Conceptualization of Pedagogical Content Knowledge

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Abstract： This study examines the effects of teachers' conceptions of learning and teaching and student characteristics (gender, prior education, age, academic motivation, personality and conceptions of learning) on students' learning strategies in higher education by means of multilevel analysis.   In this study 2,003 students from eight different professional bachelor programmes and their teacher teams participated. The study reveals that qualitative differences in regulation and processing strategies can be directly explained by student characteristics and teachers' conceptions of learning and teaching. For instance the importance of external regulation in learning within teachers' conceptions is related with the presence of unregulated student learning. Implications for further research and practice are discussed.
Keywords: teaching approaches, learning approaches, higher education, teacher beliefs, learning strategies

Introduction

There is a vast body of knowledge regarding to student learning in higher education. Especially in the domain of studies of learning styles or approaches important findings have emerged concerning the ways students engage in learning. Studies have been undertaken dealing with cognitive aspects of learning (Sadler-Smith, 1996), conceptions of learning and teaching and specific learning strategies (Säljö, 1979), aspects of self-regulation and metacognition (Zimmerman, 2001) and motivational aspects of learning (Pintrich *et al.*, 1993). In many of these studies relationships were investigated between several of these aspects. This has led to multiple definitions of how learning styles should be conceived (for a review see Jonassen & Grabowski, 1993). In the Netherlands, Vermunt (1998) has carried out research aimed to integrate many of the indicated aspects of learning within one learning style model. In Vermunt's model, learning styles are viewed as a coherent unity of learning activities which students are used to develop, the ways they regulate their learning processes, their conceptions of learning and teaching (mental learning models) and their learning orientations. Based on qualitative research Vermunt (1998) developed the 'Inventory of Learning Styles' questionnaire (ILS) which enabled to analyse four distinct learning styles among students in higher education: meaning oriented, reproduction oriented, application oriented and undirected. These learning styles can also be related to other approaches to learning (for a review see Vermunt, 1998). In order to avoid misunderstanding about learning styles as fixed 'traits', Vermunt (2005) recently uses the term 'learning patterns'. In several international studies empirical evidence was found that individual differences are found among learners using the ILS (Vermetten *et al*., 2002; Boyle *et al.*, 2003).

Many researchers indicate that student learning is affected by student characteristics. Personal influences such as age (Vermunt, 2005), gender (Severiens & Ten Dam, 1997), prior education (Vermunt, 2005), personality traits (Busato *et al.*, 1999) are understood to explain in an important extent the variance in learning strategies. However not only personal factors but also factors in the learning environment can have an influence on how students engage in learning (Donche & Van Petegem, 2006). Course-level factors such as for instance teaching qualities, study load, the quality of assessment could possibly give raise to more explanation to better understand the individual differences in learning of students in higher education (Entwistle *et al.,*2003). Learning patterns are in this respect not viewed as an invariant attribute of students but as the result of an interplay between personal and contextual variables (Vermunt, 2005). In this line many studies have been carried out to underline the relative changeability of learning strategies and learning patterns (Busato *et al.*, 1998; Vermetten *et al.*, 1999).

Research on teaching approaches or styles showed that students' approaches to learning are influenced by the way teachers teach (Entwistle et al., 2003; Entwistle & Ramsden, 1983; Kember & Gow, 1994; Prosser & Trigwell, 1999). Former findings have indicated that a surface approach of learning is more frequently used within learning environments which are characterised by heavy workload, few autonomy in learning and in which stepwise learning is supported regarding to the use of assessment forms. A study of Kember and Gow (1994) has indicated that the way teachers think about learning and teaching and the way they approach teaching in their own practice are associated with students' approaches to learning. In this study it was found that departments in which a knowledge transmission model of learning and teaching dominated, students undertook in a lesser extent a deep approach to learning. Departments in which learning processes of students are put more central, appeared to have more learners who apply in a lesser extent a surface approach to learning.

Although these studies have indicated that a relationship is present between learning approaches and teaching approaches, other studies point at problematic relationships within the constructs of learning and teaching approaches. In literature it is indicated that a clear relationship between conceptions of teaching and teaching strategies is problematic (Entwistle et al., 2003; Fang, 1996). Several studies showed different results. For instance Kember and Kwan (2000) found in a qualitative study similarities between teachers' learning content oriented conceptions of learning and teaching and teaching strategies which supported a knowledge transmission model. A similar relationship was found among teachers who had process-oriented conceptions of learning and teaching strategies directed to support student learning. In survey-studies and observation-studies, it was found that less coherence and logical relationships appear between related conceptions and teaching strategies (Bolhuis, 2000; Roelofs & Visser, 2001) which points at the presence of disjunctions and inconsistencies on the level of teaching approaches (Murray & McDonald, 1997). Parallel findings concerning the mismatch or dissonance between similar conceptions of learning and teaching and learning strategies has also been found within the concept of learning styles (Vermunt & Minnaert, 2003). The presence of 'dissonance' on the level of

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learning approaches and 'disjunctions' on the level of teaching approaches can be related to personal and contextual factors. Therefore it is important that in studies examining relationships between learning approaches and teaching approaches attention is given to (1) the possibility of inconsistencies between conceptions and strategies both on the level of students and teachers and (2) the presence of possible mediating effects of student characteristics such as gender, personality traits or prior education and contextual factors (e.g. curriculum and year group) on student learning. In the present study we take a first step in this direction by examining whether teachers' conceptions of learning and teaching do have an explanatory power regarding to students' learning strategies when different student characteristics are controlled for. Student characteristics selected in this study are based upon empirical studies who have often investigated separately the explanatory value of students' gender, age, personality traits, prior education, motivation and conceptions of learning in models explaining differences in students' learning strategies (Busato *et al*., 1999; Donche, 2005, Vallerand et al, 1999; Vermunt, 1998). The following research questions were investigated:

(1)   To what extent are differences in students' learning strategies present?

(2)   To what extent do student characteristics explain differences in learning strategies?

(3)   To what extent do teaching conceptions explain differences in learning strategies after control for the possible effects of student characteristics?

METHODOLOGY

First-year, second-year and third-year students from 8 different three-year professional study disciplines in higher education in Flanders (Dutch speaking part of Belgium) participated in this study. Eight study disciplines are involved: social work, communication sciences, journalism, electro-mechanics, hotel management, office management, business management and teacher education. 2.003 students participated, the overall student response rate was 70%. Based upon discipline and year of study, students were nested into 24 classes or student groups. The teacher population of all involved disciplines was also questioned. 176 teachers participated, the overall response rate was 77.5%.

1.1 Instruments, scales and variables

1.1.1   Surveys

Students and teachers completed surveys during two consecutive academic years. Third-year students completed surveys in the first year. Second-year and first-year students and teachers completed surveys in the second year.

1.1.2   Measures

1.1.2.1 Student level

Students' regulation and processing strategies were assessed with six scales from the self-report questionnaire 'Inventory of Learning Styles' (ILS; Vermunt, 1998). Three scales representing three different regulation strategies, that is, self-regulation (e.g., "To test my learning progress. I try to answer questions about the subject matter which I make up myself"; 11 items; $\alpha = .77$) external regulation (e.g., "I study according to the instructions given in the course materials"; 11 items; $\alpha = .65$) and

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lack of regulation (e.g., "I notice that it is difficult for me to determine whether I have mastered the subject matter sufficiently"; 6 items; α = .71). Three scales representing three different processing strategies, that is, deep processing and more in particular 'relating and structuring' (e.g., "I try to combine the subjects that are dealt with separately in a course into one whole"; 5 items; α = .82), surface processing and more in particular 'memorising' (e.g., "I memorise lists of characteristics of a certain phenomenon"; 11 items; α = .72) and concrete processing (e.g., "I pay particular attention to those parts of the course that have practical utility"; 5 items; α = .67). All items are scored, ranging from 1 (I never or hardly ever do this) to 5 (I (almost) always do this).

With respect to students' background characteristics information about gender, age, and level of prior secondary education were collected. Prior secondary education in Flanders can be largely divided into academic, technical and vocational tracks. To assess the quality and quantity of students' motivation for studying in higher education we used a self-report questionnaire the 'Academic Motivation Scale' (AMS; Vallerand *et al.*, 1992). Students had to respond to the question stem "Why are you following higher education?". The AMS contains seven subscales, reflecting one subscale of amotivation "I once had good reasons for going to college, however, now I wonder whether I should."; 4 items, α = .85), three subscales of extrinsic motivation (external regulation, introjected and identified regulation), and three subscales of intrinsic motivation (intrinsic motivation to know, to accomplish things, and to experience stimulation). In this study we considered the three subscales of intrinsic motivation to be one scale measuring intrinsic motivation as a whole with 12 items (Deci & Ryan, 2000). All items are scored, ranging from 1 (does not correspond at all) to 7 (corresponds exactly). In line with self-determination theory and the approach carried out by Vansteenkiste *et al.* (2005) we inspected the simplex pattern of the subscales and combined the scales to form an autonomous motivation composite (α = .91) by averaging the scores for the general scale of intrinsic motivation and identified regulation and a controlled motivation composite (α = .86) by averaging the scores for external regulation and introjected regulation An autonomous motivation sample item is "Because I experience pleasure and satisfaction while learning new things." A controlled motivation sample item is "to show myself that I am an intelligent person". Three personality traits who have been repeatedly found related to students' learning strategies in former studies (Busato *et al.*, 1999) have been selected in this study. By means of the Big Five related self-report questionnaire NEO-FFI (Hoekstra, Ormel & De Fruyt, 2003) we measured students' openness (12 items; α = .67), neuroticism or emotional instability (12 items; α = .86) and conscientiousness (12 items; α = .78). Students' learning conceptions were measured by use of 4 ILS-scales: intake of knowledge (e.g., "To me, learning means trying to remember the subject matter I am given"; 9 items; α = 72), construction of knowledge (e.g., "If I have difficulty understanding a particular topic, I should consult other books of my own accord"; 9 items; α = .70), use of knowledge (e.g., "The things I learn have to be useful for solving practical problems"; 6 items; α = .74) and stimulating education (e.g., "The course team

should encourage me to compare the various theories that are dealt with in a course"; 8 items; α = .86).

1.1.2.2 Teacher level

With respect to teacher characteristics information was gathered about the discipline and year of study teachers were most of the time involved in during teaching practice. This focus was taken into account when teachers filled in the questionnaire. A selection of scales from the teacher questionnaire 'Inventory of Teaching Patterns' (Donche & Van Petegem, 2007) was used to assess teachers' conceptions of learning and teaching. The questionnaire is based upon previous research and teacher questionnaires (Donche, 2005; Roelofs & Visser, 2001; Roth & Tomic, 1997). Questions were formulated as statements which teachers had to rate on a five-point Likert scale. Based upon orthogonal factor analyses 6 meaningful components each representing distinct teaching conceptions were found. The first scale 'intake of knowledge' refers to the extent that the teacher has a traditional conception of teaching in which content-delivery is a main aim (e.g., "students have to learn learning contents by heart"; 9 items; α = .65). The second scale 'construction of knowledge' refers to the extent that the teacher has an innovative and learner-centred conception of teaching (e.g., "Students need to relate learning contents to other learning contents by themselves"; 8 items; α = .66), the third scale 'use of knowledge' refers to the extent that the teacher has an application-oriented conception of the use of knowledge in education (e.g., "Practical applications should be provided in the course materials"; 7 items; α = .75). The fourth scale 'stimulating education' refers to the extent that the teacher has a more controlling view of the role of the teacher in education. The teachers has to stimulate students to engage in learning but still has to regulate their learning paths in a controlling or steering way (e.g., "The teacher has to stimulate students to engage in problem solving learning"; 8 items; α = .78). The fifth scale 'cooperative learning' refers to the extent that the teacher finds it necessary that students should cooperate with each other in the learning environment, largely in a very peer-dependent way (e.g., "I agree that students should collaborate in their study as much as possible"; 8 items; α = .83). The sixth scale 'discovery oriented learning' refers to the extent that the teacher has a more autonomous view of the role of the student in education (e.g., "In the learning environment, students must be able to choose what they want to learn"; 7 items; α = .65).

1.1.3 Data analysis

The research problem central in this study can be labelled as a multilevel problem (Hox, 2002): we want to analyse the effect of variables from the higher "hierarchical level" (teachers) on variables at the lower hierarchical level (students). The most appropriate way of dealing with such a multilevel problem is using multilevel analyses (Hox, 2002), rather than unilevel analyses on aggregated or desaggregated data. Multilevel analysis deals with the thread of "aggregation bias", statistical dependence between observations and biased standard errors (Hox, 2002). Given the fact that we have a number of possibly interrelated dependent variables, multivariate multilevel analysis was used: the different dependent variables are included and explained in a single model (Thum, 1997). By analysing the data in a multivariate way we increase the

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statistical power for our analyses and we decrease the chance on type 1 errors (Hox, 2002; De Maeyer & Rymenans, 2004). First an empty model (model 1) was tested in order to obtain the percentages of variance in the sector scores at the student and student group level. This model also allows us to examine the dependencies between the dependent variables at both the student and the student group level. In a second step model 2 with all student characteristics was tested. In a third step significant student characteristics and teacher variables were added to compose an explanatory model (model 3). In the addition of both student and teacher variables we choose to model specific effects on the different dependent variables. This means that we were able to investigate whether a student or teacher variable has a similar effect on all our dependent variables or only on specific dependent variables.

RESULTS
1.2 Variance distribution in learning strategies among student groups
In model 1 we investigated whether differences in learning strategies are associated with the type of groups students are involved in. Table 1 contains the estimates of the relevant parameters of this model.

Table 2. Parameter estimates and standard error of model 1

	Parameter estimate	Standard error
Relating and structuring	3,24	0,03
Critical processing	3,66	0,03
Memorising and rehearsal	3,24	0,04
Analysing	3,02	0,02
Concrete processing	3,22	0,03
Self-regulation	2,61	0,02
External regulation	3,21	0,03
Lack of regulation	2,58	0,04
Variance on group level		
Relating and structuring	0,012	0,005
Critical processing	0,009	0,004
Memorising and rehearsal	0,028	0,011

Analysing	0,003	0,002
Concrete processing	0,019	0,007
Self-regulation	0,002	0,001
External regulation	0,016	0,006
Lack of regulation	0,034	0,013
Variance on student level		
Relating and structuring	0,575	0,018
Critical processing	0,595	0,019
Memorising and rehearsal	0,641	0,020
Analysing	0,453	0,014
Concrete processing	0,479	0,015
Self-regulation	0,392	0,012
External regulation	0,277	0,009
Lack of regulation	0,524	0,017

From this table we conclude that there are significant differences among the student groups on the level of regulation of learning (especially external regulation and lack of regulation) and the processing of learning contents (especially deep level processing and surface processing). There are no significant differences on the level of self-regulation and the processing strategy 'analysing'.

1.3 Student characteristics explaining learning strategies among classes

It is possible that the indicated differences between student groups are related to individual student characteristics. Therefore it is needed to estimate in a second model the effects of student characteristics on learning strategies. The following student characteristics were examined in these analyses: gender, prior education, secondary education, age, motivation, personality traits and learning conceptions. Effects of student characteristics on learning strategies are presented in table 3. The symbols "+" and "–" refer to the direction of the effect; in the case of a strong effect the symbol is indicated twice.

The analyses show that differences in learning strategies can be partly explained by differences in gender, prior education, motivation, personality traits and learning conceptions. This means that regardless the discipline and year group, these student characteristics have an independent effect on students' learning strategies. Students who are for instance more conscientiousness in personality and who are more

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autonomously motivated and have a more constructivist vision on learning and teaching are likely to use a more self-regulated and deep learning strategies. Students who didn't follow an academic secondary education track, who are more amotivated in their studies and who are less emotionally stable are likely to be more unregulated in their learning. Their conception of learning and teaching is also likely to be more traditional in the sense that reproduction oriented learning is put central in their conception of 'good' learning.

Table 3. Effects of student characteristics on learning strategies

	Relating & structuring	Critical processing	Memorising	Analysing	Concrete processing	Self-regulation	External regulation	Lack of regulation
Student characteristics								
Gender		- -	+		- -			
Age								
Prior education (general education)								-
Motivation								
Autonomous motivation	+	+		+	+	+		
Controlled motivation			+				+	
Amotivation	-							+ +
Personality traits								
Conscientiousness	+ +		+ +	+ +	+	+ +	+ +	
Openness	+	+ +			+ +	+		- -
Neuroticism	-	-	+					+ +

Conceptions of learning and teaching								
Intake of knowledge	-	-	+ +	+ +			+ +	+ +
Construction of knowledge	+ +	+ +		+	+ +	+ +		
Use of knowledge		-	-	-	+ +	- -		
Stimulating education		+					+	+

1.4 Teachers' conceptions of learning and teaching   explaining learning strategies
The third model we tested in this study is called the explanatory model. In this model explanatory variables on the level of the different combinations of disciplines and year groups are added. More in particular we investigated whether teachers' conceptions have an independent effect on learning strategies after control for the impact of student characteristics on learning strategies. The significant effects are synthesised in table 4.

Table 4. Effects of teacher beliefs on student learning

	Relating and structuring	Critical processing	Memorising	Analysing	Concrete processing	Self-regulation	External regulation	Lack of regulation
Teachers' conceptions								
Intake of knowledge					- -			
Construction of knowledge								
Use of knowledge			- -					- -
Stimulating education		+ +	+ +		+ +			+ +
Cooperative learning			- -					+ +
Discovery oriented learning								

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The results indicate that teachers' conceptions have an impact on students' learning strategies. Teachers' conceptions of knowledge are related to students' concrete and stepwise processing activities. For instance teacher teams who underline in their conceptions of learning and teaching that learning goals and contents should be related to practice and daily experiences are confronted in more extent with student groups who show a less reproduction oriented approach of learning. For instance teacher teams who associate 'good education' with enhancing cooperative learning in classrooms are confronted in more extent with student groups who apply less surface processing strategies. Another important finding is that teachers' conceptions are also related to regulation strategies. Lack of regulation is more present in student groups who are taught by teacher teams who stress the importance of stimulating self-regulation and cooperative learning of students in education.

CONCLUSIONS AND DISCUSSION

The results indicate clear relationships between teachers' conceptions of learning and teaching and students' learning strategies. After control for the additional effects of student characteristics on learning strategies, it has been demonstrated that how teachers think about learning and teaching is associated with how their students learn. An important contribution of this study is that a variety of teacher conceptions has been investigated and related to different regulation and processing strategies. In this way the study has shown that teacher conceptions have a differential impact on different learning strategies. Logical relationships were found between conceptions of knowledge and students' learning strategies. At first sight a contradictory result appeared on the level of teachers' conceptions of learning and teaching and more specifically the conceptions 'stimulating education' and 'cooperative learning'. Lack of regulation was found to be more present in student groups who were taught by teacher teams who stressed the importance of stimulating self-regulation and cooperative learning of students in education. However, in 'stimulating education' the teacher is still viewed in his important influencing role as a stimulator of learning. In 'cooperative learning' learning is viewed as dependent of other external sources of regulation and more specifically peer learners. The results are therefore logical because in both teacher conceptions external regulation of learning is put central. An emphasis of the importance of external regulation in teachers' conceptions of learning and teaching is related with the presence of a lack of regulation among student groups. It is possible that the presence of these conceptions of learning and teaching within teacher teams are a response to the presence of unregulated learning within specific student groups. However this hypothesis needs to be tested in future research. The result is also in line with the found relationship between students' conceptions of learning and teaching and learning strategies. It was in particularly in our data confirmed that when students have more traditional teaching conceptions in which external regulation is put central, this went along with the presence of more externally and unregulated learning.

The results are important for practice. The results show that how students think about learning and teaching is consistently related with the use of qualitative different learning strategies. Increasing more awareness about "how" students engage in

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learning and their learning qualities as well as personal expectations regarding to education can be an important stepping stone towards learning development. Also the directional links between the quality and quantity of motivation and the qualitative different learning strategies underline the importance of increasing more awareness among students about "why" they engage in learning in higher education. Confronting students with their own learning dispositions during their study in higher education as well as their specific motivational drive can be a lever for further development of their learning strategies. Of course not only increasing more awareness of dispositions among students is important, increasing awareness of teachers about how they foster growth in learning of their students is equally important. Supporting teachers to reflect about own beliefs about 'good education' and examining the relationship with student learning can be an important lever for creating more awareness about specific learner needs within learning environments.

An important limitation in this study is that teachers' conceptions were taken into account but not teachers' teaching strategies. As disjunctions and consistencies between teaching conceptions and strategies of teachers are reported in studies it is important in future research to assess both components in relationship with student learning (Van Petegem & Donche, 2006). This could lead to more understanding of the directional impact of teacher beliefs on student learning.

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