LEARNING STRATEGIES, STUDENTS' CHARACTERISTICS AND THEIR PERCEPTIONS OF THE LEARNING ENVIRONMENT

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LEARNING STRATEGIES, STUDENTS' CHARACTERISTICS AND THEIR PERCEPTIONS OF THE LEARNING ENVIRONMENT

AN INTEGRATED STUDY AMONG BUSINESS STUDENTS

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DANKWOORD

Dat u nu in de gelukkige positie bent om dit proefschrift te lezen is niet alleen de verdienste van ondergetekende. In de afgelopen jaren hebben verschillende mensen elk op eigen tijdstip en eigen manier bijgedragen aan de totstandkoming van dit boekwerk. Gezien de tijdspanne van het schrijven, bestaat er natuurlijk altijd het gevaar van een historische vertekening, waardoor niet alle credits op de juiste plaats zullen terecht komen, daarvoor mijn excuses.

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‘Het werkstuk is af.’ Eijsden, warme en natte zomer 2006

CHAPTER 1: INTRODUCTION

What drives students' learning?

For several years John has worked as a staff member at the Faculty of Economics and Business Administration of the University of Maastricht. This faculty uses Problem-Based Learning (PBL) as its leading educational principle. John loves being a tutor and is convinced that PBL offers great opportunities to prepare students for their professional lives. He believes that PBL stimulates students to integrate material from multiple sources, to evaluate new information in relation to previous knowledge, to make connections to form deeper levels of understanding, and to apply knowledge differentially according to the circumstances of the situation.

As a course co-ordinator and as a tutor, therefore, he invests a lot of time and energy in developing appropriate course material, such as course books and tests, to both motivate students' learning and to enhance their deep approach to learning. One of the elements he spends a lot of time on is the design of authentic problems, as these are the pivotal element in PBL. He expects these authentic problems to stimulate the students to analyse in depth what is going on and to stimulate them to look for a variety of relevant perspectives that are presented in a multitude of literature sources. However, while for him it was clear what questions should be derived from a problem, students went in a lot of unexpected directions and tutors had to intervene repeatedly. Furthermore, not all the students reacted in the same way to the problems he had designed. Some students were very motivated and analyzed the problems in productive ways. Other students were rather uninspired and looked in the textbook to find any clues. This raised several questions in John's mind. How can these different reactions be explained? Is it because of individual differences between students, or does it depend on the subject matter?

Furthermore, he noticed that even a large group of second-year students who had experienced one year of PBL were still very focused on memorizing, as he observed during discussions in the tutorial group, and as became clear from their answers to his exam questions. Moreover, when talking to students, not all of them seemed to appreciate his approach in the same way. Could some personality types value his approach more than others? He started doubting if it was even possible to change students' ways of learning by changing the learning environment.

1.1 Introduction

This case illustrates the unclear situation educators like John are confronted with. They try to optimise their students' learning environments by designing appropriate problems, assignments, curricula, assessment tasks and educational formats. All this effort is made in order to enhance deep learning. "Deep" learning describes learning in terms of relating new ideas to previous knowledge, looking for patterns and underlying principles, and looking for meaning (Marton et al., 1997). There is an intrinsic motivation to develop understanding of the material. Another kind of learning used by students is "surface" learning. This consists mainly of comprehension and reproducing knowledge (rote learning) which is often forgotten by students shortly after the course has ended (Marton et al., 1997). It is apparent that in an academic environment, and in professional life, deep learning is favoured over surface learning.

Despite their good intentions, several factors might frustrate the educators' attempts to optimize the learning environment. Firstly, sometimes students perceive the learning material in a different way to the designer. For example, in Problem-Based Learning (PBL) environments students might be uncertain about the learning objectives, or perceive the use of a variety of learning resources (instead of one textbook) as negative, putting too much pressure on them and increasing their workload. Secondly, a more complex factor is that there are not only differences in perceptions of the learning environment between educators and students, but also among students themselves. Students who attend the same course and even have the same tutor may differ in their perceptions of the learning environment. Problems which seem straightforward for one student are, for other students, a source of questions. Students may differ in the perceived workload and have different opinions about the same tutor. Thirdly, students not only differ with respect to their perceptions but also in terms of prior knowledge, conceptions of learning, and personality traits. These students' characteristics may influence, directly as well indirectly, their approaches to learning, with their perceptions of the learning environment as a mediator. Furthermore, adaptability of learning approach may differ between students. Some students will adjust their learning to the requirements of the learning environment. These are the students who benefit the most from course design. Other students, however, tend to stick to their own learning behaviour, regardless of the demands that the learning environment makes of them.

Given these differences amongst students, the question is raised of whether all the efforts to develop an optimal learning environment to fit all students make sense. Up to now,

several authors have described this complex situation, and substantial empirical research has been conducted in order to gain insight into the construct of learning approaches and in the effects of students' characteristics and the learning environment. However, various theorized relationships lack empirical evidence and the findings of former research are sometimes inconclusive. With this PhD thesis we want to contribute to this field of study by looking for empirical evidence of the power of individual characteristics, as well as students' perceptions of the learning environment, to change their learning strategies more towards deep learning.

In the remainder of this introduction, firstly a model describing students' learning is introduced. Subsequently four research questions, which are the guiding questions in this thesis, will be formulated.

1.2 Conceptual model

Much of the recent research on student learning in higher education has been summarised in terms of the 3P model of Biggs (2003), containing three main elements: presage, process, and product. Several versions have been developed over time, indicating the evolution in thinking about students' learning (see Jones (2000) for a review). Similar models have been developed by Entwistle, et al. (2003), Prosser & Trigwell (1994), Sadler-Smith (1999) and Vermetten (1999). In Figure 1.1 we have interpreted the models of Biggs and Prosser & Trigwell. The model represents relationships between the students' characteristics, perceptions of the learning environment, approaches to learning, and learning outcomes.

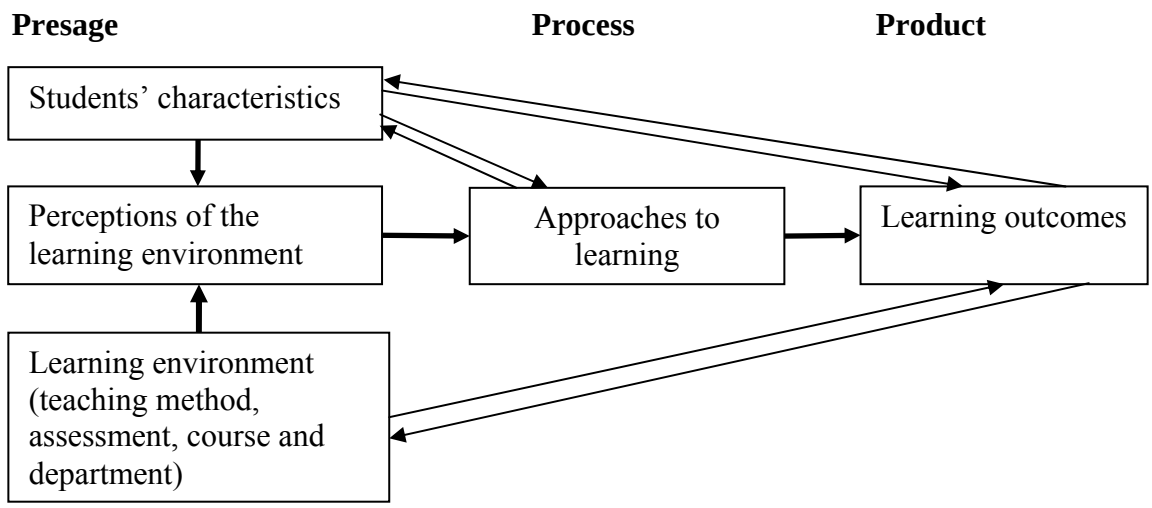

Figure 1.1: A 3P model for students' learning
(Adapted from Biggs (2003) and Prosser & Trigwell (1999))

As indicated by the arrows in the model, it is conceived as an interactive system (Biggs, 2003; Prosser & Trigwell, 1999). The bold arrows indicate that student characteristics and the learning environment (presage factors) jointly determine the students' perceptions of the learning environment. This perception influences the learning approach adopted by the students (process factor). Subsequently, the learning approach determines the learning outcome (product factor). As the model is conceived as a system, the light arrows complete the remaining connections (Biggs, 1993). Moreover, as the reverse arrows show, relationships are reciprocal, so it difficult to distinguish cause and effect. As the focus in this thesis is on factors affecting approaches to learning, we will concentrate on the unidirectional relationships between the students' characteristics, their perceptions of the learning environment and their learning approaches.

Presage factors

Presage factors are those which are present before learning takes place. Biggs (1987) identified two factors: students' characteristics and the learning environment. **Students' characteristics** are relatively stable features of students, which could directly influence the approach to learning adopted by a student. These features include gender, personality, locus of control, learning styles, age, and prior knowledge. The degree of stability of these factors may vary: although gender is normally stable, prior knowledge and age can vary over time.

The **learning environment,** or context, includes the situational factors ranging from institute, faculty and department, to the course (e.g., Biggs, 1987; Ramsden, 1988). At the course level, decisions are made about various aspects of the learning environment such as the format of the meetings, learning materials used, the use of ICT, the roles of the teacher and the student, the degree of cooperation between students, the size of groups, the degree of self regulation, workload and assessment. These can lead to the implementation of a specific instructional approach such as case based learning, problem-based learning, action learning etc. In this thesis, Problem-Based Learning (PBL) is the context for the study of students' learning.

The point of contact between the student and the learning environment is the **perceived learning environment,** depicting a relationship between these two domains (Ramsden, 1988, p. 160). It is evident that it is the students' perceived learning environment, rather than the 'objective' learning environment, that influences learning (Prosser & Trigwell, 1999). As the perceptions of the learning environment are influenced by students'

characteristics, it implies that these characteristics have both direct and indirect effects on the learning approaches.

This thesis will focus on the direct and indirect role of the individual characteristics of the students, and their perceptions of the learning environment, on the students' learning strategies.

Process factors

Process factors refer to the way students experience, and deal with, learning situations. In this respect two kinds of learning approaches are relevant: surface and deep learning. A surface approach is based on a motive or intention that is extrinsic to the real purpose of the task. Students see the task as a demand to be met, rely on memorization, and avoid personal or other meanings the task may have. Although this approach may be successful in certain learning situations, the drawback is that after a test the acquired knowledge is quickly forgotten, application of the knowledge for existing situations is hardly developed and students are not skilled in applying knowledge to new situations. The deep approach is based on a perceived need, such as intrinsic interest, to engage with the task appropriately and meaningfully. Its focus is on underlying meaning, making the task meaningful to the student's own experience and integrating aspects of the task into a whole. Students who learn in this way are capable of applying knowledge in new situations and in this way are better prepared for professional life. Students' learning approaches are not necessary stable: the same student may use a surface approach in one situation, and in another situation a deep approach may be utilized, depending on the perceived requirements of the situation.

Although the terms deep and surface learning were already defined in 1956 (Bloom, 1956), it took two decades to find empirical evidence to support this dichotomy. In Sweden, Marton & Säljö (1976) used phenomenography to describe learning processes and identified deep and surface learning as key variables to understand the way students learn. Some years later instruments were developed to measure students' learning. In the UK, Entwistle and Ramsden (1983) used individual differences theory to derive their Approaches to Study Inventory. In Australia, Biggs (1987) used information processing theory and developed the Study Process Questionnaire to measure the use of deep and surface learning approaches. Biggs (1987) argues that a learning approach captures both the student's motive (the reasons for learning) and student's strategy (the method of tackling a learning task). This distinction between motive and strategy is not specific for Biggs, as at the broadest level similar aspects are found in other inventories (Entwistle et al., 2001). Following the hypothesis of Curry

(2002) that learning constructs closest to the learning environment are most adaptable to change, in the studies reported in this thesis we will focus on learning strategies as part of the learning approach, thereby excluding the learning motives aspect.

Product factors

Product factors describe the outcomes of the learning process and include three categories. The first category refers to quantitative outcomes, which are the amount of knowledge and skills a student has acquired. This is mostly reflected in exams, assignments and essay results. The second category includes qualitative outcomes, which refer to the integration of newly learned information with previously learned information and the structure of knowledge. The third category describes affective outcomes, which are students' feelings in terms of their motivation and satisfaction with the course. Given the focus of this thesis on the factors influencing students' learning, product factors will not be taken into consideration.

1.3 Context of the thesis

The research described in this thesis is not taking place in isolation; in this respect two environments are relevant. The first is the learning environment, which is Problem-Based Learning. PBL, as initially developed by Barrows and Tamblyn (1980), typically involves students working on problems in small groups of five to twelve students, with the assistance of a faculty tutor. The tutor coaches the group by monitoring the group process and helping the students to identify the knowledge that is needed to resolve the problem. The second is the educational environment, which is Higher Education. Higher education prepares students for their professional lives and therefore aims to enhance students' deep learning. Problem-Based Learning is a learning environment which aims to constantly confront students with learning tasks that require deep learning. In this way, educators try to develop this learning approach and to make deep learning the students' preferred way for approaching problems.

1.4 Research questions

We investigated the influences of both students' characteristics and their perceptions of the learning environment on their learning strategies, starting from four research questions.

Research question 1

Previous research on learning strategies has examined the relationships between either students' characteristics and their learning strategies (e.g. Zhang, 2003), or their perceptions of the learning environment and their learning strategies (e.g., Trigwell & Prosser, 1991). However, as Lizzio et al. (2002) indicated, "studies to date have also not included a direct test of the relative influence of personal and perceived situational presage factors" (p. 31). In our first study, therefore, we addressed both factors, focussing on the relative influences of personality traits and students' perceptions of the learning environment on their learning strategies. With respect to personality, we used the five-factor model to study this variable, considering five personality traits: emotional stability, extraversion, agreeableness, conscientiousness and openness. With respect to students' perceptions of the learning environment, we addressed various elements such as the quality of the teaching, the clarity of the goals, the appropriateness of the workload and the assessment, and the level of independent learning. The central research question in the first study was:

How are perceptions of the learning environment and personality traits related to students' learning strategies, separately and jointly?

The relevant relationships under investigation are depicted in Figure 1.2.

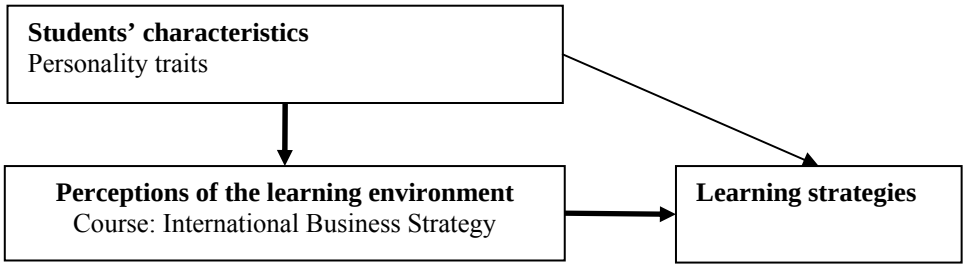

Figure 1.2: The influence of both perceptions of the learning environment and personality traits on learning strategies

Research question 2

In order to gain a deeper understanding of why students perceive a learning environment in a specific way, we focused on one specific element in Problem-Based Learning, namely the problem offered to students. The problem plays a key role in students' learning as it is the starting point for learning (Gijselaers & Schmidt, 1990). To date, little is known about students' perceptions of problems. One case in point is the study of Dochy et al. (2005), concluding that there seem to be differences in students' perceptions between various schools where PBL is implemented, between first year students, the graduate group of students and between various disciplines. However, it is unclear if, and which, students' characteristics influence their perceptions of the learning environment, and of problems in particular. Therefore, the following research question was formulated.

What is the relationship between students' characteristics and their perceptions of problems?

In order to answer this question a rather broad range of learners' characteristics relevant for learning, including personality traits, learning style, attitude to the course and prior knowledge, was related to the perceptions of problems. The relationships under investigation are depicted in Figure 1.3.

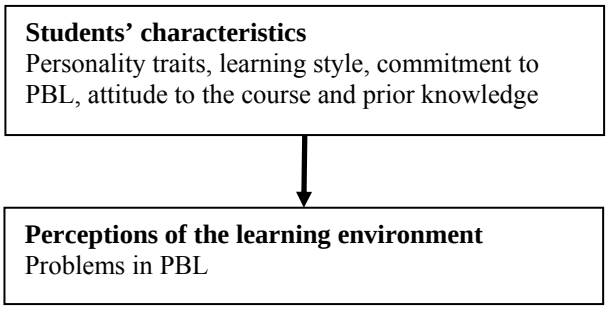

Figure 1.3: The relationships between students' characteristics and their perceptions of problems

Research questions 3 and 4

The studies addressing research questions 1 and 2 are rather static in their nature, exploring variables influencing the adoption of a learning strategy. Research questions 3 and 4 are formulated from a dynamic perspective, focussing on changes in learning strategies. Two

leading research designs can be identified in studies addressing the variability of learning strategies: between-students and within-students designs. The between-students research design focuses on the comparisons of students' learning approaches in different groups of students participating in different learning environments (e.g., Vermetten et al., 2002). In some of these studies, the impact on learning strategies of a course re-design is analyzed. The results of these studies are rather inconclusive. In order to better understand the relationships between changes in learning environment designs and students' changes of learning strategies; we investigated students' perceptions of the learning environment. The third research question is:

What are the main differences in students' perceptions of learning environments and their learning strategies, associated with the redesign of a course?

To answer this question we redesigned a course from an assignment-based format to a problem-based format. The former implies that students' learning was supported by assignments with well structured questions and with literature references that prescribed which information sources to read. The latter was characterized by authentic problems students had to tackle, which are unstructured in nature; in order to be able to analyse and solve the problems, the students had to search for relevant information by themselves, so no literature references were given. The relationships under investigation are depicted in the scheme in Figure 1.4.

Figure 1.4: The influence of different course formats on learning strategies

In the within-students research designs, researchers investigate the same group of students in different learning environments (e.g., Eley, 1992; Fazey & Lawson, 2001; Jones, 2002; Wilson & Fowler, 2005). Eley (1992) did find some changes in learning approaches; however the changes seemed not to be great. As a possible explanation for the limited change in learning approaches he indicated that the changes in the students' perceptions of the learning environment were rather small. While Eley (1992) tried to find groups with

variability in learning approaches, other studies take students mostly as a homogeneous group. The research on subgroups might be interesting, as indicated by Vermetten et al. (1999) "Some students might be quite fixed in the use of learning strategies, whereas others might be quite flexible.." (p. 17). Furthermore, although Eley (1992) tried to use changes in students' perceptions of the learning environment; other studies pay little attention to these changes. The fourth research question was, therefore:

Which subgroups of students can be discerned on the basis of variability in learning strategies?

To answer this question we used a within-students design to analyze students' perceptions of the learning environment, and their variability in learning strategies, over three different business courses: International Business Strategy, Finance & Accounting, and International Marketing (Figure 1.5).

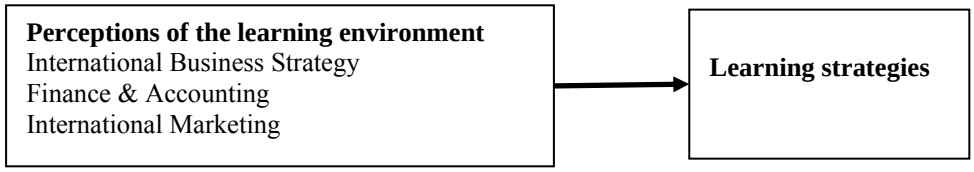

Figure 1.5: The influence of different courses on learning strategies

By answering the four research questions we hope to contribute to the knowledge in the field of student learning. In the following chapters, which are based on journal articles and a book chapter, each research question is discussed separately. As the same theoretical background is sometimes used, overlap in these chapters is inevitable. Our final thoughts and comments are presented in the last chapter.

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CHAPTER 2: THE INTERPLAY OF PERCEPTIONS OF THE LEARNING ENVIRONMENT, PERSONALITY AND LEARNING STRATEGIES: A STUDY AMONGST INTERNATIONAL BUSINESS STUDIES STUDENTS[1]

2.1 Introduction

Since Marton and Säljö (1976) introduced the constructs of deep and surface approaches to learning, educators in higher education have been interested in stimulating deep learning. One of the ways of doing so is by redesigning the learning environments (e.g., Gibbs, 1992; Kember *et al.*, 1997; Nijhuis, *et al*., 2005). Such interventions were based on the assumption that learning is influenced by the students' perceptions of the learning environment (Biggs, 1987; Ramsden, 1988). Additionally, several researchers (Biggs, 1993; Sadler-Smith, 1999) have argued that learning is influenced by enduring characteristics of the learner which have been brought to the learning situation. Factors such as locus of control (Rose *et al.*, 1996), thinking styles (Zhang, 2000), cognitive styles (Sadler-Smith, 1999), and personality traits (Zhang, 2003) also seem to play a role. Previous research on learning strategies has examined the relationships between either the learner's characteristics, perceptions of the learning environment, and learning strategies. As Lizzio *et al.*, (2002) indicated, "….studies to date have also not included a direct test of the relative influence of personal and perceived situational presage factors" (p. 31). The focus of this study is on the separate and joint relationships between the students' perceptions of the learning environment, their personality, and the learning strategies they use. The article is organized as follows. Firstly, in the theoretical background**,** we will discuss the relationships between perceptions of the learning environment, personality and students' learning. Secondly, after describing the research method, the empirical findings are reported. This is followed by a discussion and the conclusion.

[1] Nijhuis, J. Segers, M., Gijselaers, W. (in press) The interplay of perceptions of the learning environment, personality and learning strategies: a study amongst International Business Studies students, *Studies in Higher Education*.

2.2 Theoretical background

2.2.1 Learning environment perceptions and student learning

A vast amount of research indicates that when students are exposed to a particular context, they are differentially responsive to the learning environment, according to their perceptions of the teaching and learning context and its requirements (Biggs, 1987; Entwistle, 1988; Meyer & Muller, 1990; Meyer *et al.*, 1990; Ramsden, 1988, 1997).

For example, Prosser (2000) factor analyzed the scores of a sample of about 1600 Australian first-year university science students on the Study Process Questionnaire (Biggs, 1987) and the Course Experience Questionnaire (Ramsden, 1991) resulting in a two-factor solution. In the first factor**,** deep learning was associated with good teaching, clear goals, and independent learning. The second factor revealed relations between appropriate workload, appropriate assessment and a surface approach.

These findings were confirmed by Lizzio *et al.*, (2002) using a cross-disciplinary sample of 2130 Australian undergraduate students. A multiple regression analysis indicated that perceptions of good teaching, clear goals, appropriate assessment and independent learning served as good predictors for a deep approach. Students' perception of appropriate assessment and appropriate workload, however, correlated negatively with a surface approach. International studies indicate that these results can be generalised for populations of different countries. A study by Sadlo and Richardson (2003) provides a case in point. They used data from six different schools for occupational therapy located in six different Western countries. These schools used different teaching methods, namely subject-based, problem- based and hybrid curricula. The total sample consisted of 225 students. Again, good teaching, appropriate assessment and independent learning were positively – although to a low to moderate degree – related to deep learning. Values for correlations (r) ranged from 0.18 to 0.23. As in the Australian studies, students' perceptions of good teaching, clear goals, appropriate workload, appropriate assessment and independent learning were negatively related to a surface approach. They found values for correlations (r) ranging between -0.47 and -0.21.

In general, the consistent finding is that there is a positive, although low to moderate, relationship between employing a deep approach and the students' perceptions of good teaching, clear goals, and the extent to which they are encouraged to learn independently. The perceptions of appropriate workload and appropriate assessment are negatively related to a surface approach. All these studies treat students as independent replicates. That is, students are considered as repeated measurements when analyzing the association between

the variables described above. It is assumed that associations between variables are independent of certain student characteristics. The question arises, however, as to whether this is indeed a valid assumption.

Trigwell *et al.* (1996) conducted some in-depth analyses to find out whether this assumption holds true. They introduced the notion of disintegrated perceptions when trying to understand the association between perceptions of the learning environment and measured outcomes. Based on a cluster analysis, they discerned three groups of students. In the first group, students adopting a deep approach perceive the learning environment as characterized by good teaching, clear goals, appropriate workload and assessment and allowing independence in learning. In the second group, characterized by a high score on the surface approach, students perceive, in comparison with the first group, lower scores on components of the learning environment. The third group seems insensitive to the learning environment. They concluded that this group has characteristics which are consistent with the idea of disintegrated perceptions introduced by Entwistle *et al.*, (1991): "It suggests (as may be expected) that many students see no particular influence of the environment on their approach to learning, and hence no influence on the quality of their learning. In attempts to encourage deep approaches to learning, more work may need to be done in addressing factors that influence students' perceptions." (p. 4).

2.2.2 Personality and students learning

One of the factors that might influence students' learning approaches directly, as well as indirectly via students' perceptions, is students' personality. In this respect, research in the field of psychology, especially in the domain of personality and individual differences, might offer interesting insights. One of the major achievements in this field is the finding of the big five personality traits model as described by Costa and McCrae (1992). This five-factor model contains the following personality traits (Piedmont, 1998). Emotional Stability describes the way individuals deal with psychological distress. A high score on this dimension indicates that people are calm, relaxed, feel confident and are not easily disturbed. Extraversion is about social interaction with other people. People scoring high on this dimension tend to be sociable, assertive and like to work with other people. Agreeableness is about the attitude of an individual towards other people. People with high scores on this scale are characterized as being forgiving, readily helpful and peaceable. Conscientiousness deals with someone's level of organization, persistence and goal-directed behaviour. People with a high score tend to be strong-willed, responsible, neat and well organized. Openness

refers to proactive search behaviour and tolerance of and exploring the unfamiliar. People who score highly on this scale tend to be open-minded, imaginative and independent of judgment by others.

A few studies have indeed demonstrated the effects of the five-factor model of personality on learning approaches. An interesting study was conducted by Zhang (2003), who examined the responses of 420 Chinese university students in different academic disciplines such as psychology, mathematics, physics and arts. She concluded that conscientiousness and openness are good predictors of the deep approach and that there is a negative relationship between emotional stability and surface learning. However, the degree of variance in learning approaches explained by the personality traits is limited. The multiple R^2 values ranged from 0.14 (surface strategy) to 0.25 (deep strategy). In a second study, Diseth (2003) collected information from Norwegian students on an undergraduate course in psychology (n = 142) and an introductory course in philosophy (n = 162). In the psychology course, the personality traits extraversion, openness and conscientiousness were positively related to deep learning and the traits emotional stability, extraversion and conscientiousness were negatively related to surface learning. The correlation (r) ranged from 0.24 to 0.54. In the philosophy course the findings were less convincing with fewer statistically significant relationships. The personality-trait openness was positively related to deep learning and negatively to surface learning, while emotional stability was also negatively related to surface learning. The correlation (r) ranged from 0.25 to 0.46. Finally, in their study Duff *et al.* (2004) used a sample of 146 social science undergraduates at a university in Scotland. In this study, students reporting high scores on extraversion, openness and conscientiousness were more likely to employ deep- learning approaches. A surface approach to learning was found to be associated with the traits emotional stability and agreeableness. Bi-variate correlations (r) ranged between 0.21 and 0.44.

In conclusion, although the limited number of studies indicates that there are significant relationships between personality traits and learning approaches, important degrees of variance in approaches to learning remain unexplained by personality traits.

These limited research results with regard to, on the one hand, the effect of the perceptions of the learning environment on learning approaches, and, on the other hand, the effects of personality on learning approaches, lead us to the question: to what extent does the interplay between students' perceptions of the learning environment and their personality influence their learning approaches?

In this study, we extend the previous studies which focussed on separate and direct relationships by looking at the combined direct and indirect effects of personality and perceptions of the learning environment upon students' learning approaches. Given that personality is conceived to be a stable individual characteristic and students' perceptions of the learning environment are seen to be contextually dependent, it might be expected that personality can influence students' learning approaches both directly and indirectly. The indirect relationships refer to the mediating role that students' perceptions of the learning environment might play.

2.3 Research method

2.3.1 Setting

The research setting for the present study was a course on International Business Strategy at a Dutch Faculty of Economics and Business Administration. This Faculty uses Problem-Based-Learning (PBL) as its leading educational approach. In implementing this approach, the aim is not only to foster the development of knowledgeable managers but to also enable students to employ deep-learning approaches. PBL, as initially developed by Barrows and Tamblyn (1980), typically involves students working on problems in small groups of five to twelve students in so-called 'tutorial groups'. These problems are processed in a rather structured manner normally covering two sessions. In a first session, problems are analyzed and result in the formulation of learning goals, which subsequently guide the independent study of the literature at home. In the second session, the problems are analyzed in depth on the basis of the theoretical framework developed through the literature study, possible solutions are discussed and the relevance of the theoretical framework for novel problems is argued (Gijselaers, 1996; Moust, Bouhuijs, & Schmidt, 2001). A tutor coaches the group by monitoring the group process and helping the students to identify the knowledge that is needed to solve the problem.

Although PBL is the general approach in the faculty, individual course co-ordinators may make modifications in adapting the course format to their own needs and this can result in different levels of structuring the learning processes of students (Nijhuis *et al.*, 2005). Courses can differ, for example, in the complexity of the problems, number of clues for finding problem statements, and the detail of suggestions for finding literature.

However, the general idea in all courses is that students assume a considerable degree of responsibility for regulating their own learning and the setting of their own learning goals.

The participants in the present study were two consecutive cohorts of business students following the obligatory course of International Business Strategy in the second year of the International Business programme. This course lasts seven weeks, with a workload of 20 hours per week, and is completed with a written examination. There are two group sessions per week each lasting two hours. Topics discussed during the course are: the international business environment (for example, economic regions, country selection); the strategy process; internationalization strategies (for example, exporting, joint ventures, foreign direct investment); and strategy implementation issues (for example, organizational structure, plant location and control).

2.3.2 Measurements

Students responded to the self-report questionnaires, consisting of statements that had to be rated on a 5-point scale (from 1 = disagree or not accurate to 5 = agree or accurate). In Table 2.1 some sample items of these scales with regard to personality traits, learning environment and learning strategy are illustrated.

Personality traits were measured using Goldberg's questionnaire (Goldberg, 2001). This questionnaire consists of 50 items, resulting in the 5 personality dimensions as conceptualized in the Big Five Model.

Students' learning strategies were measured using a shortened version of the Study Process Questionnaire (SPQ) (Biggs, 1987). The standard questionnaire contains 42 questions, measuring three learning approaches: surface, depth and achievement. Each approach comprises two sub-scales: motive and strategy. Curry's (2002) argument that learning concepts closest to the learning environment are the most likely to be sensitive to change was adopted. In this research, therefore, only the students' learning strategies are measured. A further refinement was that that we did not include the achieving-strategy scale. This scale deals with ego enhancement as reflected, for example, in striving for higher grades (Biggs, 1993). Activities such as organizing time, planning ahead and working space belong to this strategy, and as such do not describe cognitive processes when working on a learning task (Biggs, 1988). This scale was, therefore, not included in the research. Both internal and external validity are well documented in the literature. Furthermore, the SPQ has been used in many cultures and settings.

Table 2.1: Sample items for the sub scales measuring perceived learning environment, personality trait and learning strategy

Variable	Sub scale	Sample item
Learning environment		
	Good teaching	Teaching staff gave me helpful feedback on how I am doing.
	Clear goals	I had a clear idea of where I was going and what was expected of me.
	Appropriate assessment	Too many staff asked us questions just about facts. *
	Appropriate workload	The workload was too heavy. *
	Independent learning	Students have been given a lot of choice in the work they have to do.
Personality trait		
	Agreeableness	I am the life of the party.
	Openness to experience	I have a vivid imagination.
	Conscientiousness	I am always prepared.
	Emotional stability	I am relaxed most of the time.
	Extraversion	I am interested in people.
Learning strategy		
	Deep learning	I was continually reminded of material I already know and see that material in a new light.
	Surface learning	I learned some things by rote, going over and over them until I know them by heart

*This question is formulated negatively. The score should be reversed.

Students' perceptions of the learning environment were measured by the Course Experiences Questionnaire (CEQ) (Wilson *et al*., 1997). There are several versions of the CEQ which differ in the number of scales and the number of items per scale. In this research, two versions were combined. The shorter version provides the basis for our research. The items involving the scale for generic skills were omitted since these are a measurement of output. Items concerning the independent-learning scale from another version were included because of its relationship to learning approaches and its role in PBL. These adjustments

resulted in 22 items covering five indicators or scales: i) good teaching in relation to the quality of the staff; ii) clear goals as indicating whether it was clear to the students what the course was about, and the knowledge and skills developed; iii) appropriate assessment as indicating the extent to which facts had to be known (a low score on this scale indicates a focus on reproduction); iv) appropriate workload as a measurement of the learner's perceptions of the time available for understanding the things students had to learn; and, v) independent study as an indication of the degree of choice students had in the work they carried out. The CEQ is a well-known instrument that has been used in many settings in order to measure components of learning environments.

2.3.3 Procedures

The data for this study was collected as part of a larger research project on the relationships between student characteristics, the learning environment and student learning. All the questionnaires were processed in the tutorial groups. In this manner, the problems students faced when answering the questions could be resolved directly. Furthermore, this involved no extra investment of time by the students which can improve the response rate. Because of the number of questions, the questionnaire was split into two parts which were processed in different sessions. In the first session, the personality questionnaire was processed. In the final session of the course, students were asked to formulate their experiences with the course and their learning strategies.

2.3.4 Methods of analysis

In order to analyze the separate correlations between the different variables, Pearson correlations were employed. With regard to the simultaneous analysis of the structural relationships between personality traits, the learning environment and learning strategies, path models were tested using the software tools EQS 6.1 (Bentler, 2004).

In order to assess the good fit of the model to the data a number of indicators of fit are available. One of the most commonly used indicators is the Chi Square statistic. Due to its sensitivity to sample size and the problems with many degrees of freedom, this indicator is often adjusted by dividing it in terms of degrees of freedom. Hu and Bentler (1999) suggest a two-index presentation strategy which combines an incremental and an absolute fit. In this way the researcher can better control for both type I and type II errors. They recommend the root mean squared residual (SRMR) supplemented with one other fit index. We followed their recommendations and used the SRMR, which focuses on the

discrepancies between the implied and observed covariance matrices. The lower bound of the index is 0, and low values are taken to indicate good fit. Additionally, the comparative fit index (CFI) is reported. The following cut-off criterion was used. A ratio of the chi square to the number of degrees between 2 and 5 is acceptable. CFI should have values of larger than 0.95 and SRMR has to be smaller than 0.08 to indicate an adequate fit of the model to the data.

Because of the exploratory nature of the research, the general approach was to link all the dependent and independent variables. After running the model, relationships with a level of significance above 5% were removed from the model and the revised model was run again. If necessary**,** this procedure was repeated until a model resulted with relationships significant at the 5% level.

Furthermore, R^2 was also calculated in order to get an insight into the explanatory power of exogenous variables. However, this figure is only relevant for describing the fit between the relationships in the model and not how well the model fits the data.

2.4 Results

2.4.1 Descriptives

The first cohort comprised 406 students involving 29 tutorial groups. Eleven tutors supervised these groups. The second cohort comprised 312 students in 24 tutorial groups. There were nine tutors for this course. The group size for both courses ranged between 13 and 15 participants. In both cohorts, the ratio of men to women was 55% male and 45% female. The nationalities were distributed as follows: 70% Dutch, 12 % German, and 18% other (mainly European) countries.

In total 718 students were enrolled in the course. In the first tutorial group session 624 students were present and collaborated in the research. Of this group, 522 students also participated in the final session which indicates a survival rate of 84%. The descriptive statistics of the variables are presented in Table 2.2.

There is considerable variation in the reliability of the different scales. The cronbach alpha coefficients of all personality scales and three learning environment scales are acceptable (> 0.70). The reliability of the deep-learning scale (0.62) is lower but is still acceptable in exploratory research. Three scales are lower than 0.60 which means that some conclusions need to be considered with some caution.

We report the results step-by-step by first analysing the separate relationships (both bi-variate correlations and the path model); and we subsequently present the joint relationships. In doing so, we can compare our findings with the separate analyses in other studies and by doing so we can provide more insight into the effects of using more advanced statistical techniques.

Table 2.2: Descriptives of the main variables used in the analysis (n= 522)

Scale	N_items	Average	Std.	Cronbach
Personality				
Agreeableness	10	34.9	6.5	0.84
Extraversion	10	38.8	4.8	0.79
Conscientiousness	10	33.6	5.7	0.76
Emotional stability	10	34.4	6.5	0.83
Intellect	10	35.6	4.7	0.74
Learning environment				
Good teaching*	5	16.2	3.5	0.80
Clear goals	4	13.6	2.9	0.72
Appropriate assessment	3	10.0	2.1	0.53
Appropriate workload	4	12.6	3.7	0.85
Independent learning	6	16.7	3.0	0.52
Learning approach				
Deep learning	7	23.1	3.3	0.62
Surface learning	6	16.9	3.2	0.44

*1 question left out due to misinterpretation by the students

2.4.2 Are perceptions of the learning environment and learning strategies related?

There are several statistically significant correlations, although only low to moderate, between the perceptions of the learning environment and learning strategies (see Table 2.3).

Table 2.3: Correlations between the learning environment and learning strategies (n = 522)

Learning environment element	Deep learning	Surface learning
Good Teaching	.28**	.02
Clear Goals	.30**	-.14**
Appropriate Assessment	.12**	-.20**
Appropriate Workload	.20**	-.26**
Independent learning	.28**	.08*

*p < 0.05, ** p < 0.01.

The coefficients illustrated in Table 2.3 suggest that both deep and surface learning are influenced by the learning environment. Students' perceptions of the clarity of the goals and the appropriateness of assessment and workload appear be related to learning strategies. More positive perceptions are related to more deep-learning strategies and less to surface strategies. Perception of a high quality of teaching and a high degree of independent learning seem to be related to the adoption of more deep learning, but not to the employment of surface strategies.

A path analysis of the simultaneous relationships between components of the learning environment and learning strategies results in the model shown in Figure 2.1. In the figures describing the models, only the significant ($p < 0.05$) relationships between the independent and dependent variables are shown. For the purposes of readability, the mutual relationships between independent variables and between dependent variables are excluded.

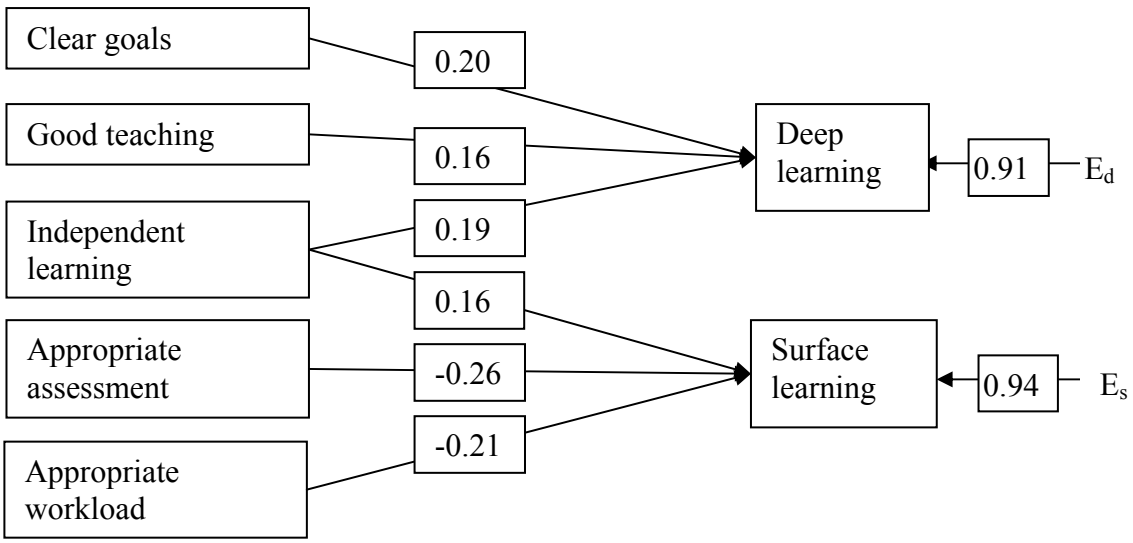

Figure 2.1: The relationships between learning environment elements and learning strategies.

The statistics indicate that there is a good fit to the data χ^2 = 9.75, df = 5, p= 0.08; CFI = 0.99; SRMR= 0.02; this to say that all indicators fit their criteria. The path analysis results in three groups of relations. Firstly, students who perceive the goals as clear and the teaching of good quality tend to adopt deep-learning strategies. Secondly, when they perceive the workload and the assessment as appropriate, they do not tend to adopt surface-learning strategies. Thirdly, the perception of the amount of independent learning positively stimulates students to undertake both deep as well as surface-learning strategies. Although the model fits the criteria, only limited variance in the dependent variables is explained by the independent variables with R^2 = 0.16 for deep learning; R^2 = 0.12 for surface learning.

2.4.3 Are personality traits and learning strategies related?

The Pearson correlation coefficients, indicating the separate relationships between the variables, show some statistically significant correlations. However, these correlations are low to moderate. Adoption of deep-learning strategies is related with being extravert, conscientious, and open. Surface learning is correlated with agreeableness, extraversion and openness. However, the direction of these relationships is negative. Being emotionally stable has no relation with either learning strategy (see Table 2.4).

Table 2.4: Correlations between personality traits and learning strategies (n = 522)

Personality trait	Deep learning	Surface learning
Agreeableness	-.02	-.20 **
Extraversion	.12**	-.10 *
Conscientiousness	.21**	-.07
Emotional stability	.07	-.14
Openness	.14**	-.37 **

*p < 0.05, ** p < 0.01.

Analysis of the relationships between personality traits and learning strategies simultaneously based upon path analysis resulted in the model shown in Figure 2.2.

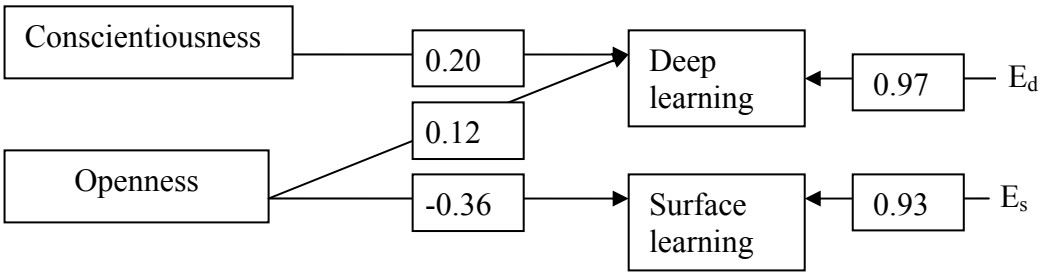

Figure 2.2: The relationships between personality traits and learning strategies.

The statistics indicate that there is a good fit to the data χ^2 = 1.97, df = 2, p= 0.37; CFI = 1.00; SRMR = 0.02; all indicators fit their criteria. The existing six statistically significant bi-variate correlations are reduced to three relationships in the path model. Two out of five personality traits, conscientiousness and openness appear in the model. The coefficients indicate that being conscientiousness is related to deep learning. Students who are open can show deep as well as surface-learning strategies. Although the model possesses good fit scores, only limited variance in the dependent variables is explained by the independent variables: for deep learning R^2 is 0.06; for surface learning R^2 is 0.13.

2.4.4 Are personality traits and perceptions of the learning environment related?

There are some significant ($p < 0.05$) correlations between personality traits and perceptions of the learning environment, see Table 2.5.

Table 2.5: Bi-variate correlations between personality traits and perceptions of the learning environment (n = 520)

Personality trait	Good Teaching	Clear Goals	Appropriate Assessment	Appropriate workload	Independent learning
Agreeableness	.06	.05	.07	.01	-.03
Extraversion	.11*	.11*	.20**	.03	.05
Conscientiousness	.07	.11*	.04	.02	.03
Emotional stability	.05	.08	.07	.19**	.03
Openness	.07	.08	.04	.14**	-.07

*p < 0.05, ** p < 0.01.

The personality trait extraversion is related to three elements of the learning environment: good teaching, clear goals, and appropriate assessment. This is to say that students who have a positive attitude to other people are more likely to: appreciate the staff better, know what is expected from them, and they perceive the assessment as focusing upon understanding instead of upon memorizing. Conscientiousness is related to clear goals. For students who are neat and well organized, there is greater clarity as to what is expected of them in comparison to students who are less well organized. Emotional stability is related to an appropriate workload. Students, who can deal with psychological stress, take the view that they have sufficient time to complete the work. Open-minded students, who score high on openness, also consider that they have sufficient time to complete the work. The personality trait of agreeableness is not related to any component of the learning environment. The perception of independent learning is not related to any personality trait. Several personality traits appear to be related to the perception of the learning environment. However, the pattern is rather fragmented.

A path model was established with all possible relationships between the scales describing personality traits and students' perceptions of the learning environment. Not all of these relationships, however, were statistically significant. The results are illustrated in Figure 2.3.

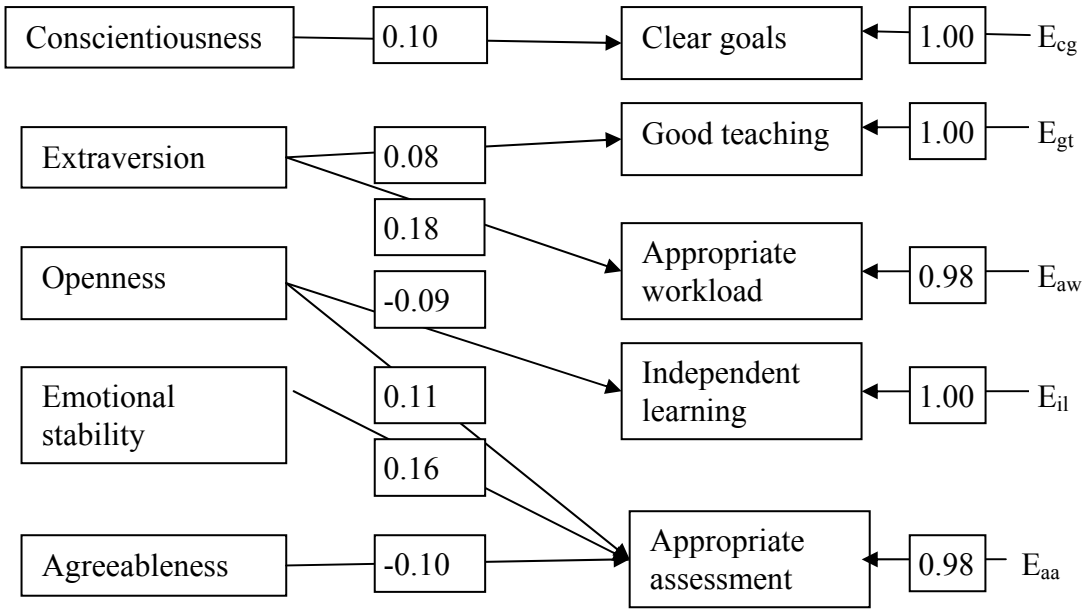

Figure 2.3: The relationships between personality traits and perceptions of the learning environment

From the statistics it can be concluded that the path model is significant $\chi 2 = 45.66$, df= 22, p = 0.002; CFI= 0.95; SRMR = 0.05. From this analysis, it seems that the five personality traits are related to the five discerned environmental factors. Students who are more conscientious perceive the goals as more clear. Extravert students tend to perceive the teaching as of better quality and the workload as more appropriate. Students who are open and emotional stable perceive the assessment as more appropriate. However, students who tend to score high on agreeableness tend to perceive assessment as less appropriate. It appears that students who are more open tend to have less positive perceptions of independent learning. Although the model is statistically significant, only limited variance in the dependent variables is explained by the independent variables, as indicated by the high scores for the error coefficients.

2.4.5 The interplay between personality, perceptions of the learning environment and learning strategies

Considering the various low to moderate significant correlations presented earlier, it is an interesting question as to whether there is a relation between the various variables discerned? Therefore the full model, incorporating the relationships derived in the sub- models, was

subsequently tested. This means that both personality traits and components of learning environments were taken into account. Due to the relationships between personality traits and the components of learning environments, all the personality traits are taken into account, instead of the two traits used in sub-model 2. The results are in Figure 2.4.

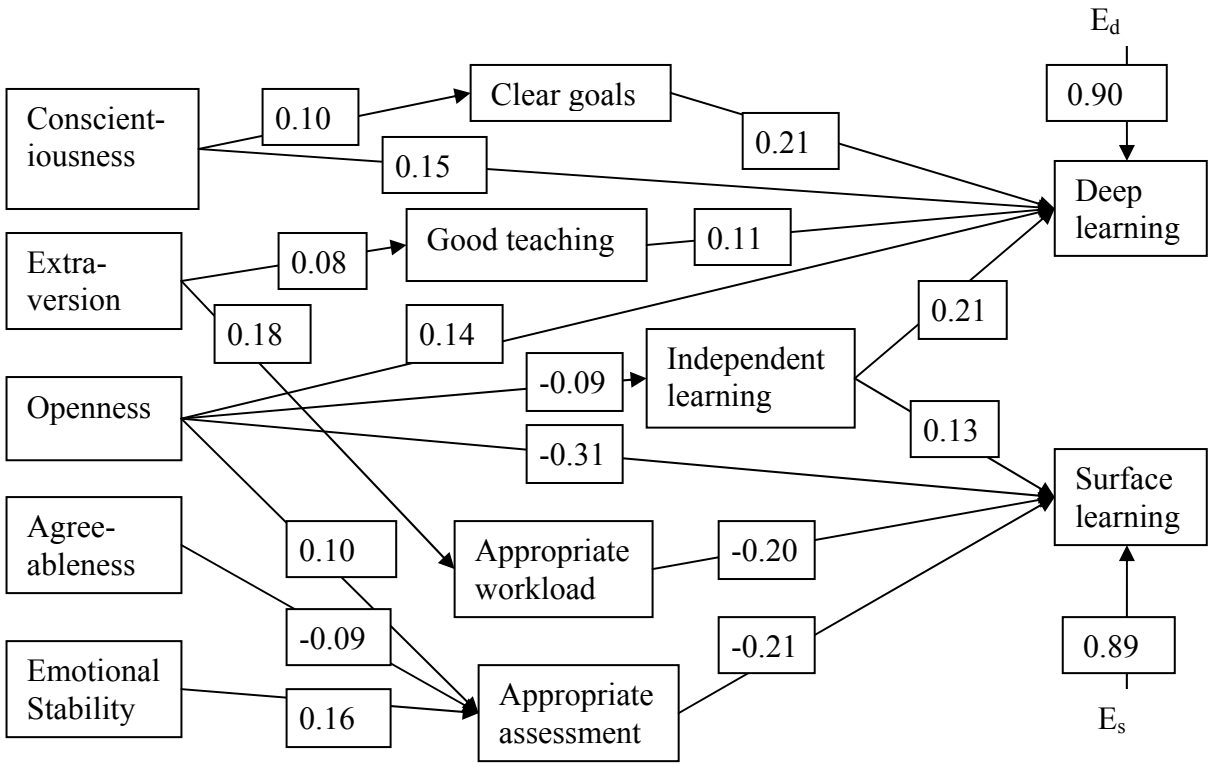

Figure 2.4: Full model of the relationships between personality traits, learning environment elements and learning strategies

The goodness of fit indices indicate that the model provides a good fit with the data χ^2 =58.7 df= 34 p = 0.005; CFI = 0.97; SRMR = 0.05. The five personality traits, as well as the five learning environment variables, have an influence on learning strategies, whether directly or indirectly.

The adoption of deep-learning strategies is directly as well as indirectly influenced by two personality traits, namely conscientiousness and openness. Students who tend to be strong willed, responsible, neat and well organized (highly conscientiousness) tend to perceive clear goals and use deep-learning strategies. Furthermore, students who are proactively searching and who are tolerant of the exploration of the unfamiliar (they are highly open) tend to use more deep-learning strategies and less surface-learning strategies.

There is, however, a mediating effect of their perceptions of the extent of independent learning. The relationship between openness and the learning environment variable is close to zero. Extraversion has indirect effects. It influences both deep and surface learning as mediated by students' perceptions of the quality of teaching and the appropriateness of the workload. Extravert students, who perceive the quality of the teaching to be good, are more likely to adopt deep-learning strategies. Furthermore, extravert students who perceive the workload as appropriate are not likely to adopt surface-learning strategies. Agreeableness and emotional stability play a less important role in the model and are only indirectly related to surface learning.

In a similar manner to the model (Figure 2.1), which describes the relationships between the learning environment and learning strategies, there are three kinds of variables in the full model. Firstly, clear goals and good teaching are positively related to deep learning. Secondly, appropriate workload and appropriate assessment are negatively related to surface learning. Thirdly, independent learning is related to both deep and surface learning.

The regression coefficients in the full model have similar values to those in the sub-models. This means that no relationships disappeared or appeared. In this sense, the full model is an addition of the two sub-models. The model is significant with $R^2 = 0.19$ for deep learning, and $R^2 = 0.21$ for surface learning.

2.5 Discussion

In order to foster students' utilization of deep-learning strategies, educationalists seek to optimize the learning environments they employ. What is the power of learning environments, however, to influence students' learning strategies? Are students' approaches to dealing with study tasks more related to their stable personal characteristics, rather than their being adaptable to learning environments? In order to answer such questions, this research analysed different models in looking for direct and indirect relationships between students' personality, their perceptions of the learning environment and their learning strategies. Empirical evidence was gathered in the context of second-year university business students who were following a problem-based course on International Business Strategy.

The full model, consisting of the learning environment, personality traits, and learning strategies, indicated several direct relationships between personality traits and learning strategies. Furthermore, there are indirect relationships where components of the learning environment mediated between personality traits and learning strategies. The results

with respect to the direct relationships confirm previous research findings (Diseth, 2003; Zhang, 2003). Students who can be characterised as conscientious and open are more willing to employ deep-learning strategies. In contrast, students scoring high on openness to experience have lower scores for surface learning.

As Zhang's study (2003) indicated, there are statistically significant relationships between extraversion and deep and surface learning. This is partly confirmed in a study by Duff *et al.* (2004) showing positive relationships between extraversion and deep learning. However, in our study, these relationships are indirect. Students' perceptions of the quality of teaching and the appropriateness of the workload play a mediating role. Although in Zhang's study agreeableness seemed to be related to surface learning, this was not confirmed in our study. Emotional stability is not related to any learning strategy, although several authors did find relationships between this trait and surface learning, (e.g., Duff *et al*., 2004).

With regard to the direct relationships between perceptions of the learning environment and the students' learning strategies, our results confirm in general the previous research of Prosser (2000) and Lizzio *et al.*, (2002). The perception of clear goals, good teaching and independent learning exerts a positive influence on deep-learning strategies, while there is a negative influence on surface learning in terms of the perception of appropriate assessment and workload. Surprisingly in our research, independent learning seems to be positively related to both deep as well as surface learning. This is probably related to the situation that students working in a PBL environment have to work independently for a large amount of their study time and that studying during this period can take place in either a surface or a deep manner.

As a consequence of the specific focus of this study, the indirect relationships between personality traits and learning strategies – with the mediating role of the students' perceptions of variables in the learning environment – are of especial interest. When taking into account the influence of personality, as well as students' perceptions of the learning environment upon their learning strategies, path analysis results in a different model from that used when analysing separate relationships. The full model indicates the interplay between various personality traits, the perceptions of various elements of the learning environment, and students' learning strategies. Students scoring high on conscientiousness – that is to say being well-organized and goal-directed – seem to perceive the goals in the problem-based course investigated as clear, and, in turn, they are more inclined to adopt deep-learning strategies. An explanation could be that these students, because they are so well-organized and goal- directed, are able to put the goals in perspective, and that they are,

therefore, more clear to them. Extravert students perceive the workload as more appropriate, which in turn leads to less surface-learning strategies. They probably have more social contacts with peer students, as well as teachers, and are able, therefore, to better cope with the demands of the course. Students scoring high on openness also perceive the assessment as being more appropriate and, in turn, adopt less surface-learning strategies. More appropriate assessment refers to staff concentrating more on understanding and less on reproducing facts. An explanation could be that open-minded students place more value on the demand for understanding, as they are themselves more analytical. The same relationships appeared for emotionally stable students – those who are calm, relaxed and able to deal with stress and possess self-confidence. The question here is whether emotionally stable students can deal more effectively with the stress of assessment. Finally, agreeableness is about the attitudes an individual holds towards other people such as: being compassionate, trusting, forgiving and soft-hearted. This is positively related to appropriate assessment and, in turn, leads to less surface-learning strategies. A possible explanation could be that the perception is more concerned with the assessor (in this case the tutor) than the assessment as such.

2.5.1 Limitations

We identify five limitations which are indicative for future research. One point for discussion is the exploratory power of the model. The full model, taking into account personality as well as students' perceptions of the learning environment, explains 19 to 21 % of the total variation in learning strategies. This implies that other variables play a role. Further research should extend the model by including variables that have previously been shown to have direct, if moderate, effects on students' learning approaches such as students' prior experiences within the discipline studied and how they conceive the nature of their field of study (e.g. Crawford *et al.*, 1998).

Additionally, the present study was conducted at one point in time, measuring students' perceptions and strategies at that point, under the currently prevalent conditions. Longitudinal studies, repeatedly measuring students' personality, perceptions and study approaches, could offer additional insights as to whether, and at which points in time, students' study approaches alter, and to what extent this is influenced by the interplay between personality and perceptions of the learning environment.

Furthermore, the research was done in a very specific setting, using second year business students, within a specific course with Problem-Based-Learning (PBL) as the main

instructional approach. Future research should consider other samples involving other courses, teaching systems and student groups.

Fourthly, co-operative learning is central to PBL. In our use of the Course Experiences Questionnaire, we did not pay attention to the social aspects of learning. Future research could take this aspect into account by incorporating items that refer to working together with, and learning from, peers.

Finally, the exclusive reliance on self-reported responses is related to the use of the questionnaires. There were no other measures to validate that the ways in which students responded to the questionnaires is a reflection of their normal behaviour. The cronbach alpha for some scales is slightly lower than 0.6, which suggests that interpretation of the results should be undertaken with considerable caution.

2.5.2 Practical implications

A final but important question refers to practical implications of this study. If we wish to influence students' learning strategies, is it worthwhile to invest in optimising the learning environment or are the mainly stable personality variables responsible for determining the students' ways of tackling study tasks? The first implication concerns the affect of the learning environment upon learning. Given that students' perceptions of the learning environment seem to influence their learning strategies – although only to a moderate extent – deep learning could be enhanced by improving the quality of various components of the learning environment, while at the same time supporting students to gradually able to define their learning goals and to study independently. A further implication results from the influence of personality traits on learning. As indicated by this study, personality traits also play both direct as well as indirect roles. Assuming that these traits are generally stable, this contributes a stable component to perceptions of the learning environment and learning strategies. For educationalists, this suggests that supporting students also implies helping them to reflect on the opportunities and threats they face when studying in learning environments which are designed to enhance deep learning. The student counsellor can play an important role in this critical self-reflection. In this respect, self-reflection should focus upon students' conscientiousness and openness since these are both directly and indirectly related to students' learning strategies. A third implication is based upon the relationships between personality traits and students' perceptions of the learning environment. As these relationships are rather weak, this implies that the personality traits play only a limited role

in predicting the perception of the learning environment. The educational system does not seem to favour any particular kind of student, this is a comforting finding.

2.6 Conclusion

The focus of this study was on the separate and joint relationships between students' perceptions of the learning environment, their personality and the learning strategies they use. Three separate analyses revealed that there are several statistically significant relationships. Firstly, students' perceptions of clear goals, good teaching and independent learning are associated with deep learning. Students' perceptions of the appropriate workload, transparent assessment and independent learning influence their surface learning. Secondly, the results demonstrate that the personality traits of conscientiousness and openness are related to learning strategies. Finally, students' perceptions of the learning environment are related to personality traits.

Analysis of the relationships established in this research suggests that all personality traits and components of learning environments play a role in explaining learning strategies. There are direct relationships between conscientiousness, openness and learning strategies. Perceptions of components of the learning environment mediated the relationships between the students' personality traits and their learning strategies.

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CHAPTER 3: LEARNING ABOUT TEACHING INFORMATION SYSTEMS IN A PROBLEM-BASED CURRICULUM: AN EXPLORATORY STUDY OF THE IMPACT OF STUDENTS' INDIVIDUAL DIFFERENCES ON THEIR CONCEPTION AND PERCEPTION OF PROBLEM TASKS[2]

3.1 Introduction

Todd (1999) describes the late 20th Century as the "Age of Information", where an emphasis is placed on the external organization, transformation and communication of information. He argues that the 21st Century will be the "Age of the Mind", where the key success factors of organizations will be the extent to which they are able to use, share and create knowledge. It is well acknowledged that in order to comply with the demands of the Age of the Mind, it is imperative for educators at all levels to develop learners with cognitive and meta-cognitive, as well as social, competencies. As Birenbaum and Dochy (1996) indicate, cognitive competencies include problem solving, critical thinking, formulating questions, searching for relevant information, making informal judgments and ensuring the efficient use of information. Since schools and universities are preparing students for society, both the new role of information and the new required competences should be taken into account when developing courses. Within a variety of disciplines, innovations in education are implemented. For informatics, new ways of teaching are described by Davey and Tatnall (1994), Jurema et al. (1995) and Penjam (1997) and are discussed at gatherings organized by the Information Systems Education Conference (ISECON).

The innovations in education are mainly based on constructivist principles of learning and teaching (Savery & Duffy, 1995). They are characterized by the view that learning means actively constructing knowledge and skills on the basis of prior knowledge, embedded in contexts that are authentic and offer ample opportunities for social interaction. One example of this kind of instruction is problem-based learning (PBL), nowadays implemented in a variety of institutions. In the field of informatics, for example, Ma (1994) reported on the implementation of PBL in a course on information systems. In PBL the problem or task is the starting point for students' learning. A task is a short description or compilation of phenomena and events that can be perceived in reality. This has to be analyzed, explained and/or solved by the tutorial group in terms of underlying principles,

[2] Nijhuis, J., Segers, M.., Gijselaers, W., (2004). Learning about Teaching Information System in a Problem-based Curriculum**:** In: R. Ottewill, L. Borredon, L. Falque, B. Macfarlane, A. Wall (Eds), *Educational Innovation in Economics and Business VIII*, pp. 229-251, London: Kluwer Academic Publishers.

mechanisms and processes (Moust, Bouhuijs & Schmidt, 1989). The importance of the problem task as the core element in PBL is emphasized by the research of Gijselaers and Schmidt (1990). On the basis of this research, Norman and Schmidt (2000) present a path model indicating the importance of the problem task in PBL and its relation with other variables of the PBL environment.

Nevertheless, up till now, limited empirical research has been conducted in this area. In their review, Albanese and Mitchell conclude that although the core of PBL is the use of problem tasks to focus learning: "little research has been conducted that will provide more than intuitive guidelines for development of problems" (1993, p. 72). Dolmans and colleagues refer to studies of Coulson and Osborne (1984), Shahabudin (1987) and Dolmans et al. (1993). They summarize that: "most studies investigating effective cases have focused on the relationship between student-generated learning issues and faculty objectives."(1997, p. 185). Although there is a growing interest in the influence of students' conceptions and perceptions on learning, it is surprising that none of the studies on problem tasks in PBL have tackled this issue from this perspective. This implies questions such as: "How do students conceive problem tasks?" "How do they experience the use of problem tasks?" "Which variables account for their conceptions and perceptions?" As Prosser and Trigwell state: "University teachers need to try to look at their designs through their students' eyes" (1999, p. 59). Also Birenbaum (2000) refers to a network of relations between perceptions and conceptions, both of which are influenced by individual characteristics, such as personality, attitudes, prior knowledge and learning styles. This paper focuses on the interrelations of a set of student characteristics within a PBL instructional context and its relations with students' conceptions and perceptions of problem tasks. The context is a second year course on information systems within a Business university program. Central elements are students' conceptions and perceptions and their relation with student attitudes, personality and learning style. Because problem tasks are the main driving forces for learning in PBL this research concentrates on this aspect of the learning environment.

The underlying research question is: "What is the link between students' individual differences and their conceptions and perceptions of problem tasks in a course in information systems?" The chapter first outlines the theoretical framework, followed by a description of the course in information systems. Next the method of data gathering is presented. Subsequently, the research findings are specified and interpreted. The chapter concludes with some implications for instruction and further research.

3.2 Students' individual differences and their conceptions and perceptions of problem tasks

PBL is frequently advanced as a powerful instructional approach that is engaging and leads to sustained and transferable learning (Bowden & Marton, 1998; De Corte, 1990; Mergendoller, Bellisimo & Maxwell, 1999). It is an instructional approach where learning is conceived as (a) an active, constructive process of the learner; (b) contextualized; (c) initiated by a cognitive stimulus; (d) a matter of extensive exercising in a variety of contexts; (e) and a social process. In this respect, PBL learning environments fit the constructivist principles of learning. This view of learning is expressed in the instructional principles that guide the practice of learning and teaching. The PBL students acquire knowledge and skills by handling authentic problems in small tutorial groups, coached by a tutor. On the basis of authentic problems, the students critically reflect on their prior knowledge and, as a result, develop their own learning objectives. Authentic refers to the cognitive demands of the problems tasks. The thinking required is consistent with the cognitive demands of the environment for which we are preparing the students (Savery & Duffy, 1995). By discussing with their peers the information gathered with respect to the learning objectives, the students elaborate their initial knowledge base. They test their ideas against alternative views and provide and receive reflection on both the content learned and the learning process.

Schmidt et al. (1995) conducted a study using structural equation modeling to clarify the relations between different instructional variables of a PBL environment and students' outcomes. The model is based on the students' perceptions of the different PBL variables. The key question was: "To what extent do the students' perceptions of the quality of a variety of PBL variables influence the students' learning outcomes?" The variables measured were the prior knowledge of the students and students' perceptions of the following variables: quality of the problems studied; tutor functioning; tutorial-group functioning, self-study time, interest in subject matter and learning outcomes. Students' perceptions were measured by means of student surveys. The variables were measured by a series of items. In figure 3.1 a graphical presentation of the model is given.

As indicated by the figures accompanying the arrows, the path coefficients indicate that the direct influence of the PBL-environment variables on learning outcomes is small. The findings suggest that the influence of the different PBL environment variables is a complex one, with the group functioning, the quality of the problems and the tutor performance having the most influence on other variables in the model. The research presented here elaborates on the variable problem tasks.

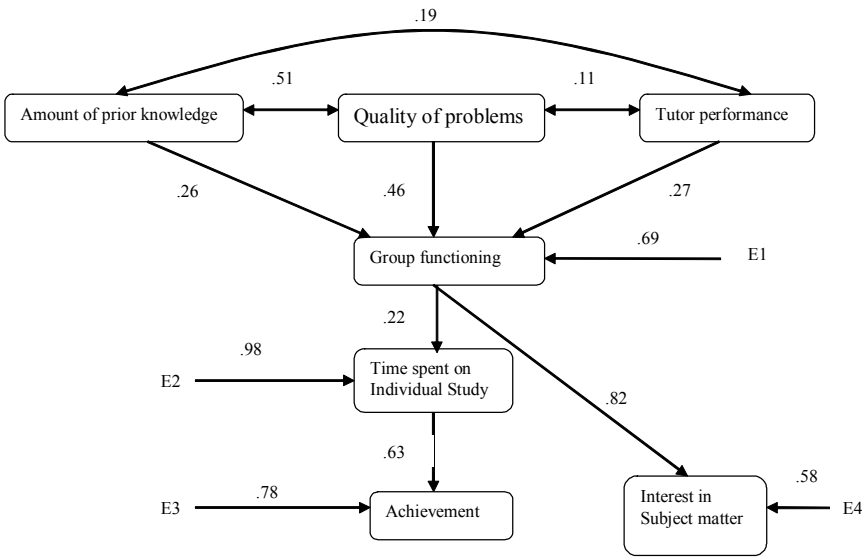

Figure 3.1: The influence of the PBL environment on learning outcomes

Prosser and Trigwell (1999) refer to a series of studies investigating the relation between conceptions of learning and their perceptions. They advocate that individual characteristics account for differences in students' conceptions and perceptions. The present study intends to explore some of these individual characteristics in the context of PBL and the problem tasks as a core element. The research focuses on the relation of the students' conceptions and perceptions with some student characteristics, specifically learning style, personality characteristics, commitment to PBL, attitude towards information systems and prior knowledge. Attention is also given to students' perceptions of the problem tasks within the course on information systems. The relations between the different variables are schematized in figure 3.2.

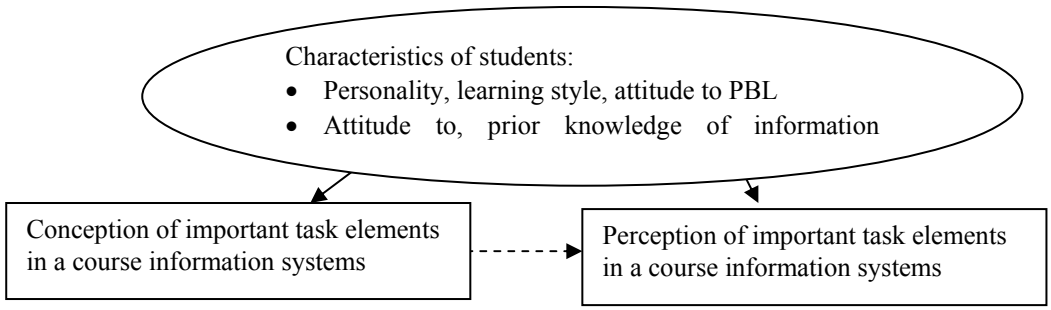

Figure 3.2: Student variables affecting students' perceptions of problem tasks

3.3 Students' conceptions

Conceptions can be described as the possible way in which learning, the learning environment and the subject matter studied can be construed or experienced. They refer to the way a phenomenon is valued within a specific context (Marton & Booth, 1997). To link the conceptions of important task elements with the person related and content related factors six research questions have been formulated. Relevant theoretical background supports each research question:

1. *How do PBL students conceive problem tasks as having a set of characteristics in order to drive learning?*

   The learning principles of constructivism (Savery & Duffy, 1995; Poikela & Poikela, 1997) and more general research on learning and cognition (Koschmann et al., 1994; Schmidt, 1993; Regehr & Norman, 1996; Boekaerts, 1997) have led to a set of principles for effective problem tasks. In addition, the analyses of the nature of today's problem situations have led to some characteristics being identified (Stoy, 1999). They can be summarized as follows: adapted to the students' prior knowledge and experiences; relevant to the future profession; integrated in a real-life context; having a relevant level of complexity; stimulating for self-directed formulation of learning goals; stimulating to search for information; stimulating to elaborate; and sustaining discussions on alternative views. The key question is: how do students value these different characteristics of problem tasks.

2. *How are students' conceptions of important task elements related to their learning styles?*

   Learning styles refer to students' preferences for particular kinds of learning activities. On the basis of a research review, Matthews (1991) concludes that researchers tend to agree that persons with some learning styles have a greater potential for success. Matthews argues that, among other factors, one reason for this difference in performance is that instruction more nearly matches the learning styles of those groups who find success. Gentry & Helgsesen argue that: "when given a choice, individuals prefer decisions situations and problem types that are consistent with their own learning style" (1999, p. 61). They used learning style information to improve the core financial management course. Prosser & Trigwell (1999) suggest that interrelations between students' conceptions, students' learning styles and students' perceptions of the learning environment may explain differences in learning outcomes.

In the research presented in this chapter, we used the Kolb concept of learning style as described in Osland, Kolb and Rubin (2001). The concept of learning style is associated with the successive stages in experiential learning: concrete experience, reflective observation, abstract conceptualization and active experimentation. Because the research focuses on problem tasks, the Kolb experiential learning model and his concept of learning style are considered as appropriate. Problem tasks stimulate students for a continuous transaction with the environment, as expressed in the problem task, on the basis of prior individual's experiences. Kolb uses two factors to describe the way persons perceive new experiences and process experiences. The scores on these two factors result in four basic learning styles: converging, diverging, assimilating and accommodating. The convergent learning style relies primarily on the dominant learning abilities of abstract conceptualization and active experimentation. The greatest strength of this approach lies in problem solving, decision-making and the practical application of ideas. The divergent learning style has the opposite learning strengths from convergence, emphasizing concrete experience and reflective observation. The greatest strength lies in imaginative ability and awareness of meaning and values. In assimilation, the dominant learning abilities are abstract conceptualization and reflective observation. The greatest strength of this orientation lies in inductive reasoning and the ability to create theoretical models, in assimilating disparate observations into an integrated explanation. The accommodative learning style has the opposite strengths form assimilation, emphasizing concrete experience and active experimentation. The greatest strength of this orientation lies in doing things, in carrying out plans and tasks and getting involved in new experiences. Because of differences in ways of learning, each with its own preference for dealing with problems, conceptions of different task elements could differ per learning style.

3. *How are students' conceptions of important task elements related to their personality characteristics?*

Prosser et al. (1994), as well as Biggs (1978, 1985), developed models of student learning. Both indicate the interaction between personality characteristics of the student, students' conceptions and perceptions of the learning environment, students' approaches to learning and their learning outcomes.

Within research, personality traits are measured in different ways, such as the big five, locus of control and self-efficacy. The big five incorporates five traits (Piedmont, 1998), based on Costa & McCrae, 1985): (i) agreeableness refers to a person's ability

to get along with others; (ii) conscientiousness refers to the order and precision a person imposes on activities; (iii) emotional stability deals with the inclination to maintain a balanced emotional state (e.g. calm, secure); (iv) extraversion indicates the person's comfort level with relationships; and (v) openness measures a person's rigidity of beliefs and range of interests. All these traits could influence the students' conceptions and perceptions of a problem task.

4. *How is students' commitment to PBL related to the conceptions of important task elements?*

   Commitment refers to the way a person has internalized certain values (Robbins, 2000). When students enter the University of Maastricht, they seldom have any experience with PBL as a learning and teaching approach. In the research reported, the students are second year students, having experienced PBL for more than one year. As described by Prosser and Trigwell (1999), these prior experiences may influence students' conceptions of the learning environment to a large extend.

5. *How is students' attitude towards information systems related to their conceptions of important task elements?*

   Attitudes can be described as a summation of emotions and feelings experienced over time. They are quite stable with moderate intensity. In contradiction with beliefs that have a high cognitive loading, attitudes have an important affective component (Gal & Garfield, 1997). There has been a vast amount of research in traditional educational settings on the nature and correlates of students' attitudes towards science (Helgeson, 1993). Also some research has been done in mathematics (McLeod, 1992). They all indicate a relation between students' attitudes towards the subject matter studied and student perceptions of the learning environment.

6. *How is students' prior knowledge about information systems related to their conceptions of important task elements?*

   It is known from ample research that prior knowledge plays a significant role in students learning. On the basis of a meta-analysis on research on prior knowledge, Dochy, Segers and Buehl (1999) conclude that generally prior knowledge has a positive effect on students' performance. Additionally, they argue that further research is necessary to understand the facilitating effect of prior knowledge in educational situations.

3.4 Students' perceptions

Perceptions refer to the way a student actually experiences his/her own situation. Own situation in this case refers to the way the tasks have been written. Similar to conceptions, the perception of the environment is influenced by individual characteristics, such as personality traits, prior knowledge, attitudes and learning style. Linking these aspects to the conception of tasks leads to a set of six research questions. They have a format similar to questions 1 to 6, so the same theoretical framework could apply.

7. *How do students perceive the problem tasks as implemented in a course on information systems?*
8. *How is students' learning style related to the perceptions of problem tasks as implemented in a course on information systems?*
9. *How are personality characteristics related to the students' perceptions of problem tasks as implemented in a course on information systems?*
10. *How is commitment to PBL related to the students' perceptions of problem tasks as implemented in a course on information systems?*
11. *How is the attitude to information systems related to the students' perceptions of the way problem tasks are implemented in a course on information systems?*
12. *How is prior knowledge related to the students' perceptions of the way problem tasks are implemented in a course on information systems?*

3.5 The Maastricht case: the information systems course

The course on information systems is an obligatory course in the second year of the International Business program at the Faculty of Economics and Business Administration at the University of Maastricht (FDEWB). The block deals with the role of information systems in an organization. Specifically, the way in which the introduction of information systems influences the structure and functioning of an organization. The technical aspects of information systems will also be dealt with. Also, the possibilities of new developments for organizations, such as enterprise resource planning systems, the Internet and electronic commerce, will be discussed. After the course students should have acquired insight in the possibilities modern information systems can offer organizations as well as in the difficulties and caveats inherent to the design, development and use of information systems.

When developing a course at FDEWB the following logistical constraints are relevant. A course lasts for seven weeks. Groups of about 13 students meet two times per week in sessions of two hours under the supervision of a tutor and work on the tasks in the

course book. Students are supposed to spend 16 hours on self-study per week. During a course students also attended a parallel course absorbing 20 hours per week. The seven weeks of instruction is followed by one week reserved for testing. The course on information systems contained about 24 problem tasks covering all the relevant topics. In figure 3.3 an example of a task is given.

Setting: Woodmac is a company that produces chain saws for wood cutting. At this moment the company's production facility and other departments are located in Aachen. The products are normally sold to German customers.

Going international (problem task)
During a management team meeting of Woodmac the following conversation could be observed.
Marketing manager: "We found out that our products are also used in the Netherlands and in Belgium. I think we should use this opportunity. We could use the global strategy "Domestic exporter" for the Netherlands. In Belgium we will open some sales locations." The production manager added: "To fulfill demand in Belgium we should build a production facility in Dinant." The general manager concluded: "Seeing this viewpoints I think we should decentralize as much as possible." The information manager follows the discussion with interest. He states: "I expect that our current information system is suitable to handle the export of products to the Netherlands. Regarding the locations in Belgium I think we should process the information in Aachen. "

Figure 3.3: Example of a task

During each session two tasks are analyzed, resulting in learning goals that are a guide for self-study. After the session students should study the relevant literature at home. Regarding the literature the students had to use either Turban et al. (1999), Information Technology for Management or Laudon and Laudon (2000), Management Information Systems. This is in line with PBL as it promotes using different sources of information. Furthermore, there was a compulsory reader and sufficient copies of other interesting books in the library. In the following session students report on their findings and apply the literature to the task. The course coordinator provided the tutors with a tutor guide with possible problem statements, a short analysis of the task and references to the relevant literature. The tutor guide is not given to the students. Assessment was done on the basis of a mark for the test with 80 true/?/false questions, a mark for participation during the meetings and a mark for a group paper about applications of information systems.

3.6 The data

To gather the necessary data for answering the research questions different approaches were used. On the basis of a literature study a questionnaire with 28 questions was developed to measure the relevant aspects of task. To measure learning styles, traits, commitment to PBL and attitude to information systems, frequently used and validated questionnaires were used. Prior knowledge was measured by just one question in the course evaluation. An overview of all the questionnaires used is given in table 3.1.

Table 3.1: Scales and their measurement

Scale	Instrument	Description
Characteristics of problems	Task Elements	A questionnaire based on a literature study.
Learning style	Kolb (1976)	A questionnaire with nine questions. Each question has four possible answers that have to be ranked. Based on the answers one of the four learning styles is determined.
Personality	Goldberg (2001)	This is a 50 item questionnaire with the subscales: extraversion, agreeableness, conscientiousness, emotional stability, openness
Commitment to PBL	Mowday, Steers, Porter (1979)	A questionnaire with 9 selected items. The original questionnaire was used to measure commitment to an organization. For the present research the word PBL replaced organization.
Attitude to information systems	Gal, Ginsburg, Schau (1997)	This is a 28 item questionnaire with the subscales: affection, cognitive competence, value and difficulty.
Prior knowledge about information systems		Prior knowledge is measured by one question in the course evaluation.

Except for the learning style questionnaire all questionnaires used a Likert scale. Twelve out of 32 groups were selected, resulting in a population of 149 students. At the beginning of the course students were asked about personality, learning style, commitment to PBL and attitude to information systems. In the last meeting the conception and perception of important task elements were measured. Because of students' absence in the first or the last session, missing values and the stratified approach to reduce the number of questions for the

students, the actual number of cases for correlation analysis is lower. To analyze the data the following techniques were used: ANOVA, factor analysis and, for correlation calculation, Spearman and Pearson.

We first studied which task elements are valued by the students as important. Only four items scored between 2.5 and 3, the others scored above 3. Indicating that students perceived almost all task aspects as important. All items were distributed normally.

The analysis of the students' learning styles is based on 94 cases, distributed as follows: diverging (51), assimilating (10), converging (15) and accommodating (19). The other descriptives of the students' characteristics are shown in table 3.2.

Table 3.2: Descriptives of the sample

Scale	n of items	Average	Standard deviation	Cronbach's alpha	n
Personality characteristics					
Agreeableness	10	36.2	6.55	0.83	129
Extraversion	10	39.5	4.62	0.77	131
Conscientiousness	10	35.0	5.95	0.77	130
Emotional stability	10	34.7	6.62	0.80	131
Openness	10	36.9	5.34	0.75	130
Commitment to PBL	9	36.1	8.82	0.84	51
Attitude to information systems					
Affect	6	28.1	6.09	0.82	50
Cognitive competence	6	28.3	5.79	0.78	50
Value	9	48.0	8.03	0.87	50
Difficulty	7	25.3	5.21	0.76	50
Prior knowledge	1	2.7	1.18	n.a.	105

3.7 The relation between students' individual differences and their conceptions and perceptions of problem tasks

The explorative study presented indicated students' conceptions as well as perceptions of the value of different problem tasks elements and the relation between a set of individual characteristics and their conceptions and perceptions.

3.7.1 Students' conceptions of problem tasks elements

To come to a set of characteristics of tasks (research question 1) a factor analysis was appropriate. The Kaiser Meyer-Olkin measure is 0.744. This indicated that the data are between middling and meritorious for doing a factor analysis (Kaiser & Rice, 1974, in Sharma, 1996, p. 116). The Principal Component Analysis was used to extract factors, the varimax with Kaiser Normalization to rotate factors, and the eigen value greater than one criterion was used to determine the number of factors. This resulted in seven factors see table 3.3.

Hair et al. (1998) provide guidelines for identifying significant factor loadings based on sample size. If the sample size is 120 then a factor loading of .50 is still significant. Because of explorative nature of the research smaller loadings were also accepted. However, no factor loading was lower than .43. We identified seven factors: motivation, guidance, solution orientation, framing, literature evaluation, uncertainty avoidance and self-direction. The reliability of the scales, in terms of the Cronbach alpha (α) is acceptable except for the last two factors, probably because of the low number of items.

The results of the factor analysis as well as the mean score of the items on scale (factor) level (sum of the item scores/number of items per scale) indicate that the students conceive the motivating aspect and the aspect of guidance as the two main task elements. Least important are the solution orientation and uncertainty avoidance.

Table 3.3: Task elements resulting from the factor analysis

Motivating (21% explained, α .76)							
Enough time to study the relevant literature.	**.74**	.18		-.11			.14
Based on real life situations.	**.69**			.32			
Reflects problems of the professional practice.	**.67**				.20	.23	
Highly motivating.	**.61**	.20	-.13		.12	.19	.21
Stimulates sufficiently self-study.	**.65**	.32	.10			.12	.47
Guidance (12% explained, α .76)							
Clear readability of language used in the task		**.78**	-.10	.24	.11		
Enough time to report in the tutorial group.	.49	**.59**	.10			-.15	
Invites search for problem-statements.	.28	**.56**		-.11	.15		
Enough cues to formulate learning objectives.	.52	**.54**	.14	.14			.26
Clear guidance to literature.	.15	**.50**	-.36				.19
Literature can be used to discuss the problems in the task.	.29	**.43**		.15	.18	-.29	.28
Solution orientation (6% explained, α .77)							
The situation is familiar to you.			**.79**	-.11		.13	
Presence of concrete questions in the task.			**.78**	.14	-.12	.13	
Much guidance by the title of the task.	-.10	.20	**.66**	.35		.25	
Has one single solution.		.13	**.53**	.47	.12	-.29	
Strict prescription what to do.		.43	**.46**	.12			-.17
Framing (6% explained, α .62)							
Clear linkage with other tasks.		.12	.19	**.66**		.25	-.10
Embedded in a case-description.	.13	.43	.18	**.56**		.12	
Correct application of the seven-jump.	.27		.13	**.53**		-.24	.28
Presence of the relevant terms in the task.	.50	-.25		**.52**	.17	.25	
Stimulates a good brainstorming.	.17	.45	-.34	**.48**	.23		
Literature evaluation (5% explained, α .60)							
Provokes extended search behaviour.		.17			**.70**	-.10	
Served to focus and summarize knowledge in the post discussion.	.21		-.14	.14	**.69**	.19	
Stimulates a critical evaluation of the literature.	.21	.49	.17		**.50**		.18
Uncertainty avoidance (4% explained, α .33)							
A lot of detailed information.			.15		-.12	**.73**	
Emphasis on a narrow range of specific subject objectives.	.12	.12	.16		.26	**.65**	
Self-directing (4% explained, α .29)							
Allows studying in different areas.	.23		-.18		-.10		**.80**
Manageable by the students themselves.	-.10				.49	.18	**.59**

3.7.2 The relation between individual differences and students' conceptions of problem task elements

Five individual characteristics were taken into account: the students' learning style, personality traits, commitment to PBL, attitude towards the subject matter studied and prior knowledge.

The first relation refers to learning style and conception (research question 2). Table 3.4 shows the scores of the different learning styles on the task elements.

Table 3.4: Conception of important task elements per learning style (n=93)

Task element	diverging	assimilating	convergence	accommodating	Total
Motivating	4.22 (.55)	4.16 (.60)	3.90 (.65)	3.98 (.68)	4.13 (.60)
Guidance	4.23 (.46)	4.17 (.41)	4.25 (.69)	4.07 (.64)	4.19 (.51)
Solution orientation	3.01 (.77)	3.14 (.99)	2.74 (.71)	2.72 (.78)	2.94 (.80)
Framing	3.68 (.55)	3.73 (.72)	3.52 (.54)	3.46 (67)	3.63 (.60)
Literature evaluation	3.71 (.70)	3.74 (.58)	4.00 (.57)	3.54 (.81)	3.71 (.69)
Uncertainty avoidance	3.09 (.80)	3.21 (.67)	3.25 (.68)	3.42 (.69)	3.19 (.75)
Self directing	3.74 (.65)	3.77 (.62)	4.00 (.62)	3.84 (.82)	3.79 (.67)

Concerning students' learning style a one-way ANOVA analysis indicated that there were no significant differences in conceptions between the different learning styles. This implies the way students conceive task elements, such as motivating is not related to their learning style.

The influence of the other four characteristics is analyzed using Pearson and Spearman correlations. The results are shown in table 3.5, in which some significant correlations can be found.

Table3.5: Conception of important task elements

Task element	**Personality characteristics**					**Commitment to PBL**	**Attitude to Information systems**				**Prior knowledge**
	Extra version	Agreeableness	Conscientiousness	Emotional stability	Open-ness		Affection	Cognitive competence	Value	Difficulty	
Motivating	0.19	-.08	0.19	0.01	-.06	0.01	0.33	0.18	0.10 **	0.22	-.11
Guidance	0.19	0.01	0.21*	0.07	0.04	0.36*	0.19	0.10	0.06	-.07	-.16
Solution orientation	0.13	-.17	0.10	0.07	-.26**	0.16	-.19	-.05	-.06	-.21	-.18
Framing	0.03	-.14	0.17	0.03	-.02	0.40*	0.17	0.19	0.29	-.06	-.08
Literature evaluation	-.03	0.07	0.17	0.16	-.00	0.06	0.07	0.23	0.17	0.04	-.08
Uncertainty avoidance	-.08	-.02	0.11	0.14	0.03	0.21	0.57**	0.61**	0.69**	0.43**	0.12
Self directing	0.14	0.23*	0.03	0.27**	0.03	-.08	0.28	0.28	0.31	0.16	-.03

* correlation is significant at the 0.05 level

** correlation is significant at the 0.01 level

Regarding students' personality traits (research question 3) there are four significant relations. The first relation is between agreeableness and self-direction. The more a student is able to get along with others, the more a task should give opportunities to be managed by the students themselves. Second, there is a significant correlation between conscientiousness and guidance. The more a student values order and precision, the more he values guidance as a task element. Thirdly, there is a relation between emotional stability and self-direction. The more emotionally stable a student is, the more a task should give opportunities to manage the learning process himself. The fourth relation is between openness and solution orientation. This correlation is negative, implying the more open students are concerning beliefs and interests, the less important they conceive the solution orientation of problem tasks. To conclude, although the correlations between personality and task elements are rather low, there are some indications that some personality characteristics do make a difference in the students' conceptions of task elements.

Beside personality traits, we explored the relation between students' attitude and their conceptions. We distinguished between attitude towards PBL as an instructional approach (research question 4) and attitude towards the subject mater studies (research question 5). Concerning commitment to PBL, as indicated by the correlation coefficients in table 5, the correlation with task aspects is low to moderate. There are two significant correlations regarding the commitment to PBL and tasks elements. First, the more PBL orientated a student is the more important guidance is. Students who have a positive attitude towards PBL indicate the necessity of guidance. Second, the more PBL oriented the student is, the more framing he indicates to be important.

Concerning the attitude towards the subject matter studied, the correlation between the scales of the attitude to information systems varies between low and high. Four correlations are rather high and significant. These deal with the four subscales: affection, cognitive competence, value and difficulty and the task element: uncertainty avoidance. This indicates that the more students like, have a positive opinion about, prefer and expect difficulties with information systems, the more certainty a task should give.

Finally, research question 6 dealt with the extent to which the students' prior knowledge of the subject matter studied, as estimated by themselves, is related to their conceptions of task elements. The Spearman coefficient indicated that the students' prior knowledge, as indicated by themselves, does not relate to the task elements. From this it can be concluded that different levels of prior knowledge do not result in different perceptions of task elements.

3.7.3 Students' perceptions of the problem task elements

Beside the students' conceptions of the value of the task elements, we asked them, after studying the course, how they had experienced the seven task elements (research question 7). Using the items of problem task conceptions questionnaire, students were asked to indicate how they had experienced the various task elements in the course on information systems they had studied. Subsequently, based on the factor analysis of the previous section the scores per factor were calculated. Table 3.6 shows the results.

Table 3.6: Descriptives of the perception scales (n = 114)

Task element	**Average**	**Standard deviation**	**Cronbach's alpha**
Motivating	3.08	.57	.60
Guidance	3.42	.56	.65
Solution orientation	3.05	.54	.62
Framing	3.16	.62	.68
Literature evaluation	2.96	.74	.63
Uncertainty avoidance	2.98	.70	.36
Self-directing	2.98	.66	.09

The reliability of most factors is acceptable, except for uncertainty avoidance and self-directing. The limited number of items per factor, namely 2, could be a reason for this. The scores on the scales are about 3, indicating an average score quality of the tasks. The guidance offered by the problem tasks is seen as the best task element.

3.7.4 The relation between individual differences and students' perceptions

Concerning students' learning style and perceptions of tasks (research question 8), we compared the averages for each task element per learning style. These averages can be found in table 3.7.

The results of the ANOVA analysis indicate that there are no differences in the scores per learning style per task element. This implies that students' perceptions of task elements, such as motivating and guidance are not related to their learning style.

Table 3.7: Perception of important task elements per learning style (n=93)

Task element	diverging	assimilating	converging	accommodating
Motivating	3.16 (.53)	2.97 (.66)	3.06 (.51)	2.95 (.62)
Guidance	3.44 (.53)	3.42 (.60)	3.28 (.69)	3.46 (.60)
Solution orientation	3.04 (.55)	3.12 (.67)	3.02 (.56)	3.02 (.42)
Framing	3.13 (.60)	3.06 (.73)	3.33 (.44)	3.27 (.68)
Literature evaluation	2.96 (.73)	3.10 (.71)	3.13 (.74)	2.78 (.84)
Uncertainty avoidance	2.88 (.66)	2.87 (.64)	3.20 (.82)	3.21 (.75)
Self-directing	3.05 (.64)	2.93 (.53)	3.20 (.54)	2.74 (.81)

For personality traits (research question 9), table 3.8 shows that the correlation with the students' perceptions of task elements is very low to low. There is one significant relation, this is between openness and literature evaluation. The more open a student is the lower a task scores on literature evaluation. So, students who are more open to different beliefs and a variety of interests, experience the problems tasks of the course as less inviting for evaluation of the literature than those who score lower on the openness personality scale.

Exploring the relation between students' perceptions and their attitude towards PBL (research question 10) and towards the subject matter studied (research question 11), the results do not indicate clear evidence. Commitment to PBL is very low to low correlated to the perceptions of problem tasks. None of the relations is significant. The commitment to PBL seems to have no influence on perception of problem tasks. For the relation between attitude towards the discipline of information systems and the students' perceptions, almost all correlations are negative. Two task elements have significant correlations. The task element, motivating, is negatively correlated to all the attitude scales. This indicates that the more affection, the more cognitive, the more value and the more difficult information systems is, the less motivating the tasks were. The task element, self-directing, is negatively correlated with three attitude scales. Thus, if students who are explicitly positive towards information systems have higher expectations they may be more disappointed afterwards.

Finally, we explored the relation between students' estimated prior knowledge of the subject matter studied and their perceptions of the task elements (research question 12). The correlation coefficients indicate that prior knowledge is very low to low correlated to the perception of the seven task elements. Two task elements are correlating significantly with prior knowledge. The first element is solution orientation, indicating that students with more

Table 3.8: Perception of important task elements

Task element	**Personality characteristics**					**Commitment to PBL**	**Attitude to Information systems**				**Prior knowledge**
	Extra version	Agreeableness	Conscientiousness	Emotional stability	Open-ness		Affection	Cognitive competence	Value	Difficulty	
Motivating	0.06	-.10	0.06	-.11	-.08	-.04	-.48**	-.52**	-.49 **	-.54**	0.05
Guidance	0.07	-.00	0.08	0.03	-.11	0.01	-.12	-.13	-.11	-.11	0.02
Solution orientation	0.10	-.09	0.02	-.03	0.07	-.14	-.04	0.01	-.03	-.08	0.26**
Framing	0.10	0.05	0.04	-.02	-.08	0.10	-.24	-.17	-.23	-.27	0.08
Literature evaluation	-.02	0.01	0.04	0.01	-.25*	-.07	-.33	-.32	-.30	-.33	0.21*
Uncertainty avoidance	-.01	-.04	-.09	0.12	-.05	-.13	-.07	0.04	-.07	-.09	0.13
Self directing	0.12	-.00	0.12	-.08	-.09	0.04	-.38*	-.40*	-.44**	-.33	0.11

* correlation is significant at the 0.05 level

** correlation is significant at the 0.01 level

prior knowledge perceive the tasks as more solution oriented. The second element is literature evaluation, indicating that students with more prior knowledge perceive the tasks as more suitable for evaluation of the literature.

3.8 Implications for instruction and further research

Seven important task elements could be distinguished which are in line with the literature. According to the students, motivating and guidance are the two most important elements. When writing tasks staff should take into account study time; real life situations; professional practice; language used; and the relation between literature and the problems. Regarding the characteristics of the students, it can be concluded that learning style and personality seem to have no relation to both conception and perception of important task elements. This could indicate that PBL does not favor a special learning style or personality of a student. Students' attitude to information systems is related to the conception of the task element, uncertainty avoidance. Although students have a positive attitude to the subject they still want to have less uncertainty. However, uncertainty avoidance is not related to personality. Students' attitude to information systems is negatively related to the perception of the task elements, motivating and self-directing. Students who have a negative attitude to information systems see the tasks as more motivating and more self-directing. This could be one of the goals of tasks, namely helping students who need extrinsic motivation. Students with a positive attitude already have an intrinsic motivation and see the tasks not as motivating.

The research was limited to uni-variate analyses; more advanced analyses could give more insight in the perception of tasks (e.g. using the conceptions of tasks to explain the perceptions of tasks). Tasks were considered as one group in this research. However, tasks differ individually. An analysis at the individual task level would be useful for more insight into task construction. The correlations gave indication that the content of a course matters in problem construction. Repeating this research in courses with another content could give more insight into the relevance of the course content. In this way more insight is obtained into the construction of task. Furthermore, other factors in PBL like the functioning of the tutor and the productivity of the group work could be related to students' characteristics.

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CHAPTER 4: INFLUENCE OF REDESGNING A LEARNING ENVIRONMENT ON STUDENT PERCEPTIONS AND LEARNING STRATEGIES[3].

4.1 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, have 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

[3] Nijhuis, J.F.H., Segers, M.S.R, Gijselaers, W.H., (2005). Influence of Redesigning a learning environment on student perceptions and learning strategies, *Learning Environments Research*, 8: 67-93.

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 the 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).

But students' approaches to learning are not only affected by factors such as instructional design and subject matter. 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?

4.2 Method

4.2.1 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.)

4.2.2 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 seven 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 4.1).

***Session 8: International Alliance**s*
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 4.1: Examples of a task in the ABL course format

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 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.

Based on 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 4.2 presents an example of a problem used within the redesigned course.

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 4.2: An example of a task in the PBL course format

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 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 4.1 summarizes the main differences between the original and the redesigned course.

Table 4.1: 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

4.2.3 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).

4.2.3.1 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.

4.2.3.2. 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 4.2 presents examples of items from different scales of the questionnaire measuring students' perceptions of the learning environment.

Table 4.2: Sample question and Cronbach Alpha reliability for each scale assessing the learning environment and test expectations

Scale	Sample question	Alpha reliability	
		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.

4.2.3.3 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 4.3 presents examples of items from different scales of the questionnaire measuring students' learning strategies.

Table 4.3: Sample question and Cronbach Alpha reliability for each scale assessing students' learning strategies

Scale	Sample question	Alpha reliability			
		ABL		PBL	
		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

4.2.4 Procedure

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

4.2.5 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 realised strategies to learning was conducted with a paired-sample test.

4.3 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 didn't attend either the first or last session, the number of paired cases was lower than the response rate in each of the sessions (Table 4.4).

Table 4.4: Response rates for the ABL and the PBL courses

Course	Enrolment	Response rate		
		First session	Last session	Paired cases
ABL	406	362 (89%)	314 (77%)	305 (75%)
PBL	312	243 (79%)	200 (64%)	196 (63%)

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.

4.3.1 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 4.5 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.)

Table 4.5: Descriptive statistics for each scale

Scale	No. of items	*N*	Minimum	Maximum	Mean	*SD*
Good teaching	6	509	6	29	18.6	3.70
Clear goals	4	597	4	20	13.4	2.98
Generic skills	6	593	6	28	19.2	3.67
Appropriate assessment	3	591	3	15	9.9	2.11
Appropriate workload	4	595	4	20	12.2	3.77
Independent study	6	588	6	25	16.7	3.06
Group members	6	595	8	30	20.9	3.16
Usefulness of the textbook	3	567	3	15	9.8	2.31
Deep testing	6	600	7	30	21.5	3.95
Surface testing	6	590	9	30	20.6	3.76
Deep strategy	7	585	12	35	23.0	3.42
Surface strategy	6	594	6	27	17.1	3.12

Number of valid cases = 456 from a course with 605 students.

The predictive values of the various models were tested by logistic regression analysis (Table 4.6). 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.

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 4.6).

Table 4.6: Logistic regression results with course as dependent variable for three models

Variable	Model 1		Model 2		Model 3	
	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	

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

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.

4.3.2. 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 4.7.

Table 4.7: Differences in learning environment, test expectations and actual learning approaches between ABL and PBL courses

Scale	Mean		*SD*		Difference		
	ABL	PBL	ABL	PBL	*t*	*p*	ES
Learning environment							
Good teaching	18.82	18.20	3.59	3.89	1.80	0.073*	0.15
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

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

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.

4.3.3 Beyond the model 2: The development of the students' learning strategies during the course

Table 4.7 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 4.8) show no statistically significant differences between the students on the two courses at the 5% level.

Table 4.8: Differences in expected learning strategies between ABL and PBL courses

Expected learning strategy	*N*	Mean		*SD*		Difference	
		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

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

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 4.3).

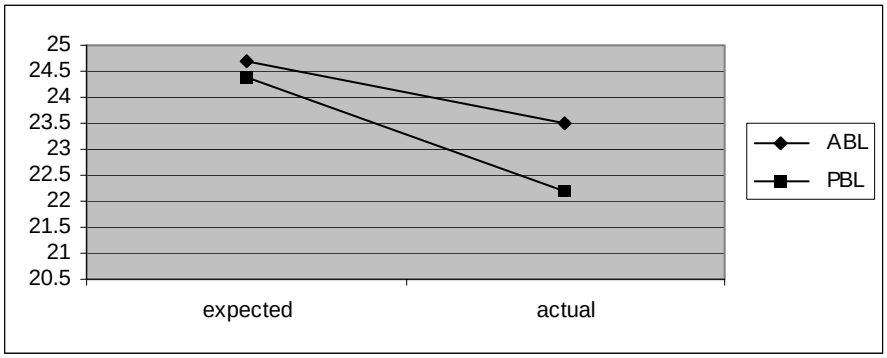

Figure 4.3: Expected and actual deep learning scores for the ABL and PBL course.

The paired sample test indicates a significant decrease in deep learning for both courses (ABL course, p = 0.000; PBL course, p = 0.000). 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 4.4 shows the different patterns in surface learning.

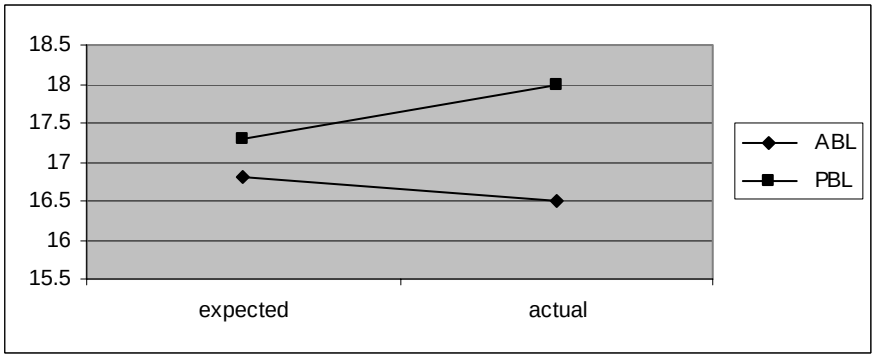

Figure 4.4: Expected and actual surface learning scores for the ABL and PBL course.

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.

4.4 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 didn't 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 & 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.

4.5 Practical implications

Implementation of innovative methods doesn't 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 didn't 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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CHAPTER 5: THE EXTENT OF VARIABILITY OF LEARNING STRATEGIES AND STUDENTS' PERCEPTIONS OF THE LEARNING ENVIRONMENT. A CLUSTER ANALYSIS[4]

5.1 Introduction

Since Marton and Säljö (1976) identified deep and surface approaches to learning, a lot of attempts have been made to influence students' levels of deep and surface learning. Marton and Säljö (1976) assumed that learning approaches are not stable psychological traits and that students adjust their approaches to learning, depending on the requirements of the task. Although, as Biggs (1993) suggests, students might have a predisposition to either deep or surface learning approaches in general, research has indeed shown that this preferred approach can be modified by the learning environment for individual courses or for particular tasks (Ramsden, 1984). Many researchers indicated that it is not the learning environment as such that influences the students' learning approaches, but it is students' perceptions of the learning environment that have these effects (e.g., Ramsden, 1988; Trigwell & Prosser, 1991; Sadlo & Richardson, 2003). In this respect, research has established several key elements of the perceived learning environment, such as: the quality of the teaching staff; the clarity of the goals and what is expected from the students; the kind of assessment; the workload; and the degree of choice students have in their work (Wilson, Lizzio, & Ramsden, 1997; Lizzio, Williams, & Simons, 2002). However, some studies (Gibbs, 1992; Vermetten, Vermunt, & Lodewijks, 2002; McParland, Noble, & Livingston, 2004) showed that there are limitations to the variability of learning approaches. A case in point is a study by Trigwell, Hazel and Prosser (1996) who describe a dissonant group of students whose learning is not influenced by the learning environment. They concluded that "It suggests (as may be expected) that many students see no particular influence of the environment on their approach to learning, and hence no influence on the quality of their learning." (p. 4). This finding would suggest that some students, or at least some groups of students, have rather stable learning approaches. Vermetten, Lodewijks and Vermunt (1999) support this notion and propose more research concentrating on differences between subgroups concerning variability of learning strategies. "Some students might be quite fixed in the use of learning strategies, whereas others might be quite flexible or versatile strategy

[4] Nijhuis, J.F.H., Segers, M.S.R, Gijselaers, W.H., (submitted). The extent of variability of learning strategies and students' perceptions of the learning environment. A cluster analysis.

users" (p. 17). As such, the stability versus variability question fits the topical trait versus state debate (Watkins, 2001). However, it is questionable to what extent students can be classified into the dichotomy, stable versus variable. Human behaviour covers a broader range than just two categories. The question can also be refined by focussing on groups of students with different levels of variability (e.g., low, medium and high). This leads to two interesting research questions. Firstly, can subgroups of learners be discerned with respect to variability in learning strategies? Secondly, if yes, considering the influence of students' perceptions of the learning environment on their learning strategies, to what extent do these subgroups differ in their perceptions of the learning environment? This study will address both questions.

5.1.1 Variability of learning strategies.

Variability in learning has been the focus of several studies, using different definitions of student learning. Some studies used Biggs' (1987) definition of a learning approach: a combination of a learning motive, indicating the reason for learning, and a learning strategy, indicating how students learn. Both concepts are closely correlated, and sometimes reported separately. Other researchers used Vermunts' (1998) definition of a learning strategy; regularly used combinations of learning activities. In the remainder of this study we will use the overall term learning strategy, indicating how students learn. Due to its overlap with learning approach it will also encompass this concept.

Two leading research designs can be identified with studies addressing the variability of learning strategies: between-students and within-students designs. The between-students research design focuses on comparisons between different groups of students in different learning environments (e.g., Nijhuis, Segers & Gijselaers, 2005; Vermetten et al., 2002). In these studies, the impact of a course re-design on learning strategies is analyzed. In the within-students research designs, researchers investigate the same group of students in different learning environments (e.g., Eley, 1992; Fazey & Lawson, 2001; Jones, 2002; Wilson & Fowler, 2005).

With respect to the between-students design, the study by Vermetten et al. (2002) is a case in point. They researched the effect of an educational reform project aimed at the improvement of teaching-learning processes. It was assumed that, by changing the learning environment, students would adjust their learning strategies. Changes in relating and structuring, and critical processing (deep learning) on the one hand, and in memorizing and analyzing (surface learning) on the other hand, were analyzed in nine different courses.

Relating and structuring increased significantly in one course, critical processing increased significantly in two courses. There was no significant improvement concerning surface learning. They concluded that the reforms largely failed to influence cognitive processing strategies. This finding may indicate the stability of learning strategies: that is, learners demonstrate stable learning strategies across different learning environments. However, a study by Nijhuis et al. (2005) showed variability in learning strategies when comparing students' learning in two different formats of the same course. The course was redesigned from a fairly well-structured format, with clear-cut questions, to a problem-based format, with unstructured problems. The results showed that, in the redesigned environment, students' levels of deep learning decreased and their levels of surface learning increased. These findings indicate variability of learning strategies. Additionally, it was shown that changes in learning strategies could be explained by changes in students' perceptions of the learning environment.

In summary, research studies comparing students in different learning environments report both stability and variability of learning strategies. However, these studies compared strategies to learning between different groups of students and therefore no conclusions can be formulated on the variability in learning of individual students.

In this respect, studies using a within-students research design offer interesting, although different, insights. For example, Eley (1992) researched the variability of learning strategies in a sample of about 150 second-year university students in four pairs of concurrent course units. The students' learning strategies and perceptions of the learning environment were analysed across courses and within students. He concluded that there were some, although small, changes in learning strategies within each pair of course units. Furthermore, changes in the perceptions of the learning environment were related to changes in learning strategies. Strangely, however, this pattern was not consistent for all students. In another study, Fazey and Lawson (2001) compared the learning strategies of a cohort of first-year students in two sequential courses: a traditional design and a design aimed at deep learning. There were no significant differences between the courses for either deep or surface learning. This indicated stability of learning strategies. By contrast, a study by Vermetten, et al. (1999) showed both stability and variability in learning strategies. They studied two cohorts of first-year Law students during courses of the Law Department in order to measure students' cognitive processing strategies. Memorizing (as part of a surface learning strategy) was the most stable over the courses. More variation was shown for relating and structuring (as part of a deep learning strategy).

Both Jones (2002), and Wilson and Fowler (2005) used within-students designs, but extended their analysis by comparing two groups of students, deep and surface learners. The research setting included two concurrent courses (one traditional course assumed to foster surface learning and one course promoting deep learning). Students were classified as deep or surface learners, based on a base-line measurement in the first week of the semester. Subsequently, in the last week, factual learning approaches in both courses were measured again. Jones (2002) reports that surface learners increased their deep strategy significantly more than the deep learners. Wilson and Fowler (2005) found that students in the typical deep learning group didn't report any significant differences in either deep or surface scales or on motive or strategy scales across the two courses. Students in the typical surface learning group only reported a greater use of deep strategy in the revised course. These studies indicate that subgroups, based on their habitual learning approaches, behave differentially regarding the degree of variability of learning. However, the groups were defined by the ratio of deep to surface learning, leaving open the question of how to group students on the basis of variability in learning approaches.

In summary, studies indicate that students show stability and variability in their learning strategies. The question can be raised whether this dichotomy in learning strategies is related to students' perceptions of the learning environment. In other words, can we explain why some students show a higher degree of variability in their learning strategies than others on the basis of differences in perceptions of the learning environment?

In order to maximize variability of learning, the present research will focus on learning strategies as part of learning approaches. This learning construct is considered to be closest to the learning environment and most likely to be sensitive to change (Curry, 2002). This leads to two main research questions:

1) Which subgroups of students can be discerned on the basis of variability in learning strategies?
2) How can these subgroups be described, in terms of variability of learning strategies, while taking the perceptions of the learning environment into account?

5.2. Method

5.2.1 Setting

Measuring variability in students' learning requires a research setting that allows the study of students in different contexts. These contexts should differ in such a way that they induce different levels of deep and surface learning. A suitable sample was found in the second year

of the International Business Programme in a university that uses Problem-Based Learning (PBL) as its leading educational approach. Second year students are very well acquainted with this approach. They have demonstrated that their academic capabilities are sufficient, as they all have successfully passed the first year (which has a selection function). International Business students study the obligatory second-year programme which contains, amongst others, the following successive courses: International Business Strategy, International Finance & Accounting, and International Marketing. These courses are a continuation of introductory business courses from the first year. The sample is suitable as, because of the obligatory element, the number of drop outs is limited. Furthermore, the sample includes the course Finance & Accounting. This is a topic that is characterized by relatively high surface learning and relatively low deep learning (Booth, Luckett, & Mladenovic, 1999; Eley, 1992). Finally, all courses use PBL, which implies that students will not experience any initial problems due to new instructional approaches.

PBL, as initially developed by Barrows and Tamblyn (1980), typically involves students working on problems in small groups of five to twelve, with the assistance of a faculty tutor. The tutor coaches the group by monitoring the group process and helping the students to identify the knowledge that is needed to resolve the problem. The general idea in all courses is that students work in groups, take great responsibility for regulating their own learning, and set their own learning goals (Gijselaers, 1996; Moust, Bouhuijs, & Schmidt, 2001). A course lasts seven weeks, with two sessions per week. After week seven there is a separate week for testing. In one session problems are analyzed, resulting in the formulation of learning goals, which guide the study of literature at home. In the next session, based on the theoretical framework developed through the literature study, the problems are analyzed in depth, solutions are discussed and the relevance of the theoretical framework for novel problems is argued. The planned workload for the course is about 20 hours per week. Parallel to the course, students have to attend a skills training course, which has a workload of another 20 hours.

Although PBL is the general approach at the faculty, individual course coordinators make modifications to adjust the course format to their own ideas. To understand learning in the different courses, it is necessary to know how the learning environment has been modified by the course coordinators. The second year starts with the course International Business Strategy which covers topics such as analysing economic regions, selection of countries in which to do business, and selection of the entry mode (e.g. export or a direct investment). The problems in the course are rather well structured; specific questions and

literature references are given to the students. The score for “clear goals” is thus expected to be high. The mandatory literature consists of an introductory textbook, probably resulting in an appropriate workload. Each session is chaired by two students, who also prepare a short presentation in which they report on the findings of their literature study. During the course, students each select a company from a set of companies to visit. Subsequently, 3 to 4 students work as a group to write a comparison. Both the presentation and the company visit give the students some choice in learning. Assessment is based on a multiple-choice exam, the quality of participation (including the presentation), and a group paper. Students have to achieve a minimum score for the multiple choice exam.

The second course is International Finance & Accounting. This course deals with topics such as relationships between international financial markets and exchange rates, valuation and consolidation of international investments, and international differences in financial statement analysis. The problems use authentic financial information from internationally operating companies. Tutorial groups have to derive their own learning objectives from the problems and no references are given to students for the problem. Although a list of chapters that has to be covered by the end of the course is given to the students, they will perceive the goals as fairly vague. Literature covers parts of four textbooks and several articles, probably inducing a higher workload for the students. Given the format of the problems and the lack of presentations or papers, there will be less choice in learning for the students. Assessment consists of a multiple choice exam.

Finally, the International Marketing course deals with marketing problems encountered when companies operate in international markets. Two parallel paths can be discerned, which are reflected in the problems for a meeting. The first problem in a session focuses on the marketing theory part and deals with topics such as globalization of the market, standardization versus adaptation, market segmentation, and international product management. It contains a short description of a situation, linked to a case study, which has to be read before the meeting. The literature for this part is a reader with articles; the sequence of the articles parallels the sequence of the problems. The second problem in each session deals with marketing research. The problem contains a short description of a phase in the market research process. The title of a task refers to the relevant chapter in the accompanying obligatory textbook. Groups of 3-4 students have to carry out market research, based on the discussions of the marketing research process in class. When analysing the results with SPSS, substantial knowledge of statistical techniques is required. The standard course evaluations show that the market research takes considerable time.

Assessment is based on a written exam (case analysis plus multiple choice questions), the market research, and participation. Students have to pass each part of the assessment. With respect to the perceived learning environment, the format of the problems, and the structure of the course, it is expected that students will know what they have to do, so goals will be reasonably clear. Furthermore, the market research will give students choice in learning; however it will also increase the perceived workload.

In summary, the three courses differ with respect to the format of the problems, the structure of the course, the degree of freedom in learning, and the workload. As a result, we expect that there will be sufficient variability in the learning environment to induce different levels of deep and surface learning.

5.2.2 Instruments

Students' deep and surface learning strategies were measured by using the learning strategy scales from the Study Process Questionnaire (SPQ) (Biggs, 1987). In this instrument the students' learning approaches are measured 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. Items can be answered on a fully anchored 5-point scale ranging from (1) disagree to (5) agree. One item in the surface strategy dimension was removed because it didn't fit into the PBL setting. The students' perceptions of the learning environment were measured by the Course Experiences Questionnaire (CEQ) (Wilson, Lizzio & Ramsden, 1997). The short version is the basis for our research. The items concerning the scale for generic skills were omitted as this is an outcome of the learning process, rather than an input for the learning strategy. Items concerning the independent learning scale were included because of its relationship to learning strategies and its role in PBL. These adjustments result in five indicators (scales): good teaching, clear goals, appropriate assessment, appropriate workload and independent learning.

5.2.3 Procedure

Both questionnaires were processed in the final session of a course. In that session some spare time is available, so no extra time investment by the students was needed. Because of its design, the research is dependent upon students' attendance in the session when the questionnaires are processed. In the present research, for one course not all tutorial groups were available for our research. Furthermore, students don't always show up in the final

session. About 370 students were present in the first session of the second year. From this group in the successive courses 317, 210, and 201 returned the questionnaires. However, useable data is available from more than 90% of the students who were present in a course's final session. Inherent to a within-students design, only cases with complete data sets are used, resulting in 124 cases. The split up of gender was 56% male, 45% female. The nationalities were distributed as follows: 70% Dutch, 12 % German, 18% other, mainly European, countries.

For the present research our subjects consisted of students who attended all three final sessions. This could form a select group, differing from students who attended only one or two final sessions, the so-called non-response group. Therefore, for each course, the learning strategies of the non-response students were compared with learning strategies of students who visited all the final sessions. There were no significant differences in learning strategies between the two groups. Accordingly, it was assumed that the sample was representative of the whole population.

5.2.4 Method of analysis

To analyse differences in learning strategies and learning environment perceptions across courses we will use ANOVA. Furthermore, regression analysis is used to determine relationships between learning strategies in different courses and relationships between the learning environments and learning strategies. In order to measure variability, we calculated the standard deviation for both deep and surface learning over the three courses.

In order to discern subgroups of students on the basis of the variability of both deep and surface learning, cluster analysis is used. Cluster analysis is a statistical technique which is commonly used in a variety of disciplines such as medicine, biology, and marketing. This technique has been used in educational research as well, although to a minor extent. For examples, see Vermetten et al. (2002), Long (2003), Lindblom-Ylänne and Lonka (1999), Entwistle, Tait and McCune (2000). Cluster analysis groups individual objects into clusters using a set of variables (Hair et al., 1998). This set is used to calculate the associations between objects. Grouping relies strongly on mathematical procedures and has no statistical foundation. Two categories of cluster analysis can be identified: hierarchical and non hierarchical, each having its own qualities. Following Hair et al. (1998), for the present study a combination of the hierarchical (for determining the number of clusters) and non hierarchical method (for fine tuning) was used. In order to estimate the number of clusters, the hierarchical procedure "Ward's method" is used. This method aims to define clusters

with about the same number of observations in each (Hair et al., 1998). Furthermore, it performs best at structure recovery in data where outliers are present. As a distance measure the Squared Euclidean Distance is taken, which gives good results with Ward's method. Subsequently, the number of clusters and the centroids of the clusters provided by the hierarchical cluster analysis are used in a K-means analysis for further fine-tuning of the solution.

One of the problems in empirical research is the detection of outliers. In cluster analysis this problem arises at two stages (Hair et al., 1998). Firstly, just as in other research methods, the researcher can look for extremes values before the analysis takes place. However, as variables are treated separately, no overall view can be distinguished. Several outliers together still could make a separate cluster. The second stage is after the analysis has been performed. An indication for an outlier is the cluster size. Widely varying or very small cluster sizes are reasons for further examination.

Subsequently, a mixed linear model (Twisk, 2003) allowing for multiple observations from the same student, was used to identify relationships between students' perceptions of the learning environment and their learning strategies. The mixed linear model assumes two effects, a random effect and a fixed effect. For the present research there is a random student effect and a fixed effect of the learning environment. All statistical methods we employ in this study are present in SPSS, version 12.0.1.

5.3. Results

This study is a search for subgroups of students on the basis of the degree of variability. We therefore started with the analysis at the course level, concentrating on differences in learning strategies and perceptions of the learning environment. Subsequently, the focus of the analysis is on the students, classifying them in subgroups.

How do students' learning strategies and perceptions of the learning environment differ across courses?

The effect of the course unit on learning strategies was explored by means of a one-way ANOVA (see Table 5.1). The learning strategy is the dependent variable; the independent variable was the course unit.

Table 5.1: Learning strategies for different business courses (n= 124)

	n of items	International Business Strategy	Finance & Accounting	Marketing	F
Deep learning	7	23.69 (3.18)	20.50 (3.74)	22.59 (3.20)	28.68***
Surface learning	6	16.27 (3.45)	18.42 (2.99)	17.22 (3.40)	13.59 ***

*** $p < 0.001$

There is an effect of the course unit on both deep and surface learning. Post-hoc comparisons between the means for deep learning of the three courses revealed that all means differed significantly ($p < 0.05$). All post-hoc comparisons concerning surface learning were seen to be significant ($p < 0.05$).

The effect of the course unit on perception of the learning environment was explored by means of a one-way ANOVA (see Table 5.2). Factors describing the learning environment are the dependent variable; the independent variable was the course unit.

Table 5.2: Students' perceptions of learning environments for different business courses (n = 125)

	n of items	International Business Strategy	Finance & Accounting	Marketing	F
Good teaching	5	16.31 (3.52)	15.94 (3.92)	16.71 (3.82)	1.33
Clear goals	4	14.11 (2.61)	12.88 (2.50)	13.22 (2.48)	8.09***
Appropriate assessment	3	10.48 (1.99)	10.86 (2.23)	10.64 (1.88)	1.06
Appropriate workload	4	14.29 (2.62)	10.08 (3.14)	9.58 (2.88)	102.00***
Independent learning	6	16.79 (3.04)	15.40 (2.78)	16.65 (3.12)	8.33***

* $p< 0.05$ **, $p < 0.01$, *** $p<0.001$

Students perceive several aspects of the learning environment significantly differently. Using a post-hoc analysis, the three courses have been compared pair-wise. Concerning the means for clear goals, the difference is caused by the high scores in the International Business Strategy course ($p < 0.01$). The means in the courses Finance & Accounting and Marketing do not differ on this aspect. Appropriate workload has the highest

score in the International Business Strategy course, thereby causing the differences in mean scores, as the score does not differ between the courses Finance & Accounting, and Marketing. Concerning independent learning, the course Finance & Accounting is different from the others ($p < 0.01$), being perceived as offering opportunities for independent learning to a lesser extent. For the two other learning environment elements, good teaching and appropriate assessment, the mean scores do not significantly differ across the three courses.

To find some indication of the variability of learning strategies across the different courses, and associations between them, Pearson correlation coefficients were calculated for each pair of courses (Vermetten, 1999). Deep learning in Marketing is significantly related to deep learning in International Business Strategy ($r = 0.37$, $p < 0.01$). Deep learning in Finance & Accounting has no significant relationships with the other courses. Surface learning across all three courses is significantly related, with coefficients ranging between 0.44 and 0.53 ($p < 0.01$). These figures could indicate that, at the group level, deep learning is more variable than surface learning.

Which subgroups of students can be discerned on the basis of variability in learning strategies?

To measure variability in learning strategies, the standard deviation over the three courses was calculated. This resulted in an average standard deviation of 2.86 for deep learning and 2.22 for surface learning. In Fig. 5.1 a scatter diagram shows the position of the cases with respect to the variability of both deep and surface learning strategies. As can be seen in the scatter diagram, some cases could be classified as outliers. However, due to the explorative nature of the research, these cases were still included in the sample.

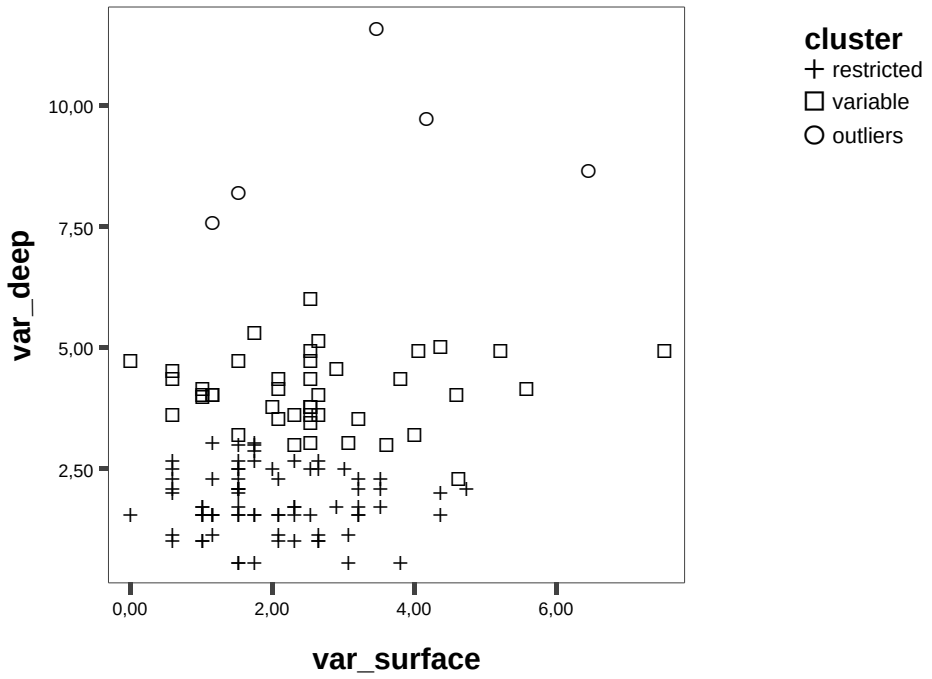

Fig. 5.1: Variability in surface learning and variability in deep learning (scatter diagram)

The hierarchical clustering analysis (Ward, Euclidean distance) revealed the following agglomeration figures for the successive numbers of clusters: (4) 201, (3) 260, (2) 382 and (1) 616. The sudden increase from 2 clusters to 1 cluster indicates that a two cluster solution might be appropriate for the sample. In this case the clusters' sizes are 51 and 73. To get a deeper insight in the final number of clusters, a three cluster solution was also examined. In this case the cluster sizes are 46, 5 and 73. The smallest cluster contains all the elements with a standard deviation for deep learning of more than 7 (see Fig. 5.1). This analysis shows that objects which might initially be classified as outliers form a separate cluster at the end. The cluster size is rather small, so it was not considered to be a third cluster and the two-cluster solution was preferred. However, the small cluster directed attention to another aspect of cluster analysis, the detection of outliers. The small size could indicate that the subjects in this cluster are possible outliers. Further analysis indicated that their variability in deep learning was caused by extreme high or extreme low scores for deep learning in some courses. In this respect the cases are not representative of the sample and were removed from the sample. To check the validity of the cluster solution, a split-file approach was used (Hair et al., 1998). The data file, without the outliers, was split up at

random in two groups. Each group was analyzed separately, revealing the following agglomeration figures for the successive numbers of clusters (4-1): (4) 47/63, (3) 64/83, (2) 107/121 and (1) 165/207 which resulted in a final number of two clusters for each group. This supports the two cluster solution.

Subsequently, a K-means cluster analysis was performed, setting the number of clusters to two and using the centroids from the hierarchical analysis as seeds. This analysis resulted in some changes in cluster membership. The final findings are presented in Table 5.3.

Table: 5.3: Differences in variability of learning strategies (average and standard deviation)

Learning strategy	Cluster 1 n = 43	Cluster 2 N = 76	t
Deep learning	4.09 (0.75)	1.81 (0.65)	17.4***
Surface learning	2.60 (1.49)	1.97 (1.00)	2.75**

** p< 0.05, *** p < 0.001

Cluster 1 (the variable cluster) is characterized by relative high variations in both deep and surface learning. Cluster 2 (the restricted cluster) is characterized by rather small changes in both deep and surface learning. Variability in both deep and surface learning differs significantly between the two clusters, indicating that both variables are relevant for clustering. A graphical representation of both clusters can be found in Fig. 1.

Analyzing the variable and restricted cluster

In order to gain a deeper insight into both clusters, the students' learning strategies, their perceptions of the learning environment and the relationships between both were compared: see Table 5.4.

With respect to the average level of learning, there is no significant difference in scores for deep and surface learning between the two clusters. Concerning the patterns students' learning strategies follow, there are two similarities. Firstly, the extent to which students employ deep learning strategies shows a similar pattern across the courses. The score for deep learning decreases from International Business Strategy to Finance & Accounting and increases from Finance & Accounting to Marketing.

Table: 5.4: Learning strategies across the courses, by clusters

	Cluster	Mean (sd)	International Business Strategy	Finance & accounting	International marketing	F
Deep learning	Variable	22.2 (4.2)	24.7 (3.4)	19.5 (3.9)	22.5 (3.7)	21.8***
	Restricted	22.4 (2.7)	23.1 (2.7)	21.5 (2.6)	22.6 (2.5)	7.3**
Surface learning	Variable	17.3 (3.8)	16.0 (3.7)	18.9 (3.6)	17.0 (4.0)	7.1**
	Restricted	17.5 (3.0)	16.5 (3.2)	18.3 (2.7)	17.5 (2.8)	7.1**

Secondly, this is also the case for the extent to which students employ surface strategies across courses: in the opposite direction, however, with an increase of scores from International Business Strategy to Finance & Accounting and a decrease from Finance & Accounting to Marketing. The F-scores indicate that there are significant differences across the courses for both deep and surface learning. A post-hoc analysis using Bonferroni revealed that all pair-wise comparisons for deep learning in the variable cluster differed significantly. The other pair-wise comparisons revealed that not all mean scores differed significantly. In the restricted cluster, the score for deep learning in the Finance & Accounting course differs significantly from the two other courses. For surface learning, the scores in International Business Strategy and in Finance & Accounting differ significantly, in both clusters. Thus, deep learning fluctuates more than surface learning in both clusters.

Concerning the perceptions of the learning environment, for each of the five elements the average score and, as an indication of variability, the standard deviation, were calculated. Subsequently, the two clusters were compared. The average scores for the learning environment factors didn't differ significantly. The variability in perceptions of the learning environment differed significantly ($p < 0.05$) for two factors; clear goals and appropriate workload scored showed more variability in the variable cluster.

Which learning strategies students employ does not only depend on the value of the perception of the learning environment, but also on the way the perception is internalized to the learning strategy. This is reflected in the regression coefficient, which has been calculated by using a linear mixed model. There are several significant relationships between elements of the learning environment and learning strategies: see Table 5.5.

Table 5.5: Comparison of the Pearson correlation coefficients between learning strategy and perception of learning environment (standard error) in the clusters

	DEEP LEARNING			SURFACE LEARNING		
	Variable cluster n = 43	Restricted cluster n = 76	t	Variable cluster n = 43	Restricted cluster n = 76	t
Good teaching	.28** (.10)	.07 (.05)	2.00 *	.12 (.09)	.11* (.05)	0.05
Clear goals	.62*** (.11)	.16* (.07)	3.53 ***	-.15 (.11)	-.10 (.08)	-0.37
Appropriate Assessment	-.01 (.17)	.08 (.09)	0.47	-.32* (.15)	-.11 (.10)	-1.19
Appropriate Workload	.42*** (.09)	.11** (.04)	3.15 **	-.17* (.08)	-.21*** (.05)	0.39
Independent learning	.47*** (.11)	.21*** (.04)	2.15 *	.12 (.09)	-.04 (.07)	1.44

* p <0.05, ** p < 0.01, *** p <0.001

In both clusters clear goals, appropriate workload and independent learning correlate with deep learning. Good teaching is only significantly related with deep learning in the variable cluster. In both clusters, only the perception of appropriate workload is significantly related to surface learning. Good teaching is significantly related to surface learning in the restricted cluster. Appropriate assessment only has a significant relationship with surface learning in the variable cluster.

A t-test was used to determine the significance of the differences in regression coefficients between the two clusters. The t values reveal that for deep learning, four regression coefficients are significantly higher in the variable cluster. For surface learning, the coefficients do not significantly differ between the two clusters.

5.4 Discussion

In previous research, the variability of students' learning strategies has been questioned as part of the trait versus state debate. Empirical research to find an answer to this question showed mixed results (Eley, 1992; Fazey & Lawson, 2001; Vermetten et al., 2002; Jones, 2002; Wilson & Fowler, 2005; Nijhuis, Segers & Gijselaers, 2005). The focus of the present research was on discerning groups, based on the degree of variability of learning strategies.

In this way it is possible to break through the usual split between stable versus variable learning strategies. For our analysis we used data about the learning strategies and learning environment perceptions of a group of second year international business students in three consecutive business courses.

Our research shows that, even with the same instructional approach (PBL), and within the same academic discipline (International Business), differences in learning strategies and perceptions of the learning environment can be observed across courses. Differences in the implementation of PBL, resulting in, for example, variation in workload, extent of independent learning, and guidance to the students, as well as differences in the nature of the subject matter of various courses under study, may influence students' learning strategies.

Grouping of students

Concerning the grouping of students on the basis of their variability in learning strategies (research question 1), two groups resulted from the cluster analysis: a "restricted" cluster and a "variable" cluster. Previous studies found stability and variability for both deep and surface learning, resulting in four possible combinations. The present research did find one group with low variability on deep as well as surface learning, and another group with higher variability on deep as well as surface learning. In the restricted cluster, variability for deep and surface learning is in the same range. In the variable cluster, variability for deep learning is higher than in surface learning. Taking the comparisons for deep and surface learning across the courses for both clusters into account (Table 5.4), we did not find a stable and a variable cluster. We did find two clusters with different levels of variability: a cluster with low variability and a cluster with high variability. A stable cluster was not observed in our data.

In the cluster analysis there was one small group of students which was kept separate till almost the end of the clustering process. Due to its size and its degree of variability, this group was classified as an outlier. The question of whether this subgroup should be included in the calculations remains. If this is the case, two options are open for dealing with this subgroup: firstly as a separate cluster; secondly as a part of another cluster. Because, in cluster analysis, the number of clusters and the definition of outliers are liable to subjectivity (Hair, et al., 1998), more research is needed to confirm the findings in this study.

Learning strategies and perception of the learning environment in the clusters

In order to describe the cluster in more depth (research question 2), learning strategies, perceptions of the learning environment, and the relationships between learning environments and learning strategies were compared.

With respect to learning strategies, both clusters showed the same pattern for deep and surface learning over the different courses. The groups are similar with regard to this aspect. However, the clusters do differ concerning the scores for learning in the Finance & Accounting course. Deep learning scores lower, and surface learning score higher, in the variable cluster than in the restricted cluster. This results in a higher variability for both surface and deep learning. The total average scores for both deep and surface learning don't differ significantly between the clusters. Although other studies (Jones, 2002; Wilson & Fowler, 2005) did find differences in variability of students' learning strategies, based on a grouping, in deep and surface learners, we found in our study that variability is not related to the level of deep or surface learning. In the present study we only used three courses; this is a limited set of courses. Future research could focus on other combinations of courses or other combinations of teaching formats.

Students' perceptions of the learning environment were researched in two ways. Firstly, there was a comparison of the factors covering the perceptions of the learning environment in the two clusters. The average scores for these factors did not differ significantly. This indicates that these aspects of the learning environment are not related to the differences of variability in learning strategies. The second comparison, focusing on the variability of these factors, revealed significant differences for two factors: clear goals and workload. Variability in these factors could result in variability of learning strategies as these factors are related to learning strategies (Wilson, Lizzio, & Ramsden, 1997; Lizzio, Williams, & Simons, 2002).

The analysis of the relationships between students' learning environments and students' learning strategies in both clusters resulted in two findings.

One finding was that there were several significant regression coefficients between both concepts. However, the patterns differ between the two clusters for both learning strategies. For deep learning, its relationships with good teaching, clear goals, and independent learning are in line with theory (Wilson, Lizzio, & Ramsden, 1997; Lizzio, Williams, & Simons, 2002). The relationship between appropriate workload and deep learning is not generally supported by empirical evidence; however it is confirmed by other research (Nijhuis et al., 2005). This relationship could be explained as follows: the less time

pressure there is for the students, the more time students have to make associations between topics (deep learning). In the restricted cluster, the relationship between good teaching and deep learning is missing. For surface learning, its relationships with appropriate assessment and appropriate workload are in line with theory (Wilson, Lizzio, & Ramsden, 1997; Lizzio, Williams, & Simons, 2002). The relationship between surface learning and good teaching in the restricted cluster is not as expected. Replications of the present study could answer the question of whether the pattern of relationships is just characteristic for the present sample or whether it can be observed in samples covering other disciplines.

Another finding was that three regression coefficients relating to deep learning are significantly higher in the variable cluster than in the restricted cluster. Thus, the same change in perception of the learning environment results in a bigger change in students' learning strategies for the variable cluster than for the restricted cluster. This is in line with the higher variability of learning strategies in the variable cluster. Our findings support the suggestion made by both Trigwell et al. (1996) and Vermetten et al. (2002); that some students are more influenced by the environment than others. Future research could pay attention to the reasons why some students are more receptive to the environment than others. When enhancing deep learning by changing the learning environment, the variable cluster seems to be the most fertile group. Changing deep learning in the restricted cluster seems to be less effective and other approaches, such as counselling, could be more appropriate. Our analysis of the regression coefficients was based on bi-variate relationships. Future research could concentrate on more complex models to correct for correlations between learning environment elements.

To conclude, the focus of this research was on variability of learning strategies. Using a within-students research design two clusters could be discerned: a variable cluster with high variation in both learning strategies and a restricted cluster with less variation. Variability in surface learning is related to variability in the perception of the learning environment. Variability in deep learning is related to both variability in perception of the learning environment and the effect of the learning environment on deep learning, expressed by the regression coefficient.

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CHAPTER 6: PUTTING IT ALL TOGETHER

6.1 What is happening?

The case study in the introduction of this thesis described some experiences of John, who works as a teacher at the University of Maastricht. Despite his intentions and attempts to enhance deep learning in his students, it does not always work out. Students react differently than expected by John and students differ from each other in their reactions, causing a muddled situation.

Indeed, education is a challenging business. Over many decades, educators have been busy designing courses in order to support students in their development towards becoming competent professionals. At first sight, educational work looks quite straightforward: defining the subject, collecting literature and choosing a specific work format. However, the educational world is far more complex. First of all, what we are aiming for has been changing over time. Looking at the demands of the workplace, growing emphasis is placed on graduates' skills in dealing with complex problems. Knowledge of the basic models and theories in a specific discipline is clearly not enough to be successful. The nature of the problems encountered at the workplace requires graduates, to a growing extent, to be able to look at them from different perspectives and to decide on actions to be taken by carefully balancing the various possible ways of seeing those problems. This requires handling and integrating various information sources and critically reflecting on them, in order to go beyond the factual information (ACNielsen, 2000; Porter & McKibbin, 1988). Or to put it into educational terms, skills are needed which are consistent with a deep approach to learning.

If this is the future workplace for our graduates, how can we as educators prepare our students? One solution is to design learning environments where tackling complex problems is the core learning activity. However, the question can be raised of whether this does guarantee that our students will react in the way we expect them to do and whether they will show deep approaches to learning. The answer seems to lie in the middle. Maybe it is yes, maybe it is no. Maybe it works with some students but will it work with others? Some students will probably appreciate this kind of learning environment more than others and are, therefore, more likely to adopt the learning approach we are aiming for. But, why are some students more positive than others about the learning environment?

In short the road between the design of learning environments and outcomes, in terms of students' approaches to learning, can be long and torturous if educators want to meet the demands of practice and of students. This thesis intends to contribute to the construction of a road map for educators by investigating factors that influence students' learning approaches.

6.2 What were we looking for?

The issue of learning approaches is clearly not new. Since the 1970s, various researchers have been studying the idea that learners differ substantially in the ways they approach learning and perceive the demands made of them in instructional settings. Different strands of research can be discerned. Some studies have focussed on the nature of learning approaches. In general, this has resulted in the identification of two approaches to learning: deep and surface approaches (Biggs, 1987; Entwistle & Ramsden, 1983; Marton & Säljö, 1979). Another strand focussed on the factors influencing learning approaches. Again, two main factors can be identified. Firstly there are student characteristics such as prior knowledge, age, gender, cognitive style (Sadler-Smith), and personality traits (Zhang, 2003). Secondly there is the learning environment in terms of, for example, workload, assessment (e.g. Wilson et al., 1997), department (e.g. Ramsden, 1997), and course design (e.g. Gibbs, 1992). Recent research emphasizes that it is not the learning environment that influences students' learning so much as its perception by the students (Prosser & Trigwell, 1999). As the perception of the learning environment is affected by student characteristics, it can be expected that these characteristics influence the learning approach both directly and indirectly. To date, however, there is hardly any empirical evidence of this.

Building on the idea of the existence of learning approaches, another strand of research addressed variability versus stability of learning approaches, focussing on the role of students' perceptions of the learning environment on their learning approaches. This research questions whether individuals prefer – or demonstrate – certain learning approaches, independently of the learning environment they are working in. Research suggests that when students are exposed to a particular context, they are indeed differentially responsive to the learning environment, according to their perceptions of the teaching and learning context and its requirements (e.g. Biggs, 1987; Entwistle, 1988; Meyer & Muller, 1990; Meyer et al., 1990; Ramsden, 1988, 1997). However, some studies (Gibbs, 1992; Vermetten et al., 2002; McParland et al., 2004) showed that there are limitations to the variability of learning approaches. Research results remain inconclusive, however. It is unclear how limitations to variability can be explained.

One of the aspects of the thesis was the variability of learning. Curry's (2002) hypothesis is that learning constructs closest to the learning environment are most adaptable to change. Biggs (1987) argues that a learning approach captures both students' motives (the reasons for learning) and students' strategies (the activities when engaging a learning task). With respect to variability, students' learning strategies are closest to their learning environments and therefore we focused on these strategies rather than on the approaches to learning. The different factors influencing learning strategies are depicted in figure 6.1.

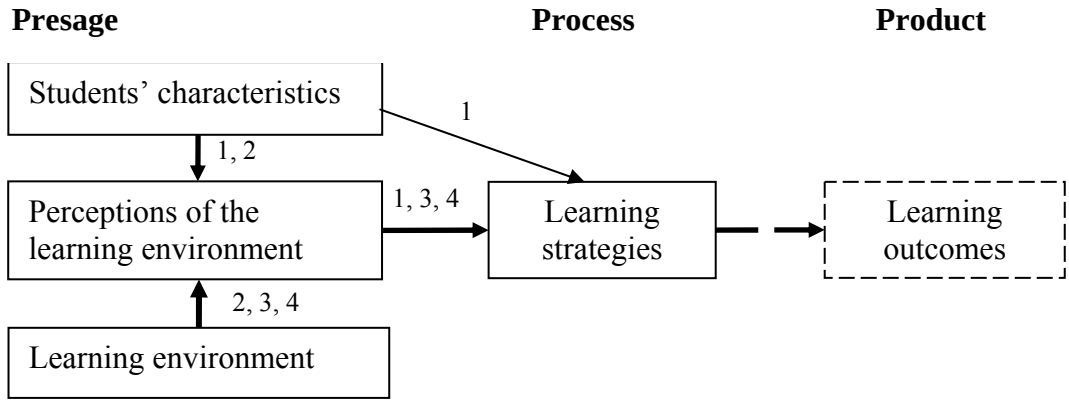

Figure 6.1 Model of student learning and the relationships under review

Our studies intend to contribute to the second and third strands of research, concerning respectively, factors influencing learning strategies and the variability of learning strategies. The next four research questions were addressed[5].

1. What are the separate and joint effects of both student related factors and environmental factors on learning strategies?
2. How are students' characteristics and their perceptions of the learning environment related? The research concerning the variability of learning strategies initiated two questions.
3. What are the effects of redesigning a learning environment in order to promote students' deep learning approaches? This setting offered us the possibility of studying to what extent students' learning approaches are variable when a learning environment is designed with the purpose of enhancing students' deep approaches to learning.

[5] The relevant relationships for each question are depicted in figure 6.1, by their question number.

4. Can different groups of students be identified with respect to the variability of their learning strategies and is this related to their perceptions of the learning environment? In order to develop a better grasp of variability, we used a within-students design for the latter research question, following a cohort of students within three successive courses.

As a setting for our research, we took students from the second year international business program of the University of Maastricht. The core instructional approach in this programme is Problem-Based Learning (PBL). The choice of this environment is not coincidental. Because of its central features, the PBL environment offers ample stimuli to students to adopt a deep approach: the students' learning is directed by the study of business problems from multiple perspectives. By discussing problems and the underlying concepts, theories and models in a small group, the differences between students' views of the problem can be made explicit, extending the individual's way of seeing.

6.3 The learning environment: Does it matter?

6.3.1 Yes, it matters

The results of our studies show that the learning environment influences students' learning strategies. In order to determine the influence of the learning environment on learning strategies, we started with an analysis of the relationships between students' perceptions of the learning environment and their learning strategies in one specific situation (Nijhuis et al., in press). It seemed that the perception of the learning environment, in terms of the clarity of the goals, the quality of the teaching, and freedom of learning, have a positive relationship with deep learning strategies. However, more freedom in learning also results in more surface learning. Another finding was that less appropriate assessment and a higher workload will also lead to more surface learning. These relationships are, of course, a promising result for educators seeking ways to influence students' learning strategies.

Next, by studying changes in learning environments, we introduced a dynamic aspect into our research. Firstly, we explored the influence of the learning environment on learning strategies by redesigning the format of a course (Nijhuis et al., 2005). This redesign was aimed at encouraging students to adopt a deep approach to learning. Compared to the original course (we called it an assignment-based learning environment), we used more authentic problem tasks where students had to find out about the problems, as well as finding the relevant information to tackle them by themselves. During the group discussion, sharing

various points of view was central, instead of the previous method of students presenting the collected information to each other. The assessment format changed from solely knowledge reproduction questions to a combination of knowledge reproduction and knowledge application questions. When measuring the students' learning approaches and comparing them with those of the students on the original course, we noticed that the students on the redesigned course even showed more surface and less deep learning than their peers on the original course. So, there was an effect, although not the intended one. How could this happen? Students' perceptions of the learning environment offered some interesting insights. 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. Secondly, we explored the relationship between students' perceptions of the learning environment and their learning strategies, looking at students' learning strategies across different courses (Nijhuis et al., 2006). The results showed that students' perceptions of the learning environment did differ between courses and that their learning strategies differed accordingly.

In short, the learning environment does matter and changes in learning environment result in changes in learning strategies. These changes can be different from those expected or aimed for. Students' perceptions of the learning environment seemed to play a role.

6.3.2 Yes, it matters, but.....

Although our studies indicate that the learning environment matters and that changes in learning environment lead to changes in students' learning strategies, this influence seems to be limited. We searched in two directions for a deeper understanding of variability of learning strategies; firstly, we focussed on other variables that might play a role, looking at certain characteristics of the students (Nijhuis et al., in press). Looking at the effects of students' characteristics, it seemed that students who are conscientious, meaning those who are goal directed, responsible and well organized, are inclined to adopt a deep strategy to learning. Students who are open to experience are also inclined to adopt a deep strategy and at the same time they are less inclined to use a surface approach. Moreover, the effects are both direct and indirect. Perceptions of the different aspects of the learning environment mediate the relationships between personality traits and learning strategies. The full model, taking into account personality traits as well as students' perceptions of the learning environment, explains 19% to 21% of the total variation in learning strategies. Secondly, we looked for differences within our sample of students with respect to the variability of their learning strategies (Nijhuis et al., 2006). The results of our study indicate that there are two

groups of students: one group that showed little variability in deep and surface learning strategies (the restricted group) and a second group, which showed more variability in both learning strategies. Although the groups did not differ in how they perceived the learning environment, the variable group seemed to be more sensitive to the learning environment than the restricted group. In both groups clear goals, appropriate workload and independent learning have a positive influence on deep learning and increasing the appropriateness of the workload will lead to less surface learning. However, the same change in the perception of the learning environment results in a bigger change in students' learning strategies for the variable cluster than for the restricted cluster.

So, as learning strategies are related to some personality traits, this relationship will limit variability in the use of learning strategies. Furthermore, there are students whose learning strategies are more variable than others.

6.4. One for all! Or, one learning environment for all students?

We can conclude from previous research that the learning environment is important for learning. However, although PBL is one learning environment for all students, students do not form a homogeneous group and may perceive the learning environment in different ways and accordingly could act differently to it. Where do these differences in perceptions come from? Several studies were helpful to us in finding an answer.

In one study (Nijhuis et al., in press), we related personality traits to perceptions of the learning environment. Students who are well-organized and goal-directed seem to perceive the goals in the problem-based course investigated as being clear. An explanation could be that these students, because they are so well-organized and goal-directed, are able to put the goals in perspective, and that they are, therefore, clearer to them. Extrovert students perceive the workload as more appropriate. They probably have more social contacts with peer students, as well as teachers, and are able, therefore, to cope better with the demands of the course. Students scoring high on openness perceive the assessment as being more appropriate. More appropriate assessment refers to staff concentrating more on understanding and less on reproducing facts. An explanation could be that open-minded students place more value on the demand for understanding, as they are more analytical themselves. The same relationships appeared for emotionally stable students - those who are calm, relaxed, self-confident and able to deal with stress. The question here is whether emotionally stable students can deal more effectively with the stress of assessment. Finally, agreeableness (the attitudes an individual holds towards other people such as being

compassionate, trusting, forgiving and soft-hearted) is positively related to appropriate assessment. A possible explanation could be that the perception is more concerned with the assessor (in this case the tutor) than the assessment as such. To conclude, differences in perceptions of the learning environment could be explained by differences in personality traits. However, the explanatory power of this model is limited.

In another study (Nijhuis, et al., 2004), we further explored the role of students' characteristics and their roles in students' perceptions. We measured two groups of characteristics. One group covered course independent variables: students' learning styles (defined as a trait), their commitment to problem-based learning, and their personality traits. Another group consisted of variables on the interface between the student and the course: the students' attitudes towards the specific field of science and their prior knowledge of the topic. Concerning the learning environment, we focussed on one central element in the PBL, i.e. the problem tasks. A striking result was that students' positive attitudes towards the field of science under study seemed to make them more critical in the sense that they perceived the problem tasks as less motivating and less stimulating of independent learning. In contrast, students who have more prior knowledge seem to be more positive in their perceptions of certain problem task elements. Students' commitment to PBL, their learning styles, and their personality traits, seemed to play a negligible role in explaining differences in their perceptions of the problem tasks. Thus, differences in perceptions of task elements could be explained by course discipline related variables.

In a third study (Nijhuis et al., 2006) we saw that students differed in the adaptability of their learning strategies to the learning environment. One group showed little variability in deep and surface learning strategies (the restricted group) and a second group showed more variability in both learning strategies. The differences in adaptability did not result in differences in perceptions of the learning environment.

In summary, students participating in a particular learning environment differ in their perceptions, which in turn can be explained by subject matter related factors. Students' characteristics play a minor role.

6.5 What are the implications for educational practice?

The different studies in this thesis indicate that the learning environment affects the learning strategies that students adopt. Thus, time and energy spent by educators on designing an appropriate learning environment to enhance deep learning can be fruitful. However, there are other consequences for educators.

First of all, given the importance of students' perceptions of the learning environment, explicit attention should be paid to how students perceive the various aspects of the learning environment. By employing various methods for student questioning, such as course evaluations, focus groups, and informal talks, it is possible to open the 'black box' of students' perceptions. The results of this questioning might be used to improve instruction. By taking an action research approach to course redesign, both scientific thinking and practical improvements can be combined. Furthermore, the results can inform teachers about how to support students in handling the requirements of a specific environment. For example, students' perceptions of a high workload might be addressed by helping them to plan the work to be done. In this respect attention should be paid to which factors contribute to the students' perceptions of a high workload.

Secondly, taking into account that a redesign might lead to more surface learning strategies instead of the expected changes towards deeper strategies, communicating and discussing changes in the learning environment with the students might help them to understand the rationale behind the redesign. This could stimulate them to adopt the expected deep learning strategies. This means that educators should open their 'black box' containing the ideas they have about education. For example, in one of our studies we changed the test demands from mere knowledge reproduction to a focus on knowledge application. We hypothesized that it might steer students towards deep learning. This did not happen. Moreover, when asking for their perceptions of the demands of the assessment, the students did not seem to observe the difference between the two assessment practices. The change, and the rationale behind it, was probably not clear to the students.

Thirdly, two student related factors seem to influence the variability of learning strategies. These are personality traits and adaptability to the learning environment. Concerning personality traits, two of them were relevant for learning: conscientiousness and openness to experience. Students scoring low on these two aspects have lower levels of deep learning. Apart from the learning environment, other ways should be considered to enhance their deep learning: for example, making these students aware of the influence of their personality traits on their learning strategies. The adaptability of learning strategies to suit the learning environment is another concern. Some students do not seem to be influenced much by the learning environment. Are they stubborn? Maybe not, but their learning strategies must be addressed in other ways, such as by counselling, training or specific courses. To help these students it first is necessary to identify them. This means that is necessary to measure several personal characteristics of each student. Such a measurement

could be embedded in a larger coaching program, beginning when students enter the university.

Fourthly, students seem to change their learning strategies according to the learning environment they participate in, and this differs from course to course. If we aim for students to adopt a deep approach to learning, courses within a program should gradually work towards this goal. This implies that the design of learning environments is not the concern of a single teacher, but of the whole group of teachers responsible for the various courses in the program. For example, students are confused if in one course they have to find literature by themselves, in order to stimulate independent learning and critical thinking, while in a preceding course the literature references were given to them. Thus, a common focus should be placed on continuity within the whole program.

Fifthly, the perception of the learning environment was not influenced by personality traits and other student related factors. This is a convenient finding as it seems that the educational system doesn't favour a special kind of student. That the perception of tasks is related to the attitude of students offers an opening for educators to working on these attitudes.

6.6 What is next?

Our research provided us with several answers and increased our understanding of students' learning. However, as may be expected, these findings give rise to new questions.

Firstly, one of the pillars of our research was the Biggs' 3P model (Biggs, 2003). Although this model is systemic by nature, we limited ourselves to bi-variate relationships. Future research could concentrate on the systemic aspect by, for example, researching the effect or influence of previous learning experiences on the learning strategies students adopt when entering a new learning environment. This would make it possible to explain students' learning not just by the characteristics of the present learning environment, but also by previous experiences. In this respect, an interesting question is via which mechanisms do previous experiences drive students' learning? Furthermore, one specific element of the learning environment, assessment, may play a decisive role determining students' learning approaches. The outcome of the assessment makes decisions about success and failure. An interesting line of future research is to investigate how students' appraisals of their former experiences with learning strategies, in terms of success and failure, influences their adoption of those learning strategies in a new situation.

Secondly, in this thesis we used Ramsden's Course Experience Questionnaire (CEQ) (Wilson et al., 1997) to assess students' perceptions of their learning environment, focusing on good teaching, clear goals, appropriate assessment, appropriate workload and independency in learning. Although assessment is taken into account, the questionnaire only focuses on staff's formative assessment (feedback) during the tutorials. The students' perceptions of the final assessment were not included. Taking into account the role of assessment in student learning, future research should pay more attention to students' perceptions of various aspects of the assessment practices, such as the amount of control they have in determining the method of assessment, the perceived cognitive assessment demands set by the test and the alignment of the assessment and instruction.

Thirdly, two aspects of PBL are interesting for further research. First, within PBL the usage of different sources of information is required in order to fully understand the problem under study. This is seen as an important stimulus for students to adopt a deep approach to learning. Energy and money is spent on finding appropriate textbooks and extra infrastructure is created to house these materials. It would be worthwhile to analyze in more depth the students' perceptions of the quality of the information sources offered to them. Second, in PBL, working in small student groups is central as it is expected that collaborative learning is more effective than individual learning. However, the role of the group in enhancing learning is not taken into account in the CEQ. On the basis of former research (Van den Bossche et al., 2004), it might be expected that certain group characteristics, such as psychological safety as perceived by the students, might play a role in the way students construct knowledge collaboratively. This implies that, given the focus on team learning, future research should take into account the students' perceptions of group processes and group characteristics.

Fourthly, in our studies we tried to explain students' learning strategies by considering their perceptions of the learning environment and their personality traits. Although we did find some promising results, not all of the variation could be explained. In the study on the perception of tasks (Nijhuis et al., 2004), we found that a student's attitude to the course was relevant to their perception of the learning environment. This variable, which is at the interface between student and course, could be interesting in explaining learning, as attitudes differ over courses and differ between students (e.g., Tempelaar & Nijhuis, in press). Courses are part of a larger entity, so the research could even be extend to higher levels of aggregation, such as the subject matter (Arbaugh, 2005; Biglan, 1973) or the department (Ramsden, 1997).

Finally, in our studies we showed relationships between the learning environment and learning strategies at the course level. Subsequently, changes in the learning environment were followed by changes in learning strategies. However, our findings are limited to the short term. More research, covering a longer period and focusing on learning strategies at the general level, rather than on the course level, could find the effect of an educational system at the curriculum level. This would mean longitudinal studies and a within students research design.

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SAMENVATTING (SUMMARY IN DUTCH)

Van hogescholen en universiteiten wordt verwacht dat zij studenten voorbereiden op hun toekomstige werkkring. Deze werkkring kenmerkt zich door o.a., complexe, ongestructureerde problemen waarvoor geen kant en klare oplossing beschikbaar is, verder dienen problemen vanuit verschillende perspectieven bekeken te worden. Dit betekent dat studenten vaardig moeten worden in: het verzamelen van informatie uit verschillende bronnen, het inschatten van de betekenis van deze informatie en in de integratie van informatie uit verschillende bronnen. Allemaal vaardigheden die betrekking hebben op een bepaalde vorm van leren, namelijk diepgaand leren. Dit in tegenstelling tot een andere vorm van leren, oppervlakkig leren.

Een van de meest gebruikte modellen om het leerproces van studenten te beschrijven is het 3P model van Biggs. Dit model bestaat uit 3 factoren: 1) De Presage of voorspellende factoren bestaande uit studentkenmerken en perceptie van de leeromgeving. 2) Het Process, of te wel de leersstrategieën, bestaande uit drie onderdelen, te weten, diepgaand leren, oppervlakkig leren en resultaatgericht leren. 3) Product, deze factor beschrijft de uitkomsten van het leren in termen van kwaliteit en kwantiteit van de opgedane kennis en tevredenheid met het leerproces. In dit proefschrift beperken we ons tot de Presage en Process factoren. De centrale vraagstelling in dit proefschrift betreft de vraag wat de directe en indirecte invloed van studentkenmerken en hun percepties van de leeromgeving is op de leerstrategieën die student hanteren. Om deze vraag te beantwoorden zijn vier onderzoeksvragen opgesteld die elk in een afzonderlijk hoofdstuk werden beantwoord.

Voor de beantwoording van de onderzoeksvragen zijn vragenlijsten afgenomen bij tweedejaars studenten Internationale Bedrijfskunde aan de Faculteit der Economische Wetenschappen, Universiteit Maastricht. In het tweede jaar is Probleem Gestuurd Onderwijs (PGO) de belangrijkste onderwijsvorm. Onderwijsgroepen bestaande uit ongeveer 12 studenten werken onder de begeleiding van een tutor aan taken. Deze taken bestaan uit een korte beschrijving van een situatie zoals de student in de latere werkkring tegen kan komen. De studenten analyseren deze situatie in termen van onderliggende principes en mechanismen door middel van een gestandaardiseerde procedure die als volgt werkt. In een groepsbijeenkomst bekijken de studenten welke mogelijke vragen de situatie oproept en welke kennis er ontbreekt om alle vragen op te lossen. Dit resulteert in het formuleren van leerdoelen. Vervolgens gaan de studenten uiteen en bestuderen zelfstandig aan de hand van deze leerdoelen de literatuur. Ten slotte komen de studenten, in een vervolg-bijeenkomst, weer bij elkaar om de gevonden resultaten te bespreken.

De eerste onderzoeksvraag (hoofdstuk 2) richtte zich op de vraag hoe percepties van de leeromgeving, persoonlijkheidskenmerken, afzonderlijk en gezamenlijk, gerelateerd zijn aan leerstrategieën van studenten. Om deze vraag te beantwoorden werd in twee opeenvolgende jaren data verzameld in een cursus International Business Strategy. Vervolgens werden vier pad-analyses uitgevoerd. De eerste pad analyse richtte zich op de relatie tussen percepties van de leeromgeving en leersstrategieën. Het bleek dat de duidelijkheid van de doelen, de kwaliteit van de docenten en de vrijheid in leren positief gerelateerd waren aan diepgaand leren. Een gebrek aan vrijheid in leren, toetsing gericht op uit het hoofd leren en een als hoog gepercipieerde werkbelasting waren relevante factoren voor de mate van oppervlakkig leren. De tweede pad analyse richtte zich op persoonlijkheidskenmerken en leerstrategieën. Uit deze analyse bleek dat studenten die zich kenmerken door nauwgezetheid en openstaan voor nieuwe ervaringen een grotere mate van

diepgaand leren toepassen. Verder bleek dat studenten die meer openstaan voor nieuwe ervaringen minder oppervlakkig leren toepassen. Vervolgens hebben we in een derde pad analyse gekeken of de perceptie van de leeromgeving verband hield met persoonlijkheidskenmerken. Alle vijf kenmerken die we in beschouwing namen, waren gerelateerd aan de vijf factoren die de percepties van leeromgeving kenmerken. Hierbij dient opgemerkt dat de verklarende waarde van dit model laag is. Ten slotte werden zowel persoonlijkheidskenmerken als percepties van de leeromgeving gezamenlijk aan leersstrategieën gerelateerd. De analyse hiervan leerde dat het gezamenlijke model een aggregatie was van de verschillende deelmodellen. Persoonlijkheidskenmerken waren zowel direct als indirect via de perceptie van de leeromgeving aan leersstrategieën gerelateerd.

Binnen Probleem Gestuurd Onderwijs spelen taken een belangrijke rol, zij zijn het startpunt voor het leerproces. Taken vormen een onderdeel van de leeromgeving en percepties daarvan kunnen van belang zijn voor het leren van studenten. Aangezien studenten in vele opzichten van elkaar verschillend zijn (presage factoren), kan worden verwacht dat ze op uiteenlopende wijze de taken percipiëren. De tweede onderzoeksvraag (hoofdstuk 3) richtte zich op student karakteristieken en hun percepties van taken. De percepties van taken werden gemeten aan de hand van de volgende kenmerken: motivatie, sturing, oplossingsoriëntatie, structurering, evaluatie van literatuur, onzekerheids-vermijding en zelfsturing. Voor dit onderzoek werden percepties van taken in een cursus Business Informatics gerelateerd aan twee soorten studentkenmerken. Ten eerste, cursus onafhankelijke variabelen, zoals persoonlijkheidskenmerken, leerstijl, en houding ten opzichte van probleem gestuurd onderwijs. Ten tweede, cursus gerelateerde kenmerken, zoals aanwezige voorkennis en vier variabelen die houding tot het onderwerp van de cursus bepalen. Deze vier variabelen zijn: affectie (positieve en negatieve gevoelens ten opzichte van het onderwerp), cognitieve competentie (houding ten opzichte van de kennis en vaardigheden), waarde (relevantie en nut van het vak) en de moeilijkheidsgraad. Het blijkt dat cursus onafhankelijke variabelen een verwaarloosbare rol spelen in het verklaren van verschillen in percepties van taken. Cursusafhankelijke variabelen spelen echter wel een rol. Alle vier factoren die de houding ten opzichte van de cursus bepalen waren van invloed op de mate waarin studenten een taak motiverend vonden. Houding speelt ook een rol bij de verklaring van verschillen tussen de mate van zelfsturing van taken. Hoe meer voorkennis studenten bezitten van de aangeboden leerinhoud, des te meer zij de taken oplossingsgeoriënteerde vinden, en meer gericht op de evaluatie van de literatuur.

De derde onderzoeksvraag (hoofdstuk 4) richtte zich op de vraag wat de invloed is van het herontwerp van een leeromgeving op de wijze waarop studenten de leeromgeving percipiëren en hun leerstrategieën. Om deze onderzoeksvraag te onderzoeken werd de onderwijsaanpak van de cursus Internationale Business Strategy veranderd. De oorspronkelijke aanpak in de cursus kenmerkte zich door het gebruik van afzonderlijke (dus niet aan elkaar gerelateerde) voorgestructureerde taken. Bij elke taak werd de te bestuderen literatuur voorgeschreven. De discussie over de taak en de literatuur vond plaats door middel van korte presentaties over de literatuur door twee studenten. De cursus werd afgesloten door een meerkeuzetoets. We omschreven deze aanpak als opdrachtgestuurd. De aanpak in de gereviseerde cursus kenmerkte zich door aan elkaar gerelateerde taken met een hoog authenticiteitsgehalte. Dit impliceerde een veel mindere mate van voorgestructureerdheid dan de taken in de opdrachtgestuurde aanpak. Daarnaast werd een gestructureerde procedure voor het analyseren van de taken gehanteerd (de zgn. zevensprong). De toets bestond uit een meerkeuze deel en een toepassingsgedeelte met open vragen. Deze aanpak was meer in overeenstemming met de ontwerpprincipes van het probleemgestuurd onderwijs en noemden

we daarom de probleemgestuurde aanpak. In beide cursussen werden de percepties van de leeromgeving en de leerstrategieën van de studenten gemeten. Uit de resultaten bleek dat het in de probleemgestuurde cursus (in vergelijking met de opdrachtgestuurde cursus) voor de studenten minder duidelijk wat er van hen verwacht werd, vonden ze de werkbelasting minder juist en werd de gebruikte literatuur als minder nuttig ervaren. De leerstrategieën die de studenten hanteerden in de herziene cursus waren, tegen de verwachting in, meer oppervlakkig leren en minder diepgaand.

De vierde onderzoeksvraag (hoofdstuk 5) betrof de vraag: Welke groepen van studenten kunnen worden onderscheiden op basis van de variabiliteit in leerstrategieën? En hieraan gerelateerd: zijn de verschillen in variabiliteit van de leerstrategieën gerelateerd aan verschillen in variabiliteit van de percepties van de leeromgeving? Om deze vragen te kunnen beantwoorden is de variabiliteit in leerstrategieën van studenten in 3 opeenvolgende cursussen berekend. Vervolgens is een cluster analyse gebruikt om groepen van studenten met verschillende niveaus van variabiliteit te kunnen onderscheiden. De analyse resulteerde in twee groepen. Ten eerste een groep gekenmerkt door lage variabiliteit in zowel diepgaande als oppervlakkige leerstrategieën (de 'beperkte' groep). Ten tweede een groep die bestond uit studenten met een hogere variabiliteit in beide leersstrategieën (de 'variabele' groep). Uit nadere analyses bleek dat de clusters verschillen in variabiliteit van de percepties van de leeromgeving. Studenten die meer variabel zijn in hun leerstrategie vertonen meer variabiliteit in hun perceptie van de helderheid van de doelen van een cursus en van de mate waarin de werkdruk haalbaar/reëel is. Verder bleek dat in het variabele cluster de perceptie van de leeromgeving een grotere invloed heeft op diepgaand leren dan in het beperkte cluster.

In het laatste hoofdstuk (hoofdstuk 6) worden de resultaten van de vorige hoofdstukken geïntegreerd en vergeleken. Gegeven de centrale onder-zoeksvraag namelijk de directe en indirecte invloed van studentkenmerken en hun percepties van de leeromgeving op de leerstrategieën die student hanteren, komen we tot de volgende bevindingen. Met betrekking tot de leeromgeving kunnen we stellen dat: 1) De wijze waarop studenten de verschillende elementen van de leeromgeving percipiëren is relevant voor het verklaren van de leerstrategieën die studenten hanteren. 2) Een herontwerp van de leeromgeving resulteert in wijziging in de perceptie van de leeromgeving en van leerstrategieën. 3) Binnen een onderwijssysteem, namelijk Probleem Gestuurd Onderwijs, percipiëren studenten cursussen als zijnde verschillende leer-omgevingen en verschillen de door hen gebruikte leerstrategieën. Met betrekking tot de studentkenmerken blijkt uit onze studies, dat: 1) Er is een direct effect van de mate van openheid voor nieuwe ervaringen en de mate van nauwgezetheid van werken op de leerstrategieën van studenten. 2) Alle (gemeten) persoonlijkheidskenmerken spelen indirect via de percepties van de leeromgeving een rol voor de leerstrategieën. 3) Studenten verschillen in de sterkte van de relatie tussen hun perceptie van de leeromgeving en diepgaand leergedrag. Ten slotte met betrekking tot studentkenmerken en de perceptie van de leeromgeving vonden we dat: 1) Persoonlijkheidskenmerken wel gekoppeld zijn aan perceptie van de leeromgeving, maar slechts een beperkte verklarende rol hebben. 2) Persoonlijkheidskenmerken, leerstijl en houding ten opzicht van PGO geen rol spelen in de verklaring van de percepties van taken. 3) De cursusgerelateerde studentkenmerken, houding ten opzichte van de cursus en voorkennis met betrekking tot de inhoud van het blok spelen echter wel een rol voor de verklaring van de perceptie van taken.

Uit het onderzoek blijkt dat er relaties bestaan tussen de perceptie van de leer-omgeving en de door de studenten gehanteerde leerstrategieën. Dit impliceert dat het is zinvol om tijd, geld en energie te investeren in het ontwerp van een leeromgeving gericht op het stimuleren van diepgaand leren. De resultaten uit onze studies indiceren dat het van belang is om rekening te houden met de percepties van studenten. Systematische programma-evaluaties om de kwaliteit van het onderwijs te monitoren zijn noodzakelijk maar niet voldoende. Het is gewenst dat docenten bij de introductie van nieuwe methoden voldoende aandacht besteden aan een dialoog over de ratio achter de nieuwe onderwijsmethode en wat dit concreet impliceert voor docenten en studenten. Dit verhoogt de acceptatie van de nieuwe aanpak door de studenten. Is op deze wijze de garantie ingebouwd dat diepgaand leren wordt bevorderd? De resultaten uit onze studies laten zien dat de invloed van de leeromgeving om diepgaand leren te bevorderen beperkt is. Persoonlijkheidskenmerken, een stabiel kenmerk van de student, bepalen eveneens de leerstrategieën. Verder zijn sommige studenten weinig tot niet gevoelig voor de leeromgeving. Daarenboven, aangezien leeromgevingen per cursus kunnen variëren, zullen ook de leerstrategieën die studenten in deze verschillende contexten hanteren, variëren van meer oppervlakkig naar meer diepgaand. Dit impliceert de expliciete afstemming tussen de opleidingsonderdelen van de wijze waarop leeromgevingen worden vormgegeven, om een eenduidig signaal naar de studenten over te dragen. Ten slotte, percepties van de leeromgeving zijn weinig tot niet gerelateerd aan de persoonlijkheidskenmerken van de student. Dit betekent dat de kenmerken van een leeromgeving bepaalde (persoonlijkheids-) typen van studenten niet bevoordelen of benadelen. Onze studies indiceren dat de attitude tot het onderwerp van de cursus daarentegen wel gerelateerd is aan de perceptie van de leeromgeving door de studenten. Het bevorderen van een positieve houding door expliciet aandacht te besteden aan de relevantie van de leerinhouden kan bijdragen tot een meer positieve perceptie van de leeromgeving.

CURRICULUM VITAE

Jan Nijhuis was born in De Lutte, The Netherlands, on November 9th, 1957. As a pre-university education he attended the comprehensive school Marianum in Groenlo from 1970-1976. In 1983 he graduated at the Faculty of Economics and Business Administration, RijksUniversiteit Groningen, with a major in logistics and operations management. Subsequently, he fulfilled his military service as a subaltern officer in the Royal Air Force. In 1984 he accepted a position at the Hanzehogeschool in Groningen, school for vocational business training. He was an instructor in organization, finance and logistics courses. Since 1987 he is affiliated to the Faculty of Economics and Business Administration, University Maastricht, department of Organization and Strategy. During the past twenty years he has been involved in many educational activities at the department. He was coordinator of both bachelor and master courses in the field of organizational science, strategy and logistics. Furthermore, he was responsible for the tutor planning and assignment of master thesis supervisors. Finally, he was the administrator of a database with test-items. In 2001 he started a research project on student learning in collaboration with the department of Educational Research and Development which resulted in several publications and this PhD thesis.

Jan Nijhuis is geboren op 9 november 1957, in De Lutte. De middelbare schooltijd bracht hij van 1970 tot 1976 door aan de scholengemeenschap Marianum in Groenlo. In 1983 studeerde hij af aan de Faculteit der Economische Wetenschappen van de Rijksuniversiteit Groningen, met als specialisatie logistiek en productiemanagement. Vervolgens vervulde hij zijn militaire dienstplicht als toegevoegd officier bij de Koninklijke Luchtmacht. In 1984 werd hij docent aan de HEAO in Groningen en verzorgde onderwijs op het gebied van organisatie, financiering en logistiek. Sinds 1987 is hij werkzaam bij de Faculteit der Economische Wetenschappen van de Universiteit Maastricht, vakgroep Organisatie en Strategie. Gedurende de afgelopen 20 jaar was hij betrokken bij een groot aantal onderwijsactiviteiten van de vakgroep. Hij was coördinator van in zowel bachelor als master cursussen op het gebied van organisatie, strategie en logistiek. Verder was hij verantwoordelijk voor de tutorplanning en stage- en scriptiecoördinator. Ten slotte beheerde hij een database met testvragen. In 2001 startte hij een onderzoeksproject naar het leren van studenten in samenwerking met de vakgroep Onderwijsonderzoek en onderwijs-ontwikkeling. Deze samenwerking resulteerde in verschillende wetenschappelijke publicaties en dit proefschrift.

Oet ‘n book leer iej aai wat; al wa ’t mer da-j better ’n aander hadden können kopen. (Twents spreekwoord)