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The relationship between students' approaches to learning and the assessment of learning outcomes

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The purpose of the present study is to gain more insight into the relationship between students' approaches to learning and students' quantitative learning outcomes, as a function of the different components of problem-solving that are measured within the assessment. Data were obtained from two sources: the revised two factor study process questionnaire (R-SPQ-2F) and students' scores in their final multiple-choice exam. Using a model of cognitive components of problem-solving translated into specifications for assessment, the multiple-choice questions were divided into three categories. Three aspects of the knowledge structure that can be targeted by assessment of problem-solving were used as the distinguishing categories. These were: understanding of concepts; understanding of the principles that link concepts; and linking of concepts and principles to application conditions and procedures. The 133 second year law school students in our sample had slightly higher scores for the deep approach than for the surface approach to learning. Plotting students' approaches to learning indicated that many students had low scores for both deep and surface approaches to learning. Correlational analysis showed no relationship between students' approaches to learning and the components of problem-solving being measured within the multiple choice assessment. Several explanations are discussed.

Introduction

Since its original publication, nearly 30 years ago, the paper by Marton and Säljö (1976) has served as an impetus for the study of students' approaches to learning in order to search for the fundamental differences students have in their approaches to engaging in learning tasks (Biggs, 1987). The study by Marton and Säljö (1976) introduced two concepts which have been widely used in educational research: 'deep' and 'surface' approaches to learning. The concept of the deep approach is associated with students' intentions to understand and construct the meaning of the content to be learned, whereas the concept of the surface approach refers to students' intentions to learn by memorizing and reproducing the factual contents of the study materials.

The original Gothenburg group looked at students' ways of approaching learning in a more qualitative way (Marton, 1981). Others, like the research group of Entwistle in the United Kingdom (Entwistle & Ramsden, 1983) or Biggs and his colleagues in Australia (1987), developed questionnaires and investigated the approaches in a more quantitative way. Although there are substantial differences between the aims, methods, and results of the different studies, they all have in common the dichotomy between a deep approach and a surface approach in students' learning (Prosser & Trigwell, 1999). Besides these two core concepts of approaches to learning, a kind of mixed approach to learning, called the strategic (or achieving) approach, is often identified (Biggs, 1993; Entwistle, 1991). The strategic approach can take place through either deep or surface processing, in line with the demands of the context (Mäkinen, 2003).

An interesting question during this time has been the relationship between students' approaches to learning and students' learning outcomes. Although the results seem to be inconsistent, the use of a deep learning approach is, in general, associated with higher quality learning outcomes and a surface approach with lower quality learning outcomes (Crawford, Gordon, Nicholas, & Prosser, 1998; Hazel, Prosser, & Trigwell, 1996; Snelgroove & Slater, 2003; Trigwell & Prosser, 1991; Van Rossum & Schenk, 1984; Zeegers, 2001).

Van Rossum and Schenk (1984) used the Structure of the Observed Learning Outcome (SOLO) taxonomy to describe the quality of the learning outcomes of 69 first-year psychology students. The SOLO taxonomy consists of five structural categories of learning outcomes, going from the lowest level: 'pre-structural' (an irrelevant response), to the most complete level, called 'extended abstract' (Biggs & Collis, 1982). Their results show a clear positive relationship between the observation of a deep study approach and high quality learning outcomes. The difference in quantitative learning outcomes (using average exam scores) between students using the surface or the deep approach was only significant for questions measuring insight, not for questions measuring the reproduction of knowledge.

Trigwell and Prosser (1991) studied the relationship between the observed approaches to learning and the learning outcomes of 122 first-year nursing students. Using the SOLO taxonomy, they found a positive correlation between a deep approach to learning and high qualitative levels in learning outcomes, but no such correlation to quantitative differences in outcome. There were no relationships found between surface approaches to learning and qualitative or quantitative outcome measures. In a later study in the field of biology, Hazel, Prosser, and Trigwell (1996) also made use of the SOLO taxonomy to analyse the learning outcomes, complemented with concept maps and phenomenographic methods. The 272 students involved in this study ended up in two clusters. In the first cluster, there was a relationship between low outcome measures, low scores on deep approaches and high scores on surface approaches. On the other hand, the second cluster reported high outcome scores related to low surface approach scores and high deep approach scores.

In the field of mathematics, Crawford and colleagues (1998) found strong correlations between 300 first-year students' observed approaches to learning and their final percentage mark in their first year mathematics course. Relatively high scores on the surface approach subscale were related to low marks in the final exam, while relatively high scores on the deep approach to learning subscale were related to higher final exam scores.

In a longitudinal study with 200 first-year science students, Zeegers (2001) used Biggs' (1987) Study Process Questionnaire (SPQ) and annual GPA scores to evaluate the predictive value of the SPQ scales on students' learning outcomes. The results showed a consistent positive correlation between the deep approach to learning and assessment outcomes.

Snelgrove and Slater (2003) also used the SPQ (Biggs, 1987) with 300 nursing students and found the deep factor to be positively and significantly correlated with average grade performance.

Recently, Watkins (2001) conducted a cross-cultural meta-analysis in which the relationship between students' approaches to learning and their academic performance was one of the central questions. It was hypothesised that surface approaches to learning would be significantly negatively correlated with students' grades, whilst the deep approach would be positively related with academic achievement. The results of his study were rather disappointing, although in the expected direction, with correlations of -.11 for surface and .16 for deep approaches.

In the literature, assessment is generally blamed for such disappointing results. Although a deep approach to learning is expected to lead to higher achievement (both in terms of higher quality outcomes and grades), the assessment system does not always reward the deep approach (Biggs, 1987; Marton & Säljö, 1976; Scouller, 1998; Scouller & Prosser, 1994). Entwistle, McCune, and Hounsell (2003, p. 90) suggest that research findings vary "due to differences in the extent to which understanding is explicitly rewarded in the assessment procedure". A recent study by Minbashian, Huon, and Bird (2004) tried to investigate this moderating effect of the type of exam questions in a study involving 49 third year psychology students using Entwistle and Tait's (1994) Revised Approaches to Studying Inventory and short essay questions. However, the hypothesis that a deep approach would be more effective for questions of higher cognitive order than for questions of lower cognitive order could not be confirmed: the observed relationship was not significant and was in the opposite direction.

The present study

The relationship between students' approaches to learning and the assessed (quantitative) learning outcomes is of interest to the present study. Today's stated learning outcomes in higher education are, to a large extent, congruent with trends in the marketplace. "With more and more routine jobs being turned over to robots and other automated devices, the jobs left for humans tend to be less routine – requiring more problem-solving skill for adequate job performance" (Gagné, Yekovich, & Yekovich, 1993, p. 210). In essence, a primary goal in higher education seems to be to enable students to solve complex problems in an efficient way (Engel, 1997; Gagné et al., 1993; Poikela & Poikela, 1997; Segers, 1997).

The literature on problem-solving is characterized by a wide variety of theoretical frameworks (e.g. de Corte, 1996; Glaser, Raghavan, & Baxter, 1992; O'Neil & Schacter, 1997; Schoenfeld, 1985; Smith, 1991). Despite their differences in details and terminology, all models agree that an organized and structured domain-specific knowledge base and meta-cognitive functions that operate on that knowledge are essential components of successful problem-solving. There is also a fairly broad consensus that motivation and beliefs account for differences in problem-solving.

As a consequence, the purpose of the present study is to explore further the relationship between students' approaches to learning and their quantitative learning outcomes, from the perspective of the different components of problem-solving that are measured with the assessment.

Research context

The study was conducted in a European law school using Problem Based Learning (PBL). Educating for successful problem-solvers is one of the main goals of PBL (Dochy, Segers, Van den Bossche, & Gijbels, 2003). Although originally developed for medical training in Canada, the orthodox version of PBL has been modified and applied globally in many disciplines (Gijselaers, 1995). The present study took place in a course on public law.

Students had to work in small tutorial groups (12-18 students) and met twice a week under the supervision of a teacher (tutor). During each session, students were confronted with a range of tasks which they had to analyse and solve by formulating 'learning goals' for self-study. In the next session, students reported their findings and started to analyse new problems. As well as this, students were enrolled on a weekly basis in somewhat larger 'practical groups' (24-36 students) and had one lecture a week. During the course, students had the opportunity to complete 3 assessment tasks on a voluntary basis. These could result in a bonus, which was added to the score of the final exam.

Method

Participants

The sample consisted of 133 second-year Law students (65% females and 35% males, mean age: 20.6) who were enrolled for the first time in a second year course on public law, using PBL. The students were divided into 17 small groups that were tutored by 7 teachers.

Instruments

Data were obtained from two sources: a questionnaire and students' final exam results for the course.

The questionnaire was a Dutch translation of Biggs, Kember, and Leung's (2001) Revised two Factor Study Process Questionnaire (R-SPQ-2F). The R-SPQ-2F is a more refined version of Biggs' (1987) original Study Process Questionnaire (SPQ). In the theoretical framework of the SPQ, three approaches to learning (surface, deep and achieving) are proposed, each with a motive and strategy subscale. Kember and Leung (1998) conducted a study with over 7000 Hong Kong students which investigated the construct and internal reliability of the SPQ. The results indicated that a model with two factors had the best fit. Other studies, including cross-cultural research, have also shown a two factor solution with deep and surfaces approaches, rather than the initial three factor solution, accounted for most of the variance (Snelgrove & Slater, 2003; Watkins & Regmi, 1996; Zhang, 2000). Biggs and colleagues (2001) accordingly refined the SPQ. The revised two factor SPQ consists of 20 items which are scored on a 5 point Likert scale and categorizes students into two different types of approaches to learning: 'surface learning approaches' and 'deep learning approaches', each containing two subscales, 'motive' and 'strategy'. The study of Biggs and colleagues (2001) indicated that the 2F-SPQ-R had reasonable Cronbach's alpha values for scale reliability and desirable goodness of fit with the intended two factor model. Leung and Chan (2001) investigated the psychometric properties and applicability of the 2F-SPQ-R in the Hong Kong Chinese context. Their results also indicated reasonably good reliability coefficients and goodness of fit for the two factor model.

Our Dutch translation of the questionnaire resulted in acceptable Cronbach's alpha values for the 2 factor model: surface learning approaches (Cronbach's alpha=0.75) and deep learning approaches (Chronbach's alpha=0.73). The subscales deep motive (Chronbach's alpha=0.60), deep strategy (Chronbach's alpha=0.54), surface motive (Chronbach's alpha=0.65) and surface strategy (Chronbach's alpha=0.48) had lower reliability coefficients and are not used for further analysis. Confirmatory Factor Analysis (CFA) using LISREL 8.52 was performed to verify whether the two factor structure could be validated (Jöreskog & Sörbom, 2002). The results indicated that the data set fits the two factor model fairly well (chi-square / df=1.64, RMSEA=0.07). Sufficient fit values are smaller than 2.0 for the first (Dolmans, Wolfhagen, Scherpbier, & Van der Vleuten, 2003; Tenenbaum, Naidu, Jegede, & Austin, 2001), and smaller than 0.08 for the Root Mean Square Error of Approximation (Browne & Cudeck, 1993; Guay, Marsh, & Boivin, 2003; Sachs & Gao, 2000).

The *final exam* consisted of 40 multiple-choice questions (Cronbachs' alpha=0.70). In order to distinguish between the different components of problem-solving for each question in the final exam, we used Sugrue's (1993, 1995) model of cognitive components of problem-solving. Sugrue translated her model into specifications for the assessment of the main cognitive components of problem-solving, and is therefore useful for our purpose. The assumption made by Sugrue is that successful problem-solving in a given domain results from the interaction of knowledge structure, meta-cognitive functions and motivation. For each of the three categories of cognitive components, Sugrue describes a limited set of variables that should be targeted by assessment.

In relation to the final exam used in our study, the knowledge structure is of special interest. Three levels which the assessment can appeal to are distinguished in the knowledge structure. These three levels are presented in Figure 1, which gives an overview of possibilities for the assessment within a 'selection' format, of which multiple-choice questions are obviously the most well-known example (Sugrue, 1995). At the first level, assessment of the understanding of concepts, which can be defined as "a category of objects, events, people, symbols or ideas that share common defining attributes or properties and are identified by the same name" (Sugrue, 1993, p. 9) is the core issue. In this case, students are confronted with several examples of the concept and asked to select those which are instances of the concept of interest. At the second level, understanding of the principles that link concepts, or in other words the organization of the knowledge structure, is the subject of assessment. Sugrue (1993, p. 9) defines a principle as

> a rule, law, formula, or if-then statement that characterizes the relationship (often causal) between two or more concepts. Principles can be used to interpret problems, to guide actions, to troubleshoot systems, to explain why something happened, or to predict the effect a change in some concept(s) will have on other concepts.

In this case, students could be asked to select the most appropriate prediction or solution from a list of given descriptions of an event. The third and final level targets the linking of concepts and principles to application conditions and procedures by assessment. A 'procedure' is defined as "a set of steps that can be carried out either to classify an instance of a concept or to change the state of a concept to effect a change in another" (Sugrue, 1993, p. 22) and 'conditions' as "aspects of the environment that indicate the existence of an instance of a concept, and/or that a principle is operating or can be applied and/or that a particular procedure is appropriate" (Sugrue, 1993, p. 22). At this level, the organized knowledge is applied under appropriate circumstances. A student can be asked to select the most appropriate procedure for a given task in order to reach a particular goal.

Levels in the knowledge structure	
Concepts	Select examples of concepts Distinguish between examples that are and are not instances of the concept of interest
Principles	Select best/similar/dissimilar problems Select best prediction Select best explanation for event
Application	Select correct procedure for identifying instances select most appropriate procedure to change the state of a concept by manipulating another

Figure 1. Construct-by-format matrix for measuring constructs related to the knowledge structure with selection-formatted questions (after Sugrue, 1995)

A major benefit of Sugrue's model is that it can easily be used to classify questions. The model allows the use of different assessment reviewers for one assessment, even if the reviewers have little subject knowledge.

Two reviewers categorized the questions in the final exam separately. After that, items that were differently classified were discussed until a clear consensus was reached. Finally, 17 questions were classified as being at the 'concepts' level, 11 questions at the 'principles' level and 12 questions at the 'application' level.

Procedure

Students were asked to complete the 2F-SPQ-R questionnaire during one of the tutorial sessions near the end of a second year law course. The final exam was administered one week after the end of the course.

Results

Results were plotted and analysed by means of descriptive statistics for the measures used in the present study and by correlation analysis to probe into the relationships between students' approaches to learning and the different components of problem-solving measured within the final exam.

Table 1

Descriptive statistics for the main measures used

Variable	Mean	*SD*
Deep approach	2.99	0.51
Surface approach	2.21	0.59
Concepts mark	12.60 (74.12%)	2.27
Principles mark	7.24 (65.82%)	2.01
Application mark	7.52 (62.67%)	1.82
Total mc-exam mark	27.36 (68.40%)	4.91

Table 1 presents descriptive statistics for the measures used in the present study. Students' scores for deep approaches were higher than their scores for surface approaches in our sample. For the assessments, students had highest average scores for the questions measuring concepts (74.12% of the questions correct). The second highest scores were obtained for questions measuring principles (65.82% of the questions correct). The questions measuring application had the lowest scores (62.67% of the questions correct).

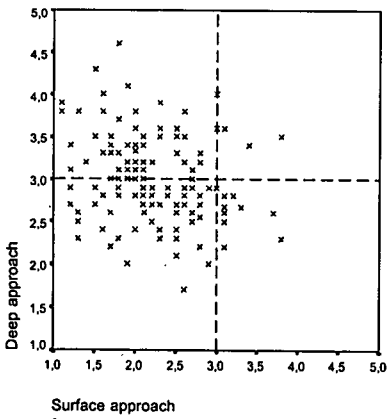

Figure 2. Plot of study approaches

The plot in Figure 2 indicates that most students fitted into two groups: a group of students with high scores for deep approach and low scores for surface approach and a group with low scores for both the deep and surface approach. Very few students employed high levels of both deep and surface approaches to learning. The group of students that had high scores for the surface approach and low scores for the deep approach to learning is also small.

Further analysis indicated that for the surface approach to learning, the mean score of women (M=2.07, SD=0.59) differs significantly from men's score [M=2.43, SD=0.53, $F(1,129)$=12.03, p<0.01]. The deep approach to learning shows a statistically significant relationship to students' ages: the older the students, the more deep approaches to learning are used (r=0.22, p=0.01).

The correlations of the main variables used in this study are presented in Table 2. The interrelationships between the three categories of measured components of problem-solving and the total exam grade are all high and statistically significant. However, neither students' final exam grades, nor their sub-results on questions in the exam asking for different components of problem-solving, are significantly (p-values all exceed 0.05) related to the extent to which they use either deep or surface approaches to learning.

Table 2

Correlations among the measures used in the present study

Variable	1	2	3	4	5	6
1. Deep approach	1.00					
2. Surface approach	-.232**	1.00				
3. Concepts mark	-.031	-.161	1.00			
4. Principles mark	.040	-.119	.585**	1.00		
5. Application mark	-.088	.020	.366**	.446**	1.00	
6. Total mc-exam	-.031	-.116	.837**	.845**	.722**	1.00

Note. ** Correlation is significant at the 0.01 level.

Discussion

In the present study we wanted to gain more insight into the relationships between students' approaches to learning and the different components of problem-solving that were being measured using a multiple choice assessment. The students in our sample showed slightly higher scores for a deep approach than for a surface approach to learning. However, plotting students' approaches to learning indicated that a lot of students had low scores for both deep and surface approaches. Previous research has shown that a profile which consists of low (or high) scores on both deep and surface approaches is quite typical of novice students even though this kind of combination could be entitled 'disintegrated' or 'dissonant' or 'not yet established' (Entwistle, Meyer, & Tait, 1991; Lindblom-Ylänne & Lonka, 1999; Lonka & Lindblom-Ylänne, 1996). A recent study with 110 (first-, second-, and third-year) law students enrolled in problem-based courses in legal history and communication skills for lawyers (Lindblom-Ylänne, 2003) revealed that 23% of the students showed clearly dissonant study orchestrations. These students seemed to

> lack the metacognitive skills to evaluate how functional their study practices were in their learning environment, and admitted to having problems with their study strategy. Many of the students realised that their study methods were not suitable for studying law, but they did no know how to develop them (p. 73).

Further analysis of our data indicated that male students adopted a significantly higher level of surface approaches and that older students adopted significantly deeper approaches to

learning. The first contradicts prior research by Richardson (1993), which showed no consistent evidence of significant differences between men's and women's approaches to learning. The latter is in line with Richardson's later (1995) research which indicated that older students are more meaning oriented when studying.

The results of our correlational analysis indicated no relationships between students' approaches to learning and the components of problem-solving being measured within the multiple choice assessment. From our data, it is impossible to associate the expected employment of deep learning approaches with higher assessment outcomes. The view that within the same question format (i.e., multiple choice questions), students with different approaches to learning would score differently on questions measuring different components of problem-solving is also not supported.

Our results are in line with those of Minbashian et al. (2004): namely, there is no evidence that a deep approach to learning would be more effective for questions assessing more complex components of problem-solving. One of the explanations they give is that the wording of the questions (from what we deduced by means of Sugrue's (1993, 1995) model of the components of problem-solving being measured) is by itself not sufficient to influence the nature of students' responses. The method of assessment probably has more influence on the way students study for, and respond to, exam questions (Minbashian et al., 2004). Related to this, students' perceptions of the method of assessment (i.e., multiple-choice questions) could be seen as a mediating factor (Segers, Dochy, & Cascallar, 2003). A recent review (Struyven, Dochy, & Janssen, 2003) indicated that students' perceptions of assessment have considerable influences on students' approaches to learning. Scouller (1998) found that success in multiple-choice examinations was related to the perception of the questions as assessing lower levels of cognitive processes and the non-employment of deep strategies. Although we did not take students' perceptions of the assessment into account, it is possible that students do not differentiate between the different questions within the same assessment method.

Another possible explanation for the lack of clear results could be the effectiveness of the classification model. We used Sugrue's (1993, 1995) model of the cognitive components of problem-solving to categorize the different questions in the multiple-choice exam, according to the three components of problem-solving that were to be measured. Although the model seems clear and exhaustive for multiple-choice questions, the two assessment reviewers reported difficulties in categorizing some questions. In their opinion, questions asking for 'the reproduction of facts', although important for assessment according to most of the law teachers, at first sight had no place in the model. Since the difference between 'a concept' and 'a fact' appeared difficult to explain, after discussing these questions the reviewers agreed to classify them in the category of 'understanding concepts'. Sugrue (1995) remarks that her model lends itself extremely well to domains such as science, mathematics, economics and geography, but that it might not be easy to use in other domains such as history. The reviewers' difficulties in classifying some questions indicate that law could also be added as a domain for which the model is complicated.

Another problem is that one can classify questions in terms of components of problem-solving being measured but one can not be sure in a multiple-choice exam that, when a student gives the wrong answer, he fails to achieve the components of problem-solving being measured by the question. When a student doesn't understand two related concepts in a familiar problem, the student will fail to select similar problems, not because (s)he does not understand the relationship between the two concepts, but simply because (s)he does not have basic understanding of the concepts. This would mean that it is very difficult to investigate the relationship between students' approaches to learning and components of problem-solving being measured within a multiple-choice setting. Furthermore, it suggests that the students' answers should be the unit of analysis, rather than the questions. However, this problem could be solved in the assessment construction process by including a multiple-choice question for each of the three components of problem-solving for each subject tested in the assessment.

The question whether it is at all possible to measure deep-level processing of knowledge as well as problem-solving skills by multiple-choice questions should also be raised here.

Although it is argued that multiple-choice questions can be appropriate for assessing the understanding and application of knowledge as well as the capability to analyse situations and solve problems (Anderson & Krathwohl, 2001; Haladyna, 2004), others, like Driessen and Van der Vleuten (2000) state that it is only possible to assess higher cognitive skills if multiple-choice questions are combined with another type of assessment like essay question using problem vignettes.

As well as the method of assessment, the content and method of teaching also influence the way in which students study for and respond to exam questions (Minbashian et al., 2004). The present study was carried out within the context of a second year law course. A recent study by Mäkinen and Olkinuora (2003) in Finland found that, in contrast to the situation in the faculty of medicine, first year law school students' study credits were negatively correlated with a deep learning orientation, whereas the grades of second year law school students were positively correlated with a deep learning orientation. Not only the content of teaching, but also the teaching method in our study, problem-based learning, must be taken into consideration. According to Biggs (2003), problem-based learning is an instructional approach that has the potential to facilitate deep approaches to learning. Although on average students had slightly higher scores for a 'deep approach' than for a 'surface approach', there is no tendency towards a use of deep approaches to learning, despite the problem-based learning environment. Seemingly, the current conditions of teaching and assessment did not make all students decide that a deep approach would give the best results, as indeed it didn't.

Interesting questions for future research in this respect would be what kind of influences the tutor or the tutorial group has on students' approaches to learning in problem-based learning environments. Trigwell, Prosser, and Waterhouse (1999) conducted an empirical study which showed that approaches to teaching are associated with approaches to learning: teacher-centred approaches to teaching are related to a surface approach to learning. Conversely, student-centred approaches to teaching were related to deeper approaches to learning. In legal education, the difference between 'traditional PBL tutors' and tutors adopting the 'Socratic method' is well known and could be a possible moderator of students' approaches to learning (Liddle, 1999, 2000).

The tutorial group also influences students' approaches to learning and the outcomes. A recent study by Lindblom-Ylänne, Pihlajamäki, and Kotkas (2003) showed that if students in a PBL group participate more evenly and actively in the discussions they achieve higher grades as a group.

Finally, like gender and age, some other elements in the learning-environment (such as the possibility students had to make three assessment tasks during the course) will have had an influence on students' approaches to learning and possibly also indirect on their final exam. More general factors such as prior academic achievement or GPA (Snelgrove & Slater, 2003; Young, 1993; Zeegers, 2001), self-confidence (Watkins & Biggs, 1996) and academic self-efficacy (Pintrich & de Groot, 1990) are potential moderators in the relation between students' approaches to learning and students' quantitative learning outcomes which should be subject of future research.

To conclude, the second-year law students enrolled in a problem-based course showed slightly higher scores for a deep approach than for a surface approach to learning. However, a lot of students had low scores for both deep and surface approaches, indicating 'dissonant' study strategies. For the first-year law students the faculty recently developed an on-line environment 'legal study- and assessment skills' where students can find information about how to develop suitable study-strategies for their law study. The present study indicates that also second-year law students would benefit from this on-line environment. The results of this study confirm to some extent, previous findings that student approaches to learning are sensitive to the learning context, as well as student age and gender, and that the values for deep and surface learning approaches may be related to academic outcomes. The specific findings here show these correlations to be weak and not statistically significant. It was suggested that students' perceptions of the method of assessment will have had considerable influences on students' approaches to learning. When re-engineering the assessment, at least

more authentic assessment-tasks should be added to the multiple-choice examination (Gijbels, Van de Watering, & Dochy, 2005). Further research should probe into the relationship between students' approaches to learning and their outcomes on and perceptions of a blend of assessment methods.

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Le but de cette étude est d'avoir une meilleure vue sur la relation qui y a entre la manière d'étudier des étudiants et les résultats quantitatifs, en fonction des différents composants de 'résolution de cas' qui sont estimés dans l'examen. Les données ont été obtenus par deux sources: le questionnaire révise de processus facteur deux [revised two factor study process questionnaire (R-SPQ-2F)] et les points obtenus par les étudiants dans leur examen choix multiple final. Employant un modèle de composants cognitifs de 'résolution de cas' traduits dans les spécifications de l'examen, les questions du choix multiple étaient divisées en trois catégories. Trois aspects de la structure concernant la connaissance qui peuvent être estimés par un examen de résolution de cas, sont repris dans l'examen distingués par catégories. Cela comprenait: la compréhension des concepts; la compréhension des principes qui lie les concepts; et lier les concepts et principes pour appliquer des conditions et procédures. Les 133 étudiants de deuxième année en droit de notre sondage avaient des points un peu meilleurs pour l'approche de l'étude en profondeur que pour l'approche en surface. Le tracé des manières d'étudier indique que beaucoup d'étudiants avaient des mauvais points pour l'approche en profondeur ainsi qu'en surface. L'analyse corrélationnel ne montre aucune relation entre la manière d'étudier et les composants de 'résolution de cas', estimée dans l'examen choix multiple. Plusieurs explications ont été débattues.

Key words: Approaches to learning, Assessment, Multiple-choice questions

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Current theme of research:

Effectiveness of (teacher) training programs. Different aspects of new learning environments such as problem-based learning, its assessment and evaluation.

Most relevant publications in the field of Psychology of Education:

Dochy, F., Segers, M., Van den Bossche, P., & Gijbels, D. (2003). Effects of problem-based learning: A meta-analysis. *Learning and Instruction, 5*(13), 533-568.

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Current theme of research:

Assessment. Study skills and study approaches in higher education.

Most relevant publications in the field of Psychology of Education:

Dierick, S., Dochy, F., & Van de Watering, G. (2001). Assessment in het hoger onderwijs: Over de implicaties van nieuwe toetsvormen voor de edumetrie [Assessment in higher education: On the implications of new modes of assessment for edumetrics]. *Tijdschrift voor Hoger Onderwijs, 19*(1), 2-18.

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Current theme of research:

Higher education. Assessment. Teacher training.

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Current theme of research:

Effects, implementation and innovation of student-centered education, c.q. Problem-based learning; including (authentic) assessment in student-centered education. Knowledge sharing and decision-making in collaborative teams.

Most relevant publications in the field of Psychology of Education:

Dochy, F., Segers, M., Van den Bossche, P., & Gijbels, D. (2003). Effects of problem-based learning: A meta-analysis. *Learning and Instruction, 5*(13), 533-568.

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