Higher Education **31**: 5–24, 1996.

Epistemologies, conceptions of learning, and study practices in medicine and psychology

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Abstract. The subjects ($N = 175$), freshmen and fifth year students in psychology ($n = 59$) and medicine ($n = 116$), described their modes of studying by answering open-ended questions and Likert-type questions, presented to them within a task booklet. They were first asked to write down their own subjective definitions of learning. Scales to classify the answers were adopted from Lonka *et al.* (1990). Second, subjects were given a comprehension monitoring probe adopted from Ryan (1984). Responses were analysed to determine the specific comprehension criteria the student employed. Third, students rated a set of 71 statements concerning learning styles, regulation of learning, and conceptions of learning (Entwistle & Ramsden, 1983; Vermunt & van Rijswijk, 1988). Embedded in the last set of statements were seven items that were used to classify students as dualists or relativists (Perry, 1968; Ryan, 1984).
It was found that constructivist conceptions of learning were the most typical of (advanced) psychology students, whereas learning was more often seen as intake of knowledge by the medical students. Highest dualism scores were obtained by the first year students, especially medical students. In general, dualists were more likely to report knowledge comprehension criteria to test their understanding than were relativists, and dualists' conceptions of learning were also more passive. Four principal components were identified that reflected qualitatively different approaches to learning and knowledge: externally regulated and reproduction-directed learning (PC1), self-regulated, meaning-directed, and goal-oriented learning (PC2), constructivist epistemology (PC3), and active professional orientation (PC4). Medical students scored higher on variables related to PC1 and PC4, whereas psychology students scored higher on scales associated with PC2 and PC3.

Introduction

Successful studying in higher education is not only a matter of effort, but is also determined by the *nature* of the study activities. For example, entry-level reading and writing skills have shown to be best predictors of medical students study success (Glaser, Hojat, Veloski, Blacklow, & Goepp, 1992). Students guide their learning and text comprehension by different monitoring procedures. Ryan (1984) showed that there are individual differences in comprehension standards which may influence students' academic performance indirectly by controlling the effectiveness of their reading efforts. This article

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first describes different epistemologies and conceptions of learning reported by medical and psychology students at different levels of their studies (first-year and fifth-year). Second, it then examines how these conceptions are related to students' comprehension criteria and comprehension testing strategies. The goal of this paper is exploratory with respect to the relationships among different aspects of learning: How do epistemologies, conceptions of learning, and comprehension monitoring standards interact with each other? How domain-specific are these phenomena?

Conceptions of learning

Previous research indicates that different approaches to learning tasks have an effect on the learning outcomes (e.g., Marton & Säljö, 1976; Entwistle & Ramsden, 1983; Marton *et al.*, 1984). Marton & Säljö (1976) introduced two qualitatively different study orientations: deep and surface level learning. The former refers to paying attention on what is *signified* by the materials to be learned (e.g., author's intention), whereas the latter concentrates more on the signs (e.g., the text in itself).

There is empirical evidence supporting the idea that active constructive efforts are signs or predictors of effective intellectual processing (e.g., Glaser, 1991). Qualitative analyses of students' conceptions of learning and understanding show that conceptions of learning and approaches to learning may be roughly divided into two categories: *surface-level reproduction* (or memorizing) versus *deep-level transformation* (or construction) of knowledge, the latter being associated with qualitatively better learning (Bereiter & Scardamalia, 1987; Entwistle & Entwistle, 1992; Lonka *et al.*, 1994; van Rossum & Schenk, 1984; Ryan, 1984; Scardamalia & Bereiter, 1991; Säljö, 1979; Thomas & Bain, 1984; Vermunt & van Rijswijk, 1988).

Lonka *et al.* (1990; 1994) studies explored the conceptualizations of learning that develop in students as they progress in their educational psychology studies. They described subjective conceptions of learning that were related to the level of expertise in this domain, using a cross-sectional design. This study focussed on three important concepts in current educational psychology, or more specifically, cognitive learning theory (e.g., Glaser, 1991): Active epistemology refers to beliefs about learners' active role in the learning process, constructivity is the idea that knowledge and cognitive strategies are constructed by the learner, and changes in students mental representations of tasks determine the nature of the learning outcomes. Lonka *et al.* (1990; 1994) developed a task booklet to include open-ended questions about the concept of learning, and it was given to 113 subjects with varying levels of expertise in educational psychology, especially, in cognitive learning theory. Laypeople were also included in order to obtain a baseline with which to compare

the students, and teachers represented professional expertise. The answers were classified on three main scales: Active Epistemology, Constructivity, and Mental Representation. The results showed that a constructivist approach to knowledge and learning was almost never found in laypeople and teachers, but that it was common among educational psychology students. In addition, laypeople did not show any evidence of using the notion of mental representation when defining learning, while this was commonly found among those who had studied psychology. However, active epistemology was not specific of psychology students only. This exploratory study indicated that conceptions of learning may be somewhat domain-specific, and further research is needed in order to analyze which aspects may be related to successful studies in higher education in general.

Epistemological standards

Another aspect that may have relevance to study practices in higher education is students' conceptions of knowledge, that is, their general epistemologies. Perry (1970) described the epistemological development of a college student as moving from a primitive dualist conception of knowledge towards a more relativistic conception. In the beginning, knowledge is seen as an unorganized set of discrete and absolute truths (dualist orientation), but this conception gradually transforms into seeing knowledge as an array of interpreted and integrated positions (relativistic orientation).

Ryan (1984) proposed that a dualist would assess his or her reading comprehension in terms of the number of propositions retrieved from memory after reading a text passage (knowledge standards). In contrast, he assumed that a relativist ought to assess reading comprehension in terms of the degree to which clear and coherent relationships can be established among propositions in a text passage (comprehension standards). Ryan's (1984) data suggested that dualists more often reported knowledge standards, whereas students classified as relativists more often reported comprehension standards. Students reporting the use of comprehension criteria earned better grades in a psychology course. Ryan (1984) concluded that these epistemological standards may have an effect on one's text processing efforts. This study examines how students' epistemologies are related to their conceptions of learning, and also, to their reported comprehension criteria and study strategies.

Study strategies

Weinstein and Mayer (1986) categorize different learning strategies as rehearsal, elaborative, organizational, metacognitive and affective. Rehearsal strategies involve repetition aiming at literal reproduction. In complex tasks, these can

involve, for instance, copying or underlining information. Elaborative strategies are used when knowledge is attached to some meaningful context or some sort of symbolic construction is developed, for example, by creating analogies, summarizing, or using prior knowledge. Organizational strategies are used to translate information into another form that will make it easier to understand, for example, by outlining, grouping, creating a conceptual diagram, or by creating a hierarchy. Rehearsal strategies differ from elaboration and organizational strategies, since the latter ask for more active and deep-level processing by the learner than is required in rote learning. Metacognitive strategies include comprehension monitoring strategies such as checking for failures, like using self-questioning to check understanding. Affective strategies aim at being alert and relaxed in order to help overcome test anxiety.

In Ryan's (1984) study, dualists more often assessed their learning on the basis of knowledge standards, whereas relativists more often reported comprehension standards. Because rehearsal strategies aim at reproduction of facts, students who express a dualist epistemology may be more likely to prefer rehearsal strategies than do students categorized as relativists. In that case, study strategies aiming at comprehension, such as elaborative or organizational strategies, would be more likely to be related to relativist notions and comprehension criteria. Of course, the same overt strategy may be used for different purposes (see Lonka *et al.*, 1994), and conclusions about students' intentions on the basis of the study strategies they report may not be quite reliable.

Self-regulation in learning

Self-regulation in learning may be thought as one aspect of metacognitive strategies, and the reported degree of self-regulation has been shown to be related to efficient studying in medicine (Lonka *et al.*, 1993) and in psychology (Vermunt and van Rijswijk, 1988). Vermunt and van Rijswijk (1988, p. 648) define self-regulated learning as "performing educational activities oneself, taking over educational tasks from teachers, educating oneself". They point out that fully self-regulated learning is less common in higher education than an intermediate form between self-regulation and teacher-regulated learning. Also, they distinguish between two different kinds of learning activities: First, self-regulated processing activities that are directed at the content, and second, regulation activities that are directed at the processing activities.

The concept of self-regulation in learning resembles Bereiter and Scardamalia's (1989) notion of intentional learning, which refers to the degree of learner's intentional activity. Also, active epistemology as defined by Lonka

et al. (1990; 1994) refers to how much learner's active role in the learning process is being emphasized.

Leading research questions

In this study, dualistic epistemology (Ryan, 1984; Perry, 1970) was expected to be closely related to phenomena such as knowledge-oriented epistemological standards (Ryan, 1984), rehearsal strategies (Weinstein & Mayer, 1986), passive and non-constructivist conceptions of learning (Lonka *et al.*, 1994; Vermunt & van Rijswijk, 1988), and to surface approach (Entwistle and Ramsden, 1983). In contrast, relativist epistemology was expected to be related to comprehension-oriented epistemological standards, elaborative study strategies, constructivist conceptions of learning, and to deep approach. Table 1 shows the aspects of learning that were thought to be contrasted with each other.

On the basis of earlier studies on Finnish students in medicine (Järvinen, 1985), Finnish medical schools have traditionally been teacher-centered and school-like (Lindblom-Ylänne *et al.*, 1992), and epistemological development from dualist toward relativist orientation has not been common in Finnish medical students as compared to education in other academic domains (Järvinen, 1985; Viitala, 1991). This does not seem to be typical of Finnish medical education only: For instance, Tooth *et al.* (1989) found that among a group of entrants to one British medical school, study habits showed declining deep and strategic approaches, and increasing surface (or rote-learning) approaches during studies. On this basis, development from dualist epistemology and externally regulated, surface-oriented learning towards more self-regulated, meaningful, and goal-oriented learning was not expected to be as evident among medical students as among psychology students.

However, since all students must master increasingly large areas of their domain, it was thought that more sophisticated study strategies, deep approach, self-regulation, and relativist epistemology would develop in some degree during studying in both domains. In our earlier study (Lonka *et al.*, 1993) the latter pattern of conceptions (a factor labelled as self-regulated, meaningful, and goal-oriented learning style by Vermunt & van Rijswijk, 1988) was related to general success in medical school during the preclinical phase (i.e., the so called book-learning phase; Gilhooly, 1990). Since medicine is not a unified domain, Lonka *et al.* (1993) found the pattern of successful studying somewhat varying accross different subdomains.

In our other earlier study (Lonka *et al.*, 1994), constructivist conceptions of learning as well as notions of mental representation were shown to be related to studies in (educational) psychology. Therefore, it was expected

Table 1. Different aspects of studying

Processes, predispositions, and conceptions that may lead to:	
a) Superficial learning	b) Deep-level learning
APPROACH (Entwistle & Ramsden, 1983; Marton & Säljö,1976)	
Surface	Deep
STUDY AND LEARNING STRATEGIES (Weinstein & Mayer, 1986; Bereiter & Scardamalia, 1987; Entwistle & Entwistle, 1992; Thomas & Bain, 1984)	
Rehearsal	Elaborative, Organizational
Knowledge telling	Knowledge transforming
Reproduction	Transformation
SELF-REGULATION (Vermunt & van Rijswijk, 1988)	
Teacher-regulated learning	Self-regulated learning
EPISTEMOLOGICAL STANDARDS (Ryan, 1984)	
Knowledge criteria	Comprehension or Application criteria
CONCEPTIONS OF LEARNING AND EPISTEMOLOGIES (Bereiter & Scardamalia, 1989; Lonka, Joram & Bryson, 1994; Perry, 1968; Vermunt & van Rijswijk, 1988)	
Non-intentional	Intentional
Passive Epistemology	Active Epistemology
Dualist	Relativist
Intake of knowledge	Construction of knowledge

that constructivist conceptions of learning would not be as common among medical students, but instead, would develop in psychology students as they progress in their studies.

Thus, it was expected that there would be both domain-specific and domain-general aspects in students' epistemological development. First-year students (i.e., undergraduates) were expected to be likely to express dualism, external regulation, surface approach, and to test their knowledge on the basis of knowledge standards. Fifth year students were expected to be more likely to express deep approach, self-regulated learning, relativist epistemology, and to test their knowledge by using comprehension standards.

Method

Subjects

In Finland, high-school graduates participate in an entrance examination in order to apply to a 6-year study program combining undergraduate and graduate studies in psychology. This program gives the legitimate right to act as a professional psychologist. Compared to other European programs, the Finnish program most closely resembles the German "Diplom-Psychologen-Studium". In the University of Helsinki, approximately 35–45 students (of approximately 300–400 applicants) are accepted in the psychologist program each year. Again, all those high-school graduates who want to become physicians must participate in an entrance examination in order to apply for admission to a 6-year study program combining medical school and graduate studies. At the University of Helsinki, 110–125 students are accepted each year (of approximately 500–600 applicants).

The subjects in this study comprised 175 students who had started their studies in 1988 (fifth-year students called *advanced students*) or in 1992 (first-year students called *novices*), 116 medical students and 59 major psychology students. The psychology students were 33 novices and 26 advanced students. The medical students were 49 novices and 67 advanced students.

Materials

The task booklet consisted of open-ended questions and Likert-type questions:

In the open questions, students were first asked to give their own *subjective definitions of learning*. Scales to score the answers were adopted from Lonka *et al.* (1990; 1994). On the Active Epistemology scale (1–4), the lowest score was obtained by those subjects who simply saw the learner as an object of education (i.e., "learning is to be taught") (1), or those who implicitly saw the learner as having a passive role (2). Highest scores were obtained by those who saw learning as an activity (3) like problem solving, or by those who explicitly emphasized intentionality and students' active roles in the learning process (4). On the Constructivity scale (1–4) the lowest score (1) was obtained if learning was seen simply as acquiring knowledge that already exists. Medium scores (2–3) were obtained if learning was seen as assimilation (into a framework), or as reorganization of knowledge structures in memory. The highest Constructivity score (4) was obtained if learning is viewed as the construction of new ideas, or if constructivist notions were otherwise emphasized. We also assessed whether subjects used the terminology of mental representation as a means for explaining learning. On the Representation scale (1–4) a response

was classified as not using the representational terms in it (1), expressing a folk notion (2), expressing an implicit notion (3), or explicitly applying this notion (4), i.e., mentioning schemata, knowledge structures, and other theoretical (cognitive and representationalist) concepts.

Second, subjects were given *a comprehension monitoring probe* (Ryan, 1984) where they were asked to write their responses to the following questions:

"How do you determine (when you have completed a reading assignment or when you are reviewing the material) whether you have understood the material well enough? What specific information do you use to assess the degree to which you have understood the material you have read in a chapter? On what basis would you decide that you need to go over the chapter again or to seek help in figuring it out?".

Each student's response to the comprehension monitoring probe was analyzed to determine the specific comprehension criteria he or she employed. An effort was made to score each response for as many different comprehension criteria as possible in order to capture the full range of each student's comprehension monitoring capabilities. Comprehension monitoring criteria were adopted from Ryan (1984), classified as knowledge criteria (learning facts) or comprehension/application criteria (understanding). In addition, each response was analyzed in order to see if Weinstein and Mayer's (1986) study strategies (rehearsal, elaborative, organizational, affective or metacognitive strategies) were suggested for assessing comprehension.

Finally, students rated a set of 71 statements concerning learning approach, regulation of learning and conceptions of learning on a five-point scale. The first fourteen statements consisted of three scales adopted from the *Approaches to Studying Inventory* (ASI, Entwistle & Ramsden, 1983). The three scales were Deep Approach (4 statements), Surface Approach (6 statements) and Achievement Motivation (4 statements). The scale varied from (1) totally disagree, to (5) totally agree.

Twenty-five statements consisted of three regulation-of-learning scales adopted from the *Inventory of Learning Styles* (ILS, Vermunt & van Rijswijk, 1988). The three scales were: Self-regulation, External regulation and Lack of regulation. Self-regulation consisted of two subscales: Learning process (6 statements) and Learning contents and results (4 statements). External regulation consisted of two subscales: Learning process (5 statements) and Learning results (5 statements). One Lack-of-regulation scale consisted of 5 statements. The scale varied from (1) I seldom or never do this to (5) I (almost) always do this.

The remaining 32 statements described five conceptions of learning adopted from as many subscales of the same Inventory of Learning Styles (Vermunt

& van Rijswijk, 1988): Intake of knowledge (5 statements), Construction of knowledge (5 statements), Use of knowledge (5 statements), Stimulating education (5 statements) and Cooperation with fellow students (5 statements). Embedded in this set of 25 statements were an additional seven items that were used to classify students as dualist or relativist. *Perry's (1968) seven item dualism scale* was adopted from Ryan (1984). The scale varied from (1) I seldom or never do this to (5) I (almost) always do this.

Procedures

Data collection

The data were collected in 1993. All medical students who started their studies in 1988 were mailed questionnaires, but only 67 (60%) returned them. Two groups of psychology students were also mailed the questionnaires: to all freshmen, of whom 33 (77%) returned, and to fifth-year students, of whom 26 (63%) returned the task booklet. These three groups of students participated in a lottery where they could win a gift purchase for a bookstore, and a second set of task booklets was sent for the students who did not return the first one. For practical reasons, the first-year medical students did not participate in the lottery, but instead, were given the task booklet on an anatomy course. Of those first-year students who were present in the anatomy class, 49 (82%) filled in the task booklet.

Statistical procedures

Following Ryan's (1984) study, students whose mean score on the Perry's dualism scale was 3.0 or more on a 5-point scale, were classified as "dualists". The students with scores lower than 3 were classified as "relativists". Also, the numbers of both knowledge criteria and comprehension criteria were counted on the basis of open-ended responses to the comprehension monitoring probe. A variable was created that expressed whether subjects reported more knowledge criteria than comprehension criteria ("fact-oriented", score 1), as many knowledge criteria as comprension criteria ("neutral", score 2), or more comprehension criteria than knowledge criteria ("comprehension-oriented", score 3).

Dualists and relativists were compared in terms of their epistemological standards (i.e., how many different knowledge and comprehension criteria they had applied, and which criteria dominated). Their comprehension criteria were also compared in terms of the study strategies they suggested (rehearsal strategies, elaborative strategies, organizational strategies, metacognitive strategies, or affective strategies).

Means and Cronbach Alphas for different scales were calculated: deep approach, surface approach, achievement orientation, dualism, self-regulation,

external regulation, lack of regulation, intake of knowledge, construction of knowledge, stimulating education, cooperation, use of knowledge, constructivity, active epistemology, and notion of representation.

Correlations were computed and principal component analyses done in order to examine the interactions between study orientations, epistemologies, and conceptions of learning. A four- principal component varimax solution was chosen identically with Vermunt and van Rijswijk (1988). The two main principal components were expected to resemble two of their principal components, and to reflect criteria for efficient learning as contrasted in Table 1. However, conceptions of knowledge (epistemologies) were expected to be separate from these two principal components. Also, a fourth principal component was expected to reflect the practical orientation of the medical students. Interactions between study orientations and level/domain of studies were looked at by combining the individual scales according to their varimax rotation principal component structure (using principal component scores for each subject), and then comparing different subject groups on the basis of these principal component scores.

A two-way ANOVA (2 × 2) was applied to compare different groups (2 Levels × 2 Domains). A log-linear model was also applied in order to examine the interactions between level of studies, dualism, and the two domains. SPSSPC 4.0 software was applied for the analyses.

Results

Individual scales and their reliabilities

Table 2 shows Cronbach Alphas for each scale adopted from the *Approaches to Studying Inventory* (Entwistle & Ramsden, 1983), the *Inventory of Learning Styles* (Vermunt & van Rijswijk, 1988), and *Perry's (1968) seven item dualism scale* (Ryan, 1984). The internal consistency of the scales in this sample varied from .50 to .79. The interrater reliability of Constructivity, Active Epistemology, and Representation have been reported earlier, and they varied from 68% to 82% of unanimity between two independent raters (Lonka *et al.*, 1994).

Relationships between different scales

Table 3 shows the principal component loadings of the task booklet scales in a 4-component Varimax solution (explaining 50% of total variance). This solution was satisfactory both theoretically and statistically, all eigen values exceeding 1 (see Statistical Procedures). The first two principal components resemble those in Vermunt and van Rijswijk's (1988) study, and

Table 2. Reliabilities of scales: internal consistency (Cronbach Alphas), number of items, item means, and minimum/maximum values per scale (N = 176)

Scales	n of items	Cronbach α	Item means	Min./Max.
Learning approach (Entwistle & Ramsden, 1983)				
Surface approach	6	0.57	2.56	1.5/5.0
Deep approach	4	0.56	3.72	1.0/4.7
Achievement motivation	4	0.51	2.83	1.3/4.8
Regulation of learning (Vermunt & van Rijswijk, 1988)				
External regulation	10	0.65	2.41	1.2/4.0
Self-regulation	10	0.72	2.49	1.1/4.2
Lack of regulation	5	0.68	2.19	1.0/4.4
Conceptions of learning (Vermunt & van Rijswijk, 1988)				
Intake of knowledge	5	0.62	3.09	1.2/4.8
Construction of knowledge	5	0.50	4.20	2.6/5.0
Use of knowledge	5	0.64	4.35	2.4/5.0
Stimulating education	5	0.65	3.61	1.6/5.0
Cooperation	5	0.79	2.67	1.0/4.8
Epistemology (Perry, 1968; Ryan, 1984)				
Dualism	7	0.60	2.56	1.1/4.9

their names have been adopted accordingly: The first principal component (PC1) is characterized by high loadings on surface approach, dualism, external regulation, lack of regulation, stimulating education, cooperation, and intake of knowledge. This principal component is *called externally regulated and reproduction-directed learning*. The second principal component (PC2) shows high loadings on deep approach, self-regulation, construction of knowledge, and achievement motivation. Negative loadings on surface approach and lack of regulation are also quite strong. This component is called *self-regulated, meaning-directed, and goal-oriented learning*. Characteristic of the third principal component (PC3) are high loadings on constructivity and representation scales (adopted from Lonka et al., 1994), and the number of comprehension criteria reported. On the contrary, knowledge criteria and dualism have negative loadings on this principal component. This component is named *constructive epistemology*, since it reflects more epistemologies and epistemological standards than conceptions of learning. The fourth principal component (PC4) has high loadings on the active epistemology scale and use of knowledge, and negative loadings on representation scale and achievement

Table 3. Principal component loadings (a 4-component Varimax solution) of scales from approaches to studying inventory (Entwistle & Ramsden 1983), inventory of learning styles (Vermunt & van Rijkswijk 1988), Perry's (1968) seven item dualism scale, epistemological standards (Ryan, 1984), and conceptions of learning and knowledge (Lonka *et al.*, 1994)

Variable	Principal component				Communality
	PC1	PC2	PC3	PC4	
Learning approach					
Deep approach		81			0.66
Surface approach	55	−43			0.53
Achievement motivation		43		−45	0.46
Regulation of learning					
Self-regulation		79			0.65
External regulation	67				0.51
Lack of regulation	52	−50			0.52
Conceptions of learning					
Intake of knowledge	72				0.61
Construction of knowledge		62			0.50
Use of knowledge				66	0.49
Stimulating education	63				0.45
Cooperation	57				0.33
Epistemology and Epistemological Standards					
Dualism	45		−48		0.48
Knowledge criteria			−43		0.27
Comprehension criteria			60		0.49
Conceptions of Learning and Knowledge					
Constructivity			65		0.45
Representation			45	−58	0.47
Active epistemology				62	0.55
Percentage of variance	20	13	10	7	

Decimal places and loadings less than 0.30 are omitted.

motivation. The interpretation of this principal component is somewhat problematic. This component may be characterised as *active use of knowledge*, where students who score 'high' are not very competitive and are interested in active professional development, not so much in academic theoretical questions.

Table 4. Component scores of PC1, PC2, PC3, and PC4 by novices and advanced students in two domains. Means/Standard Deviations and F-values

Domain	Level of Students		Results of ANOVA	
	Advanced	Novices	Source	F
PC1: Externally regulated and reproduction-directed learning				
Medicine	0.00/0.93	0.31/0.96	Domain	6.0*
Psychology	−0.36/1.09	−0.11/1.01	Level	3.5
Total	−0.10/0.99	0.12/1.05	DOM X LEVEL	0.3
PC2: Self-regulated, meaning-directed, and goal- oriented learning				
Medicine	−0.30/0.92	0.19/0.83	Domain	2.9
Psychology	0.27/1.14	0.17/1.11	Level	3.1
Total	−0.14/1.01	0.18/0.96	DOM X LEVEL	3.3
PC3: Constructivist Epistemology				
Medicine	−0.08/0.89	−0.33/0.91	Domain	12.4***
Psychology	0.63/1.14	0.08/1.01	Level	5.4*
Total	0.11/1.01	−0.14/0.97	DOM X LEVEL	0.9
PC4: Active Use of Knowledge				
Medicine	0.48/0.60	−0.09/0.81	Domain	22.1***
Psychology	−0.63/1.42	−0.39/1.05	Level	3.6
Total	0.18/1.02	−0.22/0.93	DOM X LEVEL	7.4**
Numbers of students:			Degrees of freedom:	
Medicine	67	42	Domain	df=1,167
Psychology	25	37	Level	df=1,167
Total	92	79	DOM X LEVEL	df=1,167

Note: * $p < 0.05$, ** $p < 0.01$. *** $p < 0.001$

Study orientations in different subject groups

To check whether medical and psychology students or students at different level of their studies (first-/fifth-year) differed from each other in their orientation, principal component scores were computed (Table 3). Four variables were thus formed describing *externally regulated and reproduction-directed learning* (called PC1), *self-regulated, meaning-directed, and goal-oriented learning* (PC2), *constructivist epistemology* (PC3), and *active use of knowledge* (PC4). Table 4 shows the mean scores on the four principal component score scales of different groups of students.

On the PC1 scale, psychology students scored lower than medical students, and novice medical students scored highest. Measured by two-way ANOVA (2 Domains × 2 Levels), the effect of domain was statistically significant

(F(df=1,167) = 5.98, $p < 0.05$), but the effect of level of studying was not (F(df=1,167) = 3.47, $p = 0.064$). There was no interaction between the two effects.

On the scale PC2, neither the main effect for level of studies (F(df=1,167) = 2.90, $p = 0.09$) nor the effect for domain was significant (F(df=1,167) = 3.11, $p = 0.08$). The interaction between the two effects did not reach statistical significance (F(df=1,167) = 3.32, $p = 0.07$).

The highest PC3 scores were obtained by advanced psychology students, and in general, psychology students scored higher on this scale. Measured by a two-way ANOVA (2 Domains × 2 Levels of Studying), the main effect of domain was statistically significant (F(df=1,167) = 12.39, $p < 0.001$), and so was the main effect of level of studies (F(df=1,167) = 5.42, $p < 0.05$). There was no interaction between the main effects.

On the PC4 scale, the highest scores were obtained by advanced medical students, and psychology students scored lower in general. The main effect for domain was significant (F(df=1,167) = 22.06, $p < 0.001$), but the effect for level was not (F(df=1,167) = 3.62, $p = 0.06$). The interaction between the main effects also reached statistical significance (F(df=1,167) = 7.36, $p < 0.01$), indicating that among psychology students the scores declined from novices to advanced students, whereas the scores of medical students increased, respectively.

Dualism and epistemological standards

Table 5 shows that in all groups of students, there were more relativists than dualists. There were most dualists among novice medical students, and most relativists among advanced psychology students. The distributions among different subject groups differed significantly ($\chi^2(3) = 14.46$, $p < 0.01$). However, there were more advanced students among medical students than among psychology students. All interactions between the three variables (level of studies, domain, and dualism) were looked at the same time by constructing a loglinear model where level of studies and domain interacted, level of studies and dualism interacted, and domain and dualism interacted, and that there are no other interactions among these variables. This model fits well with the data (G2(1) = 0.026, $p = .872$).

Table 5 also shows that novice medical students scored highest on dualism scores, second highest were the advanced medical students, then novice psychology students, and lowest the advanced psychology students. Measured by two-way ANOVA (2 Domains × 2 Levels of Studying), there was a significant main effect for domain (F(df=1,170) = 17.07, $p < 0.001$), and also for level of studies (F(df=1,170) = 7.20, $p < 0.01$). There was no significant interaction between these two main effects.

Table 5. Dualism scores of different subject groups

Student group	Dualism Mean/SD	Relativists % (n)	Dualists % (n)	Total n
Advanced Medicine	2.6/0.65	76% (51)	24% (16)	67
Advanced Psychology	2.2/0.58	93% (26)	7% (2)	28
Novice Medicine	2.9/0.65	56% (27)	44% (21)	48
Novice Psychology	2.4/0.49	82% (27)	18% (6)	33

Table 6. Epistemology and epistemological standards

Epistemology	Epistemological Standard			
	Fact-oriented % (n)	Neutral % (n)	Comprehension-oriented % (n)	TOTAL % N
Relativist	33% (42)	27% (35)	40% (52)	100% 129
Dualist	56% (25)	20% (9)	24% (11)	100% 45
Total	39% (67)	25% (44)	36% (63)	100% 174

The principal component analysis (Table 3) already showed that the number of comprehension criteria was negatively, but the number of knowledge criteria positively associated with dualism. Table 6 shows that the ratio of comprehension criteria and knowledge criteria were related to epistemologies. Relativists were more often comprehension-oriented (i.e., reported more comprehension criteria than knowledge criteria) or neutral (i.e., reported as many comprehension criteria as knowledge criteria) than were the dualists. Dualists were more often fact-oriented (i.e., reported more knowledge criteria than comprehension criteria). In this respect, the distributions of dualists and relativists differed significantly ($\chi^2(2) = 6.97, p < 0.05$).

The question of whether there were any differences between dualists and relativists in terms of different study strategies for assessing comprehension (Weinstein and Mayer, 1986) was also addressed. It appeared that relativists more often suggested elaborative strategies (46%) than did dualists (29%). This difference was statistically significant ($\chi^2(1) = 4.10, p < 0.05$). On the other hand, dualists more often suggested rehearsal strategies (87%) than did relativists (72%). This difference was very close to statistical significance ($\chi^2(1) = 3.77, p = 0.051$). Another trend close to statistical significance

was relativists suggesting affective strategies more often (28%) than dualists (13%), $\chi^2(1) = 3.78$, $p = 0.051$). There were no differences between the two groups in the frequencies of organizational and metacognitive strategies.

Discussion

Some methodological reflections

This study clearly reflects the so called 'student approaches to learning' (SAL) position, rather than 'information processing' (IP) position (Biggs, 1993; Entwistle & Waterston, 1988): We were not tapping students' on-line processing while doing a task, but asking what they would usually do. We assume that many of the results reflect context-specific phenomena, instead of some general aspects of students' information processing. According to Ramsden (1988), three related contextual domains constitute influences on students' deployment of strategies of learning in the institutional settings of higher education: the teaching, the assessment, and the curriculum.

Meyer, Parsons and Dunne (1990) call 'study orchestrations' the associations of constructs that represent students' approaches to studying at an individual level, and which may be considered as context-specific responses. These orchestrations are affected by *the qualitative level of perception of the individual towards certain key elements of learning context* (Meyer *et al.* 1990, p. 67.) Their study suggests that it might have been interesting to look at our findings not only dimension by dimension, but also, on the basis of students' scores on each of the four dimensions together (see also Meyer, 1991). In our ongoing study (Lonka & Lindblom-Ylänne, in preparation) we will more closely look at the unique ways in which students orchestrate their studying, and also, the relationship of these different orchestrations with their study success.

Biggs (1993) pointed out that mixing constructs derived from the IP position with those derived from the SAL tradition leads to problems of interpretation. We found that, as long as we were asking the students about what they would do (rather than making assumptions of their actual processing), our results and measures showed conceptual coherence, and also, construct validity. For instance, students' suggestions for their comprehension testing on the basis of Weinstein and Mayer's (1986) classification matched their epistemological beliefs as we expected.

Mixing Perry's (1968; 1970), Ryan's (1984), and Lonka *et al.* (1994) measures in the same study with approaches to learning provided a chance to look at the interactions between different theoretical constructs. However, com-

bining different theoretical approaches is problematic, and this study should be considered exploratory.

How are conceptions of learning and epistemologies related?

The main objective of this study was to explore how different conceptions and epistemologies are interrelated. Scales adopted from different sources were combined to look at interactions between different aspects of students' responses (Entwistle & Ramsden, 1983; Lonka *et al.*, 1990, 1994; Perry, 1968; Ryan, 1984; Vermunt & van Rijswijk, 1988).

Although measures were not quite similar to previous studies, two principal components were found which resemble those reported by Entwistle & Tait (1990) or Vermunt & van Rijswijk (1988). These two strong principal components reflected *self-regulated, meaning-directed and goal-oriented* and *externally regulated and reproduction-oriented learning*. In the present study, however, it was notable that Perry's seven item dualism scale (Perry, 1968; Ryan, 1984) was related to the reproduction principal component. Again, Perry's dualism scale was negatively related to the third principal component, called *constructivist epistemology*. On this principal component, comprehension criteria loaded positively and knowledge criteria negatively (these interactions give support to Ryan, 1984). In addition, high loadings of the scales Constructivity and Representation were typical of this principal component. This principal component reflects conceptions of knowledge rather than those of learning. The fourth principal component, labelled as *active use of knowledge*, most probably reflects a professional orientation. It is interesting that the scale Active Epistemology, referring to learner's active role, is not necessarily related to a constructivist epistemology.

In sum, interactions between conceptions of learning and conceptions of knowledge appear theoretically interesting. We can assume that these conceptions affect students' study habits by guiding their reading efforts (Ryan, 1984). Conceptions of knowledge (epistemologies) may not only guide comprehension standards, but also, study strategies and orientations. Our results indicate that relativists more often than dualists suggest elaborative study strategies for testing their comprehension.

General and domain-specific aspects of students' conceptions

As expected, externally regulated and reproduction-directed learning (as measured by PC1) was more common among medical students than among psychology students. Also, epistemological development towards constructive ideas of learning and knowledge was found to be domain-specific, more

typical of psychology students. On the contrary, students' active role was emphasized by all students, especially by advanced medical students.

On the dualist epistemology scale, both domain and level of studies appeared important. The general level of dualism was higher among medical students than in psychology students, but in both domains there was a shift towards more relativist views.

Students' epistemological development and their conceptions of learning should be taken into account in instruction. Especially, dualism and non-constructive epistemologies in medical students may be obstacles to their academic development. Medical students appear more likely to express professional orientation, where only directly applicable information is appreciated. However, our previous studies indicate that this kind of approach is not related to study success in most preclinical studies (Lonka *et al.*, 1993). A dualist epistemology may be especially problematic, when problem-based learning (PBL) is going to be introduced to Finnish medical students. Previous research indicates that PBL students are more likely to study for meaning and less likely to study for reproduction (Albanese & Mitchell, 1993). We assume that skills in self-regulation will be important for PBL students. Also, PBL may enhance not only clinical reasoning skills, but also, general epistemological development. The measures introduced in this study are going to be used in further comparisons between conventional and PBL students, and their conceptual validity appears promising.

Acknowledgements

This article is based on a poster presented at Conceptual Change Symposium, Jena, Germany, August 31–September 5, 1994. The research was partly supported by Finnish Ministry of Education. We gratefully acknowledge the help in data analyses by our research assistants Sini Maury and Anu Mäkelä, and the statistical consultation by Associate Professor Esko Leskinen. Also, were are very grateful for the comments of Professors Piet J. Janssen and Erik Meyer on the previous versions of this manuscript. We also wish to thank MD Heikki Hervonen who collected data in his anatomy class.

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