried to increase the depth of students' learning by changing the format of a so-called assignment-based learning to a problem-based learning course. The goals of this research were to determine if students, firstly, perceived the redesigned course as being more challenging and, secondly, adjusted their learning strategies towards deeper learning. Participants were two groups of second-year International Business Studies students attending the International Business Strategy course in consecutive years. Students' perceptions of the learning environment and their learning strategies were measured in both the original ($n = 406$ students) and the redesigned course ($n = 312$ students) using the Ramsden Course Experiences Questionnaire and the Biggs Study Processes Questionnaire. In contrast to our expectations, the results indicated that the students from the redesigned course showed a higher degree of surface learning and a lower level of deep learning than the students from the assignment-based learning course. Additionally, the students perceived the new learning environment to be less positive in terms of the clarity of its goals, the usefulness of the textbook and the workload. Improvement in terms of students' perceptions of the learning environment and their learning strategies could be expected to be fostered by the implementation of a more advanced staff development program, focusing the curricular assessment system on problem-solving skills, supporting the students in the development of the skills necessary to cope with the demands of the redesigned course, and giving them more opportunities to experience this instructional approach.

KEY WORDS: change, course design, implementation, learning environment, learning strategies

1. INTRODUCTION

A variety of closely-related factors influence the expectations that the labour market and society in general hold for higher education. Amongst others, globalisation with knowledge as a competitive advantage, the increased impact of information technology, and the complexity of societal problems are seen as characteristics of today's society. It is argued that there is a growing need for competencies such as critical thinking, aptitude for self-management, learning, reflective thinking and the ability to solve novel problems (Field, 2001; Kember, Charlesworth, Davies, McKay & Stott, 1997; Tynjälä, 1999). However, higher education in general, and

management education in particular, has been criticised for not developing these characteristics of professional expertise (ACNielsen, 2000; Boyatzis, Stubbs & Taylor, 2002; Business Higher Education Forum, 1995). Kember et al. (1997) argue that graduates frequently lack the very competencies consistent with a deep approach to learning. These qualities are the ability to appropriately engage with, and respond to, the professional situations which they encounter, to understand the structural complexity of the task and the rationale behind facts, and to seek meanings.

In education, approaches to learning have been the subject of study for many years and in many disciplines. Later research, based on the phenomenographic studies by Marton and Säljö (1976) who described conceptions of learning, identified the constructs behind deep and surface approaches to learning (Biggs, 1987; Entwistle & Ramsden, 1983). Deep learning is associated with an interest in the learning task, searching for meaning in the task and integration of task aspects into a whole. This kind of learning is driven by an intrinsic motive to seek meaning and understanding. Surface learning is characterised by only acquiring sufficient knowledge to complete the task. As such, the student relies on memorisation and reproduction of material and does not seek further connections, meaning, or the implications of what is learned. This approach is driven by an extrinsic motive to gain a paper qualification or a reward (Biggs, 1987; Entwistle & Ramsden, 1983).

Learning approaches are not considered to be stable psychological traits which are independent of the characteristics of the learning environment. Educational research has shown that learning approaches can be modified by the teaching context, or learning environment for individual courses, by particular learning tasks, or by the assessment (Kember et al., 1997; Scouller, 1998). Authors such as Dart (1997) have argued that deep approaches to learning are associated with constructive learning environments. Inspired by these research findings, many different so-called innovative learning environments have been implemented, with Problem-Based Learning (PBL) as a clear example (Savery & Duffy, 1995). PBL can be interpreted as congruent with two distinct streams of theory about knowledge and learning: constructivism (Hmelo & Evensen, 2000) and cognitive psychology (Schmidt, 1993).

PBL can be defined by the following set of characteristics. In problem-based learning environments, students typically work on ill-structured problems in small groups of 5–12 students who are coached by a faculty tutor. The discussion that takes place is relatively well structured using several steps, often referred to as the seven-jump learning procedure (Schmidt, 1989). Firstly, an initial analysis of the problems leads to a formulation of the students' learning goals, reflecting the knowledge and skills that they want to acquire in order to work in depth on the problems. In the initial

analysis, students are encouraged to test ideas against alternative views and alternative contexts. This implies activating and elaborating prior knowledge. The learning goals guide the students' independent search for information after the meeting. In the subsequent meeting, students use group discussions as a tool for reflection on the information gathered and the ideas which have been developed. Finally, the new ideas are related to the problem, which was the starting point for discussion.

Various studies have attempted to find empirical evidence for the expected benefits of PBL in terms of students' learning. Educational research has mainly focused on the cognitive effects of PBL in terms of learning outcomes. The results related to the cognitive effects are not conclusive. There are indications that PBL students outperform students from more traditional curricula on problem-solving tasks (Albanese & Mitchell, 1993; Vernon & Blake, 1993). The results of a recent meta-analysis by Dochy, Segers, Van den Bossche and Gijbels (2003) indicate that there is a robust effect from PBL on the skills of students. However, a tendency for negative results is discerned when considering the effect of PBL on the knowledge of students. Some authors (Albanese & Mitchell, 1993) have argued that poor implementation of PBL could underlay the minor differences found in effect studies. For knowledge-related outcomes, several studies suggest that the differences between students in PBL and traditional curricula, encountered in the first and second year, disappear later on (Dochy et al., 2003). In their review, Dochy and his co-workers also conclude that students in PBL gained slightly less knowledge, but remembered more of the acquired knowledge.

Research results concerning the effect of PBL on students' learning approaches are not conclusive either. On one hand, Biggs (1991), Albanese and Mitchell (1993), Greening (1998), and Blumberg (2000) conclude that PBL does support the development of deep-level processing in students. On the other hand, a few studies analysing the problem-solving process of students in a PBL environment reveal a lack of deep learning. De Grave, Boshuizen and Schmidt (1996) explain this result by hypothesising that small groups tend to avoid profound problem analysis, leading to prejudices and misconceptions. Researchers like Houlden, Collier, Frid, John and Pross (2001) found support for this hypothesis. They showed that PBL students tended to develop problem-solving behaviour aiming at rapidly focusing on a single solution. In-depth analysis of a problem seemed to be avoided.

Only a few studies have tried to find explanations for these phenomena. Oliver and Omari (1999) attribute this behaviour to the format of the problems presented, suggesting that problems tend to be overly structured and not sufficiently stimulating for extensive analysis. Studies on small-group learning have indeed indicated that highly-structured and closed

tasks, which allow only one fixed answer, lead to low-group productivity (Cohen, 1994). By contrast, ill-structured and complex tasks provoked extended elaboration amongst group members and were associated with higher-order conceptual learning. In short, it seems to be unclear to what degree, and through which mechanisms in the learning environment, PBL influences students' use of deep learning (Blumberg, 2000).

Students' approaches to learning are not only affected by factors such as instructional design and subject matter, but Prosser and Trigwell (1999) showed that the students' perceptions of the teaching and assessment procedures, rather than the instructional methods themselves, affect student learning most directly. Other research has demonstrated that this seems to be particularly true for students' perceptions of course assessment (Scouller, 1998; Segers & Dochy, 2001). In this respect, Gielen, Dochy and Dierick (2003) refer to the pre-assessment effect: students' expectations of assessment influence the way in which they approach their learning. Depending on the nature of the examination, students will develop different learning approaches during the course.

The aim of the present study is to provide more insight into the effects of PBL on the students' learning approaches, as driven by students' perceptions of the learning environment. Therefore, we compared both constructs in two different learning environments: an Assignment Based Learning (ABL) environment (Vermunt, 2003) and a PBL environment. According to Vermunt (2003), ABL environments differ from PBL environments in two aspects. In ABL environments, precise instructions in the assignments guide the students' self-study whereas, in PBL environments, ill-structured authentic problems are the starting point for learning. Additionally, ABL teachers regulate the students' learning processes to a large extent, whereas PBL tutors coach the self-regulated learning process of the students.

In order to capture students' learning approaches, in accordance with Biggs (1987), we defined the students' learning approaches using two dimensions: a motivation dimension and a strategy dimension. The motive dimension refers to the reasons why students learn. The strategy dimension indicates how the task is engaged, thereby referring to the activities performed. The two dimensions are closely related. Following the reasoning of Curry (2000), that learning concepts closest to the learning environment are the most likely to be sensitive to change, and taking into account the short-term intervention in this study, the present research focused on the students' learning strategies.

In summary, the research presented in this article focused on the following research question: What are the main differences in students' perceptions of the learning environment and their learning strategies associated with the redesign of a course from an assignment-based format to a problem-based format?

2. METHOD

2.1. *Participants*

The participants in this study were second-year students attending a course titled International Business Strategy. In the academic year 2000–2001, an assignment-based format (Vermunt, 2003) was used for the course, which was attended by 406 students. In the academic year 2001–2002, the course was redesigned according to the problem-based learning format and was attended by 312 students. (The reduction in the number of students was caused by a limit in enrolments in the first year imposed by the faculty board.)

2.2. *International Business Strategy Course*

The International Business Strategy course is obligatory in the second year of the International Business Program. It serves as a bridge between the first-year International Business course and the third-year Advanced International Business Strategy course. Goals of the course are to provide insights into the process of strategy formulation, the scope of strategic decisions, the internationalisation process, different methods of internationalisation, and the relationships between strategic and functional departments like marketing, production and finance. The planned workload is 20 hours per week, over 7 weeks, with two meetings of the tutorial group per week. Students' final marks are based on participation, a presentation, a paper and a written final test. Students are familiar with PBL as it is introduced and applied in all courses during their first year. A variety of tutors supervise the groups: senior staff, junior staff and student assistants. As part of their introduction to the faculty, all of them followed an introductory PBL staff development program. To support them as tutors for this course, they received an instructor's manual. During the course, there are two tutor meetings to discuss course progress and potential instructional problems.

With changes of co-ordinators responsible for the course, the course design has changed during recent years. The course format moved away from the intended PBL instructional principles to the ABL format. The course can be characterised in the following way: firstly, the tasks used in the course were not ill-structured professional problems, but well-structured study tasks with an assignment format which included clear-cut questions to be answered (see the example in Figure 1).

Secondly, the whole course was structured around *International Business*, a textbook by Griffin and Pustay (1999). This book deals with several aspects of international business, such as globalisation, the international

Session 8: International Alliances
Griffin & Pustay (1999), Chapter 12: International Strategic Alliances

Task 15: Describe some possible negative aspects of alliances. When might you expect an alliance to fail? Give some examples (from outside research) of alliances that failed or are in trouble. Use current examples. Discuss probable reasons for failure.

Task 16: Most large firms engage in many alliances. Does a firm necessarily need to have a known preference for a certain alliance type? Evidence suggests that firms do indeed have preferences but, if a firm has multiple different needs (alliance goals), how can it be reasonable to use the same mode of inter-firm alliance (e.g. equity Joint Venture) for every project/partner? In the same spirit, how might a firm have too many alliances?

Figure 1. Examples of a task in the ABL course format.

environment, international strategic management, entry modes, and organisational structure. The topics in the course follow the sequence of the chapters in the textbook. Thirdly, the tasks were rather loosely coupled between the different sessions, although each task was related to international business strategy. There was no clear thread and the tasks could be discussed separately. Fourthly, each task contained clear references to the relevant literature that was necessary for answering the questions in the task. This means that there was no need for students to look for information themselves. Fifthly, only a very small number of the students were involved in actively constructing knowledge in the tutorial group meetings. The meetings were organised as follows. One pair of students acted as the chair for a meeting. These pairs were formed at the beginning of the course. Each meeting consisted of two parts, separated by a short break. Before the break, the pair of students presented their answers to the assignment, which were initiated in the previous meeting. Subsequently, there was time for discussion. After the break, two new assignments were initiated. In practice, this format gave the presenters responsibility for the learning process and an active role in building knowledge; the other students played a passive role as their audience. Sixthly, the assessment was based on four components: a test with about 80 closed questions, participation, presentations, and a group paper in which four students analysed and compared the companies that they had visited during the course. The course's final score was the weighted average of the mark for the four components.

When comparing the course with the instructional principles derived from the constructivist propositions (Savery & Duffy, 1995), several mismatches can be observed. Firstly, the tasks can be described as assignments, rather than as descriptions of a set of events (problems) that needed analysis. They consisted of clear-cut questions, a situation that is rather uncommon in later professional life, when students have to formulate questions

themselves, based on their observations. The assignments stimulated the students neither to develop multiple representations of a problem, nor to analyse a problem in depth, taking various perspectives into account. In this respect, the format of the tasks did not support the learner in developing ownership of the overall problem. Secondly, the study of relevant information sources was rather limited as there was only one textbook and the chapter to study was prescribed. Because of this, the students were not invited to consult and compare different sources. Additionally, the learners did not have ownership of the problem itself, nor of the problem-solving process. The student was told what to study and what to learn in relation to the so-called problem. In this respect, the learners were not encouraged to test ideas against alternative views and alternative contexts. As Savery and Duffy (1995, p. 33) state: "Clearly, with this pre-specification of activities, the students are not going to be engaged in authentic thinking and problem-solving in that domain". Thirdly, the course consisted of small separate tasks, which were rather loosely coupled. There was no overall structure. In this respect, learning was not anchored to a larger problem. Fourthly, because of the presentations in which students had to describe the literature studied to their peer students, the latter developed a passive (listening) role. This implies that the learning environment was not supporting and challenging the learners' thinking. Fifthly, the assessment, with a dominant weighting towards knowledge reproduction tests in the students' final mark, tended to enhance surface learning, rather than deep learning. In conclusion, to a large extent, the ABL format does not match constructivist principles.

On the basis of this analysis of the course within a constructivist framework, the course was redesigned. Firstly, all problems presented to the students were described in the context of an existing company. This company starts as a local producer and enters progressively into other countries, becoming an international company. In this description of the company, basic information was given which could be used in the subsequent problems. These described discussions in quarterly board meetings about decisions that were part of the internationalisation process. In the discussions, the different functional managers gave their views on the topic at hand. Figure 2 presents an example of a problem used within the redesigned course.

Secondly, regarding the format of the meetings, students were prompted to define the problem themselves by following the seven-jump learning procedure (Schmidt, 1989). They had to brainstorm about possible explanations and formulate their own learning goals based on the problem. Thirdly, to stimulate more diverse searching for information and to challenge the learners' thinking through testing ideas against alternative views, no references from the literature were given and the number of potential sources was extended. The sources were: a textbook, *International Business*

Task 10: Working Together

The new expansion ideas of the management team put the company under a lot of stress. The future will become more complex, dynamic and uncertain. Another result is that the company will need more raw materials. Mr Svennson (production and purchasing) suggests that "the company should have closer relations with suppliers. In this way, they could have more control over the supply. Furthermore more suppliers are needed and, regarding the production capacity, he concluded that this is insufficient and so expansion is needed. Collaboration with others could be a solution."

Also Mrs Fältskog is looking for ways to collaborate with other parties, and she is even thinking about joining warehouses with one of the competitors. In any case, production should still stay in Sweden because the customers relate the products to Swedish wood. Mr Ulvaeus (research and development) is not happy with collaboration in production because this would mean that they would give away the advanced production technology of the company.

Figure 2. An example of a task in the PBL course format.

Strategy (Ellis & Williams, 1995); chapters of various textbooks in the library; and articles that could be retrieved from an automated database. To stimulate active participation of all group members in the reporting phase, the presentations were replaced by discussion within the tutorial group. Fourthly, to align the assessment with the teaching and learning in this course, the assessment was changed. The new assessment task contained questions that required knowledge application, as well as knowledge reproduction. In the application part, the students had to analyse a case study of a company on the basis of the knowledge that they had acquired during the course. In more detail, they had to relate information presented and ideas explored in the case study to the main concepts and theories learned during the course. Furthermore, students were asked to give specific advice to the company described in the case, based on relevant arguments. An example is: "Where should the company locate its new warehouse?" In summary, with the redesign of these five variables, the course was designed in line with the PBL format. Table I summarises the main differences between the original and the redesigned course.

2.3. *Instruments*

To measure the students' perceptions of the learning environment, we used the Course Experiences Questionnaire (CEQ) (Wilson, Lizzio & Ramsden, 1997), extended with the Scouller assessment questionnaire (Scouller & Prosser, 1994). We measured the students' learning strategies with an adapted version of the Study Process Questionnaire (SPQ) (Biggs, 1987).

TABLE I
The Main Differences Between the ABL and the PBL Course

Aspect	ABL course	PBL course
Structure of the course	Structured around the sequence in the book	Structured around a case
Structure of problems/tasks	Well-structured study tasks with an assignment format	Ill-structured, real-life problems
Literature	One textbook	Variety of information sources
Format of the meetings	Each session a presentation by two students	Problem analysis using the seven-jump learning procedure
Assessment	Knowledge-reproduction questions	Knowledge-reproduction and knowledge-application questions

2.3.1. *Course Experience Questionnaire*
Wilson et al. (1997) describe several versions of the CEQ, each with a different number of questions and scales. The 23-item version was used, together with items concerning the scale of Independent Study. This resulted in the following six scales:

- Good Teaching, relating to the quality of the staff;
- Clear Goals, indicating if it is clear to the students what the course is about and what knowledge and skills are being developed;
- Generic Skills, referring to the problem-solving, analytic and communication skills that the course was aiming to develop;
- Appropriate Assessment, indicating the extent to which facts had to be known. A low score means a focus on reproduction;
- Appropriate Workload, giving perceptions of the time available for understanding the things which students had to learn;
- Independent Study, indicating the degree of choice students had in the work they did.

We want to emphasise that the CEQ is a context-independent instrument. For the purposes of increasing the face validity of the CEQ and its acceptability for student raters, we designed two additional sections to be included in the CEQ. Firstly, as co-operative learning is crucial in PBL, we asked the students six additional questions about the contribution of the other group members to their learning. Secondly, taking into account the influence of course materials on students' learning, we added three questions to the questionnaire dealing with the usefulness of the textbook. The questions in both sections were derived from the standard course evaluation questionnaires as used at our university (Schmidt, Dolmans, Gijselaers & Des Marchais, 1995). All questions had to be answered on a Likert scale.

2.3.2. *Assessment Perception Questionnaire*

The students' expectations of the assessment are an indicator of what the students perceived as the expected outcomes of the course. In that sense, assessment is a strong stimulus for learning (Segers, Dochy & Cascallar, 2003). We therefore measured the students' perceptions of the learning environment from an assessment perspective, using the Scouller Assessment Questionnaire (Scouller & Prosser, 1994). This indicates the students' perceptions of the level of cognitive skills measured by the assessment task. The questionnaire contains 12 questions on a Likert scale. Two scales result from this questionnaire: one for low-level surface skills and one for high-level deep skills of intellectual processing. Table II presents examples

TABLE II

Sample Question and Cronbach Alpha Reliability for Each Scale Assessing the Learning Environment and Test Expectations

		Alpha reliability	
Scale	Sample question	ABL	PBL
Learning environment			
Good teaching	Teaching staff motivated me to do my best.	0.70	0.73
Clear goals	I knew the standard of the work that was expected from me.	0.65	0.68
Generic skills	This course helped me to develop the ability to plan my own work.	0.65	0.74
Appropriate assessment	Staff seemed more interested in testing what you had memorised than what you had understood.[a]	0.52	0.52
Appropriate workload	We generally had enough time to understand the things that we had to learn.	0.71	0.72
Independent study	I had a great deal of choice over how I was going to learn in this course.	0.54	0.52
Group members	Other students helped with the collection of information.	0.66	0.67
Usefulness of the textbook	The textbook helped me to develop new ways of thinking.	0.38	0.71
Test expectations			
Assessment of surface learning skills	I expect the test to assess my ability to reproduce key terms and definitions.	0.76	0.75
Assessment of deep learning skills	I expect the test to assess my ability to integrate from a variety of sources.	0.69	0.69

[a]Reverse-scored item.

of items from different scales of the questionnaire measuring students' perceptions of the learning environment.

2.3.3. *Study Process Questionnaire*

The learning strategies were measured by using an adapted version of the Study Process Questionnaire (SPQ) (Biggs, 1987). According to Kember et al. (1997), the SPQ can be used to evaluate the effectiveness of innovations aimed at enhancing deep learning. The standard questionnaire contains 42 questions, measuring three learning approaches: Surface, Deep and Achieving. Each approach is composed of two subscales: motive and strategy. For the present research, the deep and surface strategies are relevant as they describe ways in which students engage with the actual task. The achieving strategy concentrates on organisation of time and workspace to obtain the highest marks, whether or not the material is interesting (Biggs, 1987). So, it is not linked to the learning context but to students' personality characteristics. Therefore, the section on the achieving strategy was not included in the current instrument. Some questions had to be adapted to the PBL setting. As the tutor has a coaching role and the fellow students play an important role in knowledge acquisition, the questions were referring to other students, rather than to the tutor. This resulted in 13 questions which had to be answered on a Likert scale. Table III presents examples of items from different scales of the questionnaire measuring students' learning strategies.

2.4. *Procedure*

All questionnaires were processed in the tutorial groups. In this way, problems that students faced when answering the questions could be solved

TABLE III

Sample Question and Cronbach Alpha Reliability for Each Scale Assessing Students' Learning Strategies

		Alpha reliability			
		ABL		PBL	
Scale	Sample question	Expected	Actual	Expected	Actual
Surface strategy	I learned some things by rote, going over them until I knew them by heart.	0.44	0.45	0.41	0.31
Deep strategy	I related material, as I was reading it, to what I already knew on that topic.	0.58	0.60	0.69	0.64

directly. The study-process questionnaire was processed twice, following the procedure of Sivan, Wong Leung, Woon and Kember (2000). This procedure consists of the following steps. At the start of the course, the expected learning strategy was measured. It is assumed that this learning strategy was mainly based on prior experiences and was not influenced by knowledge about the course in question. In the last session, students were asked to frame their actual learning strategy. The course experience questionnaire and the test expectations questionnaire were only processed in the last session before the assessment took place.

2.5. *Method of Analysis*

Several statistical techniques were part of the analysis. To find the most important variables for explaining the differences between the two learning environments, logistical regression was used. Logistical regression is a useful technique because it is capable of selecting the discriminating variables on which two groups differ. Based on the selected variables, objects can be classified into one of the two groups. Furthermore, a *t*-test was performed to analyse the differences between the two courses more in detail. Analysis of the differences between students' expected strategies to learning and the actual strategies to learning was conducted with a paired-sample test.

3. RESULTS

In the original course, 406 students were enlisted, resulting in 29 tutorial groups. Eleven tutors supervised the groups. In the redesigned course, 312 students were enlisted, giving 24 groups. There were nine tutors for this course. The group size for both courses ranged between 13 and 15 students. Because some students did not attend either the first or last session, the number of paired cases was lower than the response rate in each of the sessions (Table IV).

In both courses, the group consisted of 55% male and 45% female. The nationalities were distributed as follows: 70% Dutch, 12% German, and 18% other, mainly European, countries.

TABLE IV
Response Rates for the ABL and the PBL Courses

		Response rate		
Course	Enrolment	First session	Last session	Paired cases
ABL	406	363 (89%)	314 (77%)	305 (75%)
PBL	312	248 (79%)	200 (64%)	196 (63%)

TABLE V
Descriptive Statistics for Each Scale

Scale	No. of items	*N*	Minimum	Maximum	Mean	*SD*
Good teaching	6	518	6	29	18.6	3.69
Clear goals	4	606	4	20	13.3	2.99
Generic skills	6	593	6	28	19.2	3.67
Appropriate assessment	3	600	3	15	9.9	2.12
Appropriate workload	4	604	4	20	12.2	3.79
Independent study	6	597	6	25	16.7	3.09
Group members	6	604	8	30	20.9	3.16
Usefulness of the textbook	3	576	3	15	9.8	2.31
Deep testing	6	609	7	30	21.5	3.92
Surface testing	6	599	9	30	20.6	3.76
Deep strategy	7	594	12	35	23.0	3.40
Surface strategy	6	603	6	27	17.1	3.10

Number of valid cases = 465 from a course with 604 students.

3.1. *Differentiating Between the ABL and the PBL Course*

Is there a difference between the ABL course and the PBL course with respect to students' perceptions of the course and their learning strategies? In order to answer this question, a logistic regression was performed. Table V shows the descriptive statistics for the variables used in the analysis. (Via SPSS, three models were analysed, using the following settings: block entry of variables, pin [0.05], pout [0.10] and cut rate [0.5]. A constant is included.)

The predictive values of the various models were tested by logistic regression analysis (Table VI). To compare the models, the percentage of cases correctly predicted by the model (the percentage of students correctly allocated to the ABL or the PBL course) and the predictive value of the model (expressed by the coefficient Nagelkerke R^2) are presented.

The first model considers the Learning Environment variables, as measured by the Course Experience Questionnaire. The overall model was significant at the 0.01 level according to the model chi-square statistic. The model classified 88.7% of the students correctly (Nagelkerke $R^2 = 0.69$). This means that, for 88.7% of the students, the model predicted correctly which course (ABL or PBL) they attended. In this model, four variables played a significant role ($p < 0.01$): clear goals (−0.20), appropriate assessment (−0.21), appropriate workload (−0.66) and the usefulness of the textbook (−0.31). The sign of the coefficients indicate that, in the PBL course, the students perceive these four variables as less satisfactory.

TABLE VI
Logistic Regression Results with Course as Dependent Variable for Three Models

	Model 1		Model 2		Model 3	
Variable	Coefficient	*p*	Coefficient	*p*	Coefficient	*p*
Constant	8.82	0.000***	8.10	0.000***	7.34	0.002***
Good teaching	0.08	0.131	0.08	0.127	0.09	0.111
Clear goals	−0.20	0.005***	−0.24	0.001***	−0.23	0.003***
Generic skills	0.11	0.062*	0.10	0.105	0.10	0.104
Appropriate assessment	−0.21	0.009***	−0.17	0.051*	−0.15	0.082*
Appropriate workload	−0.66	0.000***	−0.70	0.000***	−0.69	0.000***
Independent study	0.10	0.068*	0.10	0.142	0.08	0.235
Group work	0.03	0.623	0.06	0.327	0.06	0.350
Usefulness of the textbook	−0.31	0.000***	−0.31	0.000***	−0.33	0.000***
Deep testing			0.00	0.956	0.01	0.825
Surface testing			0.05	0.333	0.04	0.479
Deep learning					−0.06	0.374
Surface learning					0.10	0.121
Chi-square (*df*)	326.92 (8)	0.000	339.50 (10)	0.000	339.46 (12)	0.000
% correct predicted	88.7		89.9		89.5	
Nagelkerke R^2	0.69		0.72		0.73	

*$p < 0.10$. **$p < 0.05$. ***$p < 0.01$.

The second model was an extension of the first model, including the students' test expectations as measured by the Scouller questionnaire. By adding the two variables (surface testing, deep testing), the model was still statistically significant. The percentage of predicted cases increased to 89.9%, and the percentage of explained variance by the model (Nagelkerke R^2) increased to 0.72. The coefficients for the two extra variables were not statistically significant. The role of the appropriate assessment variable becomes less significant.

The third model included perceptions of the learning environment, test expectations and the learning strategies. By adding the learning strategies, the model still was statistically significant. The percentage correct was 89.5% and the percentage of variance explained by the model (Nagelkerke R^2) increased to 0.73. The two extra variables, deep and surface learning, were not significant in discriminating between the groups (Table VI).

In conclusion, by extending the first model with extra variables, it improved the criteria in terms of the overall fit: the overall significance of the model (expressed by chi-square); the percentage of cases correctly predicted; and the percentage explained variance of the model. However, the improvements were rather small. Apart from the three variables of clear goals, appropriate workload and the usefulness of the textbook, no other variables in either Model 2 or Model 3 were statistically significant ($p < 0.01$) in discriminating between the conditions.

3.2. *Beyond the Model 1: The Magnitude of the Differences*

The analyses in the previous section indicated on which variables (students' perceptions of the course, test expectations and learning strategies) we could allocate students to the ABL or the PBL course. In other words, in what respects did the courses differ? However, the logistic regression analysis did not present indications of the magnitude of the differences between both courses. Therefore, *t*-tests and effect sizes were used to compare the means for both courses. The results are presented in Table VII.

TABLE VII

Differences in Learning Environment, Test Expectations and Actual Learning Approaches Between ABL and PBL Courses

	Mean		*SD*		Difference		
Scale	ABL	PBL	ABL	PBL	*t*	*p*	Effect size
Learning environment							
Good teaching	18.82	18.20	3.59	3.89	1.80	0.073*	0.2
Clear goals	14.35	11.89	2.45	3.09	10.36	0.000***	0.9
Generic skills	18.82	19.80	3.72	3.53	−3.23	0.001***	0.3
Appropriate assessment	10.17	9.65	2.07	2.15	2.96	0.003***	0.2
Appropriate workload	14.36	9.07	2.61	2.91	22.60	0.000***	1.9
Independent study	17.04	16.30	3.03	3.05	2.90	0.004***	0.2
Group members	20.78	21.12	3.15	3.16	−1.32	0.187	0.1
Usefulness of the textbook	10.45	8.65	1.78	2.62	8.96	0.000***	0.8
Test expectations							
Surface testing	20.38	20.89	3.63	3.95	−1.59	0.112	0.0
Deep/higher level testing	21.46	21.50	3.92	3.99	−0.129	0.897	0.0
Actual learning approaches							
Level of surface approach	16.54	17.98	3.11	2.93	−5.64	0.000***	0.5
Level of deep approach	23.50	22.22	3.28	3.47	4.52	0.000***	0.4

$N = 362$ students in ABL course and 248 students in PBL course.
*$p < 0.10$. **$p < 0.05$. ***$p < 0.01$.

The three variables resulting from the logistical analysis—clear goals, appropriate workload and usefulness of the textbook—were perceived as significantly less satisfactory in the PBL course. This was confirmed by the effect size. Apart from this, there were significant differences between the courses in students' perceptions of the extent to which the acquisition of generic skills was stimulated, of the appropriateness of the assessment, of the extent of independent study and of the students' learning strategies. The effect size was low, however, and these variables did not play a significant role in the logistic regression model. No significant differences were found in the students' perceptions of good teaching, the role of group members or the students' test expectations.

To conclude, the students in the two courses differed significantly with respect to six variables: the perception of clearness of goals; appropriateness of workload; usefulness of the textbook; generic skills stimulated; appropriateness of the assessment; independent study; and the students' learning strategies. Three of these variables appeared in the logistical function.

3.3. *Beyond Model 2: The Development of the Students' Learning Strategies During the Course*

Table VII shows that the two actual learning strategies differed significantly between the ABL and the PBL courses, although the differences were rather small. The question is: To what extent did the students' learning strategies change during the course and, in that respect, is there a difference between the courses? With respect to the expected learning strategies as indicated by the students when entering the course, the results of the *t*-tests (Table VIII) show no statistically significant differences between the students on the two courses at the 5% level.

When comparing the expected and actual deep learning strategies as measured in both courses, there are similar patterns; the actual level of deep learning was lower than the expected learning strategy (Figure 3).

The paired sample test indicates a significant decrease in deep learning for both courses (ABL course, $p = 0.000$; PBL course, $p = 0.000$).

TABLE VIII
Differences in Expected Learning Approaches Between ABL and PBL Courses

		Mean		*SD*		Difference	
Expected learning approach	*N*	ABL	PBL	ABL	PBL	*t*	*p*
Level of surface learning	7	16.80	17.30	3.16	2.96	−1.78	0.075*
Level of deep learning	6	24.72	24.40	3.04	3.47	1.08	0.282

*$p < 0.10$. **$p < 0.05$. ***$p < 0.01$.

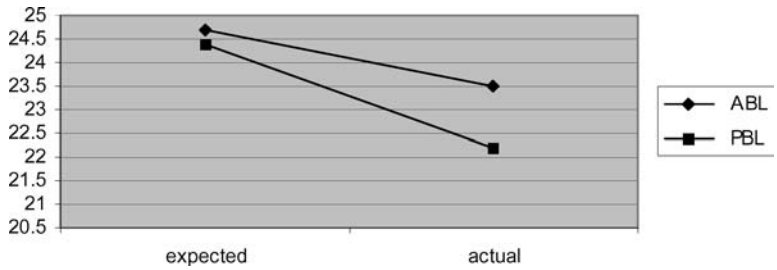

Figure 3. Expected and actual deep learning scores for ABL and PBL courses.

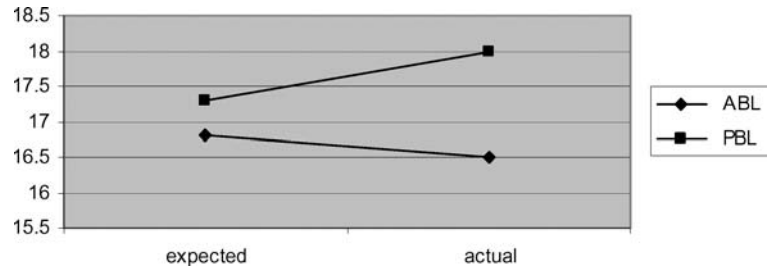

Figure 4. Expected and actual surface learning scores for ABL and PBL courses.

This indicates that expectations have not been met. The decrease for the PBL course indicates a significantly lower actual deep learning strategy compared to the ABL course. In conclusion, the students in the PBL course showed significantly reduced deep strategies to learning when compared with the students on the ABL course.

When comparing the expected and actual surface learning strategy on the PBL course, the actual level of surface learning was higher than was expected. This trend is opposite to that of the ABL course. Figure 4 shows the different patterns in surface learning.

The paired-sample test indicates that, in the ABL course, the actual learning strategy did not differ significantly from the expected learning strategy. In the PBL course, the actual learning strategy was significantly higher than the expected learning strategy (t-test, $p = 0.001$). The result was a significantly higher actual level of surface learning for the PBL course. In conclusion, there are indications that the PBL course led to a significantly higher level of surface learning.

4. Conclusion and Discussion

In order to enhance a deep learning strategy, an International Business Strategy course was redesigned. The original assignment-based format

(ABL) was transformed into a problem-based learning format (PBL), congruent with the design principles for PBL as proposed by Schmidt (1989) and Savery and Duffy (1995). It was expected that students in the PBL format would adopt more deep learning than those in the ABL course. Furthermore, it was expected that the students' perceptions of the learning environment would act as a filter between the learning as designed and the students' learning strategies.

The results of this study indicated that both deep and surface learning strategies changed significantly, although the effect size was limited. However, the direction of the changes was unexpected. In the PBL course, in comparison with the ABL course, deep learning decreased and surface learning increased.

The ABL course and the PBL course were perceived significantly differently by the students in three aspects, and this was confirmed by an effect size larger than 0.8. First, in comparison with the ABL course, students of the PBL course perceived the goals as less clear. Indeed, in the PBL course, students had to derive their own questions, instead of working on the provided clear-cut questions. On the one hand, this procedure gave the students the freedom to decide what to study; on the other hand, it might have evoked feelings of uncertainty about the 'correctness' or relevance of the questions.

Two factors that might contribute to the perception of less clear goals are the omission of references from the literature and the use of different information resources in the PBL course. Authors like Stinson and Milter (1996) and Greening (1998) refer to the lack of clear goals as one of the comments reported by students when entering a PBL program. However, in this study, the students (second year of study) already had experienced PBL for a year. Is this lack of clear goals a problem? Earlier research by Dolmans, Gijselaers, Schmidt and Van der Meer (1993) indicates that students in PBL, although they are not offered the learning goals that they have to master, are well capable of determining what is relevant to learn. Albanese and Mitchell (1993) note in their review that graduates sometimes report a lack of confidence about having learned enough of the content required by their teachers. It seems that the problem of less clear goals is more a matter of uncertainty than of competencies.

The question remains as to why students, although they have already experienced PBL for one academic year, still perceive difficulties with being responsible themselves for formulating learning goals. A closer look at the prior experiences of the students within their secondary education, as well as during the first year of the curriculum, might reveal answers to this question. Secondly, in line with comments on PBL by Greening (1998), there was a difference in the perceptions of appropriate workload, favouring the ABL course. In the PBL course, the students had to study different books

in the library and articles in an automated database, resulting in extra search time. They suggested reducing this search time by providing a reader. The search for, and analysis of, different sources is probably a less-developed skill for the students. Thirdly, students perceived the new textbook as less useful. The book in the redesigned course was less straightforward and clear cut than in the original course. Furthermore, it is more conceptual, more holistic, and takes a more cross-disciplinary approach. It seems that these students lack the skills which are needed to analyse and interpret this kind of information, starting from a question or problem which they face. In this research, we only concentrated on the students' perceptions of the textbook although, in the PBL course, we asked students to use a variety of information sources. An extension of the questionnaire to include all information resources used by the students could contribute to a better insight into the students' perceptions of this variable.

Three other aspects differed significantly between the two courses, but the effect size was small (0.2 or less). Firstly, the students perceived the assessment by the staff as less appropriate, indicating that the staff concentrated more on memorising than on understanding, although the latter is a core goal within PBL curricula. There are several possible different explanations for this result. Probably, although informed in different ways, the tutors might not yet have a complete overview of the goals and the learning content of the new course, and therefore might have relied on factual knowledge. Additionally, the tutors themselves, as well as the students, had to deal with the diversity of literature, which takes extra preparation time and discussion time in the tutorial groups. The perception of not being able to cope with this aspect might have driven students towards the use of surface teaching approaches. Secondly, the students perceived the PBL course to be more focused on generic skills, dealing with problem-solving and analytical skills, than the students in the ABL course. This result is in line with the intended effects. Thirdly, in comparison with the ABL students, the students perceived the PBL course to be less stimulating in terms of independent study. This seems surprising as the PBL students were given more freedom than the ABL students in the topics to be studied and their learning activities.

Despite the students' negative perceptions of various aspects of the PBL course, no significant differences could be observed for the students' perceptions of the functioning of the tutor, the role of the group members and test expectations. According to Nuy (1991), the social structure to which the tutor and the group belong can help students to structure their learning in PBL. He suggests that it is quite possible that the organisational and social structures compensate somehow for the lack of content structure in problem-based learning. From this viewpoint, it could be expected that, because the goals are less clear, students would make more use of the tutor as a resource for structuring their learning and, in that sense, value his role.

Schmidt (1994) found empirical evidence for the suggestions of Nuy: a tutor can make a difference when there is a lack of environmental structure for the students. Students tended to ask their tutors for additional help and guidance. Stinson and Milter (1996) also observed this behaviour. However, the students' perceptions were that tutors coached the groups in the same way as those in the ABL course.

Apart from the role of the tutor, the results of this study indicate that the roles of the group members, as perceived by the students, did not differ significantly between the courses. From Nuy's (1991) point of view it could be expected that, because the goals are less clear, students would use the other group members as a resource for structuring their learning. However, this seems not to have happened. Even after one year's experience of PBL, students still do not perceive the added value of using the tutorial group as a tool for learning. This is in line with the observation made by Evans and Nation (2000, p. 31): "Many students begin their university experience with a history of success through effective and instrumental learning strategies. They are unskilled and often unwilling to make the efforts to use tools and techniques that require them to think deeply and to collaborate extensively with peers".

Assessment is another critical factor in student learning (Segers et al., 2003). The ABL course and the PBL course used different modes of assessment: a knowledge test measuring knowledge reproduction (multiple-choice) versus a knowledge test together with a case-based assessment instrument measuring application of knowledge in authentic contexts. Scouller (1998) indicates that students perceive Multiple Choice Question and essay tests differently and adjust their strategy to learning to suit the testing method. We expected, therefore, that a change in assessment format would lead to changes in student learning. However, the implementation of the case-based assessment instrument did not result in different test expectations. The absence of differences in expectations could have several causes. One reason could be that students still relied on the experiences in their first years with knowledge tests and therefore they did not expect any differences in the test format. Another reason could be that students were aware of the different test formats, but that they did not perceive them as being different. A posttest survey could give more information about the way the assessment was perceived in the ABL and the PBL course.

In short, in line with the findings of Ramsden (1992) and Prosser and Trigwell (1999), the results indicate that students' negative perceptions of different aspects of the PBL environment have acted as a filter between the learning environment as designed and the students' learning strategies.

The perception of the learning environment and students' learning strategies are related in several ways. Firstly, several authors (Ramsden, Prosser, Trigwell & Martin, 1997; Trigwell & Prosser, 1991) found that deep

learning was positively related to clear goals and independent study. The PBL students perceived both factors as less positive than the ABL students, which might have resulted in a lower level of deep learning strategies for these students. Secondly, surface learning is negatively related to perceptions of both appropriate workload and appropriate assessment (Ramsden et al., 1997; Trigwell & Prosser, 1991). This means the lower scores on appropriate workload and on appropriate assessment are associated with more surface learning strategies being used. The PBL students perceived both factors as less positive than did the ABL students, which might have resulted in a higher level of surface learning strategies for these students. So, the changes in students' learning strategies can be explained by the changes in students' perceptions of the learning environment.

This research has some limitations. Firstly, in educational practice, not all factors can be controlled, unlike in a laboratory setting. This is inherent in a real-life setting when working with teachers and students. However, based on the theoretical principles underlying the current study, we feel that we tried as hard as we could to establish a research setting which allowed us to draw generalisable conclusions. Although the tutors were instructed in many ways in various matters concerning the implementation of the PBL course, we could not control the actual behaviour of tutors. Observation of actual tutor behaviour might reveal clearer insights into the degree to which tutor behaviour stimulated the students to use a surface learning strategy. Secondly, although in former research the SPQ showed acceptable values for the Cronbach alpha reliability coefficient (Albaili, 1995; Zhang, 2000), the alpha reliability for the scale measuring surface learning in both the ABL and PBL course was low (about 0.40 in our study). This implies that some conclusions should be considered with caution. The same is true for the scales of appropriate assessment and independent learning (with alpha reliabilities of about 0.52). Finally, because of the short-term character of the PBL course, the research was limited to the measurement of the students' learning strategies. However, it would be interesting to investigate both the students' learning strategies and their motives in case the proposed PBL approach was implemented in the long term.

This implies that, for further research, as the effects of innovations are often only visible in the long term, longitudinal research is relevant. This means capturing the change in students' perceptions of the learning environment and in their learning approaches (strategies as well as motives) during and after the intervention. Another area for further research is a more in-depth analysis of the students' perceptions of the learning environment by means of semi-structured interviews. In this way, the students' first-year experiences, and the transition from the instructional approach in their first year of study to the approach in their second year, could be researched. Additionally, observations of the group and learning processes in the

tutorial groups might reveal more insights into what is happening in the classroom and therefore offer more insight into students' perceptions. Furthermore, extending the research with the motive aspect would give more insight into the understanding of learning approaches, as some students use a surface strategy in order to have a deeper understanding of the topic (Marton, Watkins & Tang, 1997). Finally, a follow-up study of the effects of the PBL course, revised on the basis of the practical implications described below, could reveal additional information about the effect of the various instructional variables.

5. Practical Implications

Implementation of innovative methods does not always result in the desired outcomes. Lockwood (1992) concludes that instructional devices do not change the behaviour of students as easily as course designers might imagine. Gibbs (1992) indicates that not all innovations result directly in the desired changes in learning approaches and fine-tuning is necessary. Fullan and Stiegelbauer (1991) refer to various factors that obstruct educational change, such as lack of communication of the change and not rewarding the making of the change. The design of the PBL course was based on the assumption that second-year students were sufficiently trained in their first year of study in order to be able to handle complex problem tasks and a higher variety of literature sources than in their first year. We based this assumption on Vermunt (2003), who proposes that independent learning and thinking can be reached by a gradual transfer of control over students' learning processes from teachers to students. This was what was planned to happen in the course under study. However, if students do not master the learning or thinking activities on which the staff capitalises, there is destructive friction (Vermunt & Verloop, 1999). This could cause a decrease in learning and thinking skills. The question could be raised as to whether the students in the PBL course were capable of making the transition from more surface approaches in their secondary school and, to a certain extent, in their first year of studying at university, to deep approaches to learning in the course under study. Those who are unable to make these transitions in learning might have experienced a disjunction that disables them and often results in "a shift towards individualism, strategic approaches to learning and an overall sense of fragmentation in the learning process" (Savin-Baden, 1998, p. 5).

Destructive friction can be solved either by more control from the teachers or by training students in adjusting their behaviour to the new learning environment. The former would imply that the new course design was a 'bridge too far' and more teacher support is needed by, for example,

modelling to the students the analysis of complex problem tasks, giving more time to the discussion of the formulation of learning goals by the students, and modelling of and giving feedback on the comparative analysis of various information resources.

Furthermore, communication might be an important key to successful implementation of this PBL course. This means providing the tutors with extra support for understanding the rationale behind the redesign, with more information on the course content, more support in handling diverse information sources themselves, and more coaching of the students in the process of self-dependent learning. For example, explaining possible relationships between the different articles to be used by the students could enhance the transition of the tutors to the new learning environment. Communication also refers to the students. Savin-Baden (1998) refers to the mismatch between students' conceptions of learning when entering a PBL environment and those underlying the environment. She points to various barriers to learning through PBL: "In the context of problem-based learning students' concepts of learning and knowledge are often challenged because of the ways in which they are expected to be researchers of, and creators of, knowledge in ways that few have experienced in prior experiences of learning" (p. 4). Stinson and Milter (1996) argued that "a great deal of coaching is required as students make the transition into problem-based learning. Students must be helped and encouraged as they start to take on responsibility for their own learning. Rather than just giving an assignment, the teacher must work with the students as they take their first halting steps into an ill-structured problem/situation" (p. 41). In short, both communicating the ideas behind PBL to students and training students in dealing with the PBL learning environment are needed.

With respect to assessment, it is clear from previous research that it has an impact on students' learning. However, convincing students of the value of another test format is difficult. As Gibbs (1992) stated: "Assessment systems dominate what students are oriented towards in their learning. Even when lecturers say that they want students to be creative and thoughtful, students often recognize that what is really necessary, or at least what is sufficient, is to memorize" (p. 10). This view indicates the inertia of changing the learning of students. However, in this research, the test expectations did not differ between the two course formats, although effort was put into changing the test. For the assessment in the PBL module, several improvements can be suggested. Firstly, deep teaching with time for formative assessment should be encouraged, giving the students more feedback on the way in which they process the problem tasks. It is well known that formative assessment has a positive influence not only on the learning process but also on final test scores (Black & William, 1998). Secondly, the new mode of assessment should be better communicated to the students. This

can result in a better match between the goals of the assessment and students' expectations. A third option concerns a more radical change of the assessment system on curriculum level, thereby making the profile of the learning environment, including assessment, much clearer to the students. Being self-dependent learners, and focusing on deep learning, should be explicitly rewarded. The main characteristics of the learning environment, including assessment, should be putting authentic problems at the heart of the learning as well as the assessment process, asking students to formulate their own problem definition and analysis, and looking for additional information to fully understand and solve the problem.

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