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Training the brain or tending a garden? Students' metaphors of learning predict self-reported learning patterns

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Abstract

Conceptions of learning are seen as an important factor in shaping students' patterns of learning. However, conceptions are often implicit and difficult to assess. Metaphors have been proposed as a method to assess conceptions, because metaphors are closely linked to the conceptual system. Therefore, in our study we assessed which conceptions of learning are visible in students' metaphors of learning and examined whether these metaphors predict differences in students' learning patterns. Altogether, N = 91 students of educational science from a German university filled in a questionnaire on their personal metaphors of learning, their learning strategy use, epistemological beliefs, and their motivation. Four kinds of metaphors could be differentiated: regulation-related metaphors, learning as knowledge acquisition, learning as problem solving, or as personality development. A discriminant analysis revealed that students with personality development metaphors and with problem solving metaphors were more intrinsically motivated and more aware of the relativism of knowledge than students with regulation-related or knowledge acquisition metaphors. Students with personality development metaphors differed from students with problem solving metaphors in their stronger use of deep processing strategies, their lower extrinsic motivation and their stronger rejection of a dualism of knowledge. The study demonstrates that metaphors of learning are a suitable tool for assessing students' conceptions of learning and gives new insights on using this innovative method as an assessment tool.

Keywords: conceptions of learning; metaphors; learning patterns; approaches to learning

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"Learning is like rowing against the current. As soon as you stop, you drift back again." Benjamin Britten (1913-76)

"The roots of education are bitter, but the fruit is sweet" (Aristotle, 384 -382 b.c.)

1. Introduction

A great number of proverbs tell us in in metaphors what learning is like, how learning occurs, and what the benefits of learning are. Such metaphorical expressions have received a lot of attention from researchers from as diverse domains as philosophy (Black, 1993), cognitive science (Gick & Holyoak, 1980) or cognitive linguistics (Lakoff & Johnson, 1980), because metaphors have been identified as being more than a deviation from the 'normal use' of language. Instead, metaphors are closely linked to the way our conceptual system is structured, thus being one of the basic mechanisms in which we perceive the world (Lakoff & Johnson, 1980). In the context of cognitively oriented research, conceptual metaphors are usually defined as a situation or an object X that shares a similarity with a situation or an object Y ("X is like Y"). The situation or object X that is characterized by the metaphor is called the "target", and the situation or object Y that is the medium of comparison, the "source" of the metaphor. Because conceptual metaphors are based on the detection of similarities of new experiences with familiar experiences, they help to understand novel information, concepts, or information (Gentner & Holyoak, 1997, p. 32). For example, Britten's metaphor of learning as rowing against the current helps to convey the importance of learning continuously. However, metaphors only *partially* structure an experience, because the target and source of a metaphor never match completely. Obviously, the rowing metaphor leaves out important other aspects of learning, such as that learning produces positive outcomes, as in Aristotle's metaphor of education, or that learning requires the learner to link new information to existing knowledge, which becomes visible in a metaphor such as "Learning is like weaving a net". According to Lakoff and Johnson's conceptual metaphor theory, the metaphors that are used also feed back into our conceptual systems. For example, the metaphors "TIME IS A RESOURCE" and "WORK IS A RESOURCE" bring us to the realisation that leisure time is also a resource, thus influencing our concepts of leisure to be perceived as a valuable good that must not be wasted (Lakoff & Johnson, 1980). Thus metaphors act as a lens through which we perceive the world around us. Landau, Meier and Keefer (2010) suggest that metaphors are so fundamental for human thinking, that in order to understand individuals' actions with regard to abstract social concepts, such as justice, spirituality, or happiness, it is central to look at how individuals structure these concepts metaphorically:

> "…metaphor is a cognitive tool that people routinely use to interpret and evaluate information related to those abstract concepts. Put simply, a metaphor-enriched perspective suggests that a complete account of the meanings people give to abstract, socially relevant concepts requires an understanding not only of their schematic knowledge about those concepts in isolation but also how they structure those concepts in terms of superficially dissimilar, relatively more concrete concepts." (p.1047)

Therefore, we assume that metaphors could be an important tool to assess how students structure their concepts of learning. The aim of the current study was therefore to assess which kind of metaphors students use to describe learning and which impact the metaphors have on students' learning. So far, there is only very little research assessing students' metaphors of learning. However, we find ample research on students' *conceptions* of learning. Therefore, we will first outline findings on conceptions of learning and their role for how students learn. Afterwards we will elaborate on how metaphors and conceptions might relate to each other and how metaphors have been used to assess conceptions. Finally we will present evidence from our study indicating that indeed the metaphors that students use relate to their self-reported learning activities, their motivation and their epistemological beliefs, that is, their beliefs about knowledge and knowing.

1.1 Conceptions of learning

Conceptions can be defined as an "individual's personal and therefore variable response to a concept" (Entwistle & Peterson, 2004, p. 408). Conceptions are usually understood as systems of beliefs (e.g. Marton & Säljö, 1976; Richardson, 2007), which act as a filter for cognition (see Pajares, 1992). The kind of conception of learning a student holds organizes the student's perception of learning environments, the interpretation of learning tasks, the expectations towards teaching staff and other students, motivation and also the choice of learning strategies (Pajares, 1992). Early studies on students' conceptions of learning (Säljö, 1979) differentiated between five different conceptions, ranging from reproductive conceptions such as understanding learning as the acquisition of factual information and as memorizing what has been learned, over learning as the application and use of knowledge, to meaning oriented conceptions such as understanding what has been learned and as seeing things in a different way. According to the phenomenographic perspective, conceptions are understood as qualitatively distinct categories, but "higher" conceptions such as "developing as a person" subsume lower conceptions, such as "acquisition of knowledge". Individuals develop towards more advanced conceptions (e.g. Marton & Säljö, 1976). Other researchers do not assume a developmental order of distinct and developmental categories of conceptions (e,g. Richardson, 2007).

Later research focused on how students' understanding of learning is related to students' use of learning strategies, their learning motivation and their epistemological beliefs. In this productive area of research, two merging research frameworks can be discerned (Vanthournout, Donche, Gijbels & van Petegem, 2014), namely the *learning patterns* framework (Vermunt, 1996; Vermunt & Vermetten, 2004) and the *approaches to learning* framework (e.g. Entwistle & Peterson, 2004; Entwistle & Ramsden, 1983). Both frameworks are based on the assumption that there are, on the one hand, different dimensions of learning on which students individually vary (such as their use of learning strategies, their learning motivation or their self-regulation strategies), but that on the other hand, these dimensions form systematic clusters, which are called learning patterns or approaches to learning. Richardson (2011) assumes that students' conceptions of learning are important for forming these systematic clusters.

Interestingly, in both research frameworks, we find a pattern that is characterized by an intrinsic interest in studying and in learning contents (*deep approach / meaning-directed learning pattern*). Students with this pattern use deep processing strategies and have a high level of self-regulation, and according to Vermunt (1996), this pattern is characterized by a mental model of learning as construction of knowledge. Also, both frameworks describe an opposing pattern in which students have the major intention to cope with course requirements, are externally motivated, see contents as unrelated bits of knowledge and fail to see the meaning or value of the contents. This goes in hand with learning strategies that focus on rehearsal and involve little reflection, and also with a feeling of pressure and anxiety (*surface approach / reproduction-directed learning pattern*). This pattern is based on the mental model of learning as intake of knowledge (Vermunt, 1996).

Both frameworks also describe, apart from these two more or less identical types of students, additional patterns or approaches. Within the learning patterns framework, Vermunt (1996) describes a type of students with an *undirected learning pattern*. This pattern is characterized by a lack of regulation, ambivalent motivation, and no identifiable mental model of learning. The other type of student described by Vermunt (1996) are those with an *application directed learning pattern*, which is based on the mental model of learning as the use of knowledge, an intrinsic (vocational) orientation and concrete processing of information. The approaches to learning framework additionally includes a *strategic approach* (Biggs, 1987; Entwistle, Tait, & McCune, 2000). This approach is characterized by a strong motivation to do well in the course and to complete the degree in order to accomplish personal goals. Students with a strategic approach organize their studying well, manage their time effectively, and are alert to assessment requirements and criteria (Virtanen & Lindblom-Ylänne, 2010). In a comprehensive review, Vermunt and Vermetten (2004) found that an undirected pattern/surface approach leads to the worst studying results; the best studying results are yielded by the meaning-directed pattern/deep approach. Reproduction-directed pattern and application-directed pattern had no clear relation to studying success.

1.2 Assessing conceptions of learning

Taken together, we can draw from research that conceptions play an important role in shaping students' learning, and thus have an impact on their studying. However, assessment of conceptions is not as simple as it seems. As we have pointed out above, conceptions are partly implicit and therefore difficult to assess. Interviews which could be used to assess also implicit aspects of conceptions are time consuming and are not suitable for large scale studies. Often, questionnaires with dimensional assessment scales such as the Inventory of Learning Styles (ILS, Vermunt, 1994) are used to assign students to distinct groups by using cluster analysis (e.g. Parpala, Lindblom-Ylänne, Komulainen, Litmanen, & Hirsto, 2010; Entwistle & McCune, 2013; Richardson, 2007). However, the technique of cluster analysis carries the risk of methodological artefacts, because general answer tendencies might account for correlations between two variables (Richardson, 2011). For example, some persons tend to agree rather than to disagree on items (acquiescent response style), whereas others tend to choose extreme response categories on all scales. This can result in clusters not based on differences in the assessed dimensions, but on the general answer tendencies. Another problem is that clusters can only be determined post hoc in large samples, but it is difficult to make an individual diagnosis of conceptions. Consequently, assessment techniques are needed to determine conceptions of learning. Given the important role of metaphors for our cognitive system, it comes as no surprise that recently in the area of teacher education and of higher education in general, metaphors have become increasingly popular for assessing implicit constructs such as conceptions (Löfström, Nevgi, Wegner, & Karm, 2015).

1.3 Using metaphors for understanding conceptions

To use metaphors to assess conceptions of learning, we need to take a closer look into how metaphors and conceptions are assumed to relate to each other, and how this has been exploited in research. Unfortunately, educational researchers using metaphors often do not explicate which relation between metaphors and conceptions they assume. This is problematic because Lakoff's and Johnson's cognitive metaphor theory, which is still the most prominent metaphor theory, allows for different assumptions about the relation between metaphors and cognition. Murphy (1996) describes a "strong version" of this theory, stating "that some concepts are not understood via their own representations but instead by (metaphoric) reference to a different domain" (p. 201). This would imply that a metaphor of learning is identical to a conception of learning. A person who describes learning as the construction of a skyscraper would then literally have the conception that learning is construction. In contrast, the "weak version" of cognitive metaphor theory assumes that both the source and the target concept of the metaphor are more or less developed separate cognitive structures. Under this view, a certain conception is the reason why a person can identify features that are mappings between one's own conception and a certain metaphor (Haser, 2005). Thus, a person who has the conception of learning as a construction of knowledge would single out identical features between learning and building a skyscraper, but not between learning and eating, and thus prefer to use the metaphor of learning as building a skyscraper then as eating a cake as a descriptor.

In research using metaphors for assessing conceptions we can find works based on the "strong" and the "weak" versions of cognitive metaphor theory. Those researchers who are interested in examining the development and change of conceptions, for example in the context of educational development programs (e.g. Bullough, 1991; Clandinin, 1985), tend to argue on the base of a strong version of cognitive metaphor theory because they usually assume that changing the metaphor a person uses also leads to a change in the person's conception. In contrast, researchers using metaphors mainly for assessment of conceptions (e.g. Saban, Kocbeker & Saban, 2007; Patchen & Crawford, 2011) usually argue on the base of a weak version of the cognitive metaphor theory, assuming that metaphors help to express or to identify an underlying conception. Based on the longstanding tradition on research on conceptions of teaching and learning (e.g. Gow & Kember, 1993; Vermunt & Vermetten, 2004), we assume that there are indeed underlying

conceptions that are separate from metaphors, and thus would adhere to a weak version of cognitive metaphor theory. We assume that the underlying conception enables or prompts a person to identify structural mappings between one's own conception and the metaphor.

Two principally different approaches can be discerned in assessing conceptions via metaphors (Löfström et. al., 2015). On the one hand, researchers themselves generate metaphors and use them as a stimulus for assessing conceptions. For example, some researchers have developed questionnaires in which participants are asked to rate metaphors (e.g., Lehmann, 2012). Others have asked participants to reflect on preselected written metaphors (e.g., Visser-Wijnween, van Driel, van der Rijst, Verloop & Visser, 2009) or metaphorical pictures (Ben-Peretz, Mendelson & Kron, 2003), and analysed the participants' responses with regard to the underlying conception. In both cases, the participants mapped preselected metaphors to their own conception. On the other hand, researchers also asked participants to produce metaphors on their own, and then analysed these metaphors according to their conceptual content. For example, Saban et al. (2007) asked more than 1000 students to write down a metaphor on being a teacher and identified six dominant conceptual mappings for the metaphors: knowledge provider, craftsperson, facilitator, nurturer, counsellor and democratic leader. Interestingly, these conceptual categories are similar to conceptions of teaching as described in the "teaching perspectives inventory" by Collins and Pratt (2011), namely, transmission, apprenticeship, developmental, nurturing and social reform. Other studies (Patchen & Crawford, 2011; Wegner & Nückles, 2015a) classified metaphors based on the two scientific paradigms of learning as acquisition vs. as participation according to Sfard (1998). Only a few studies focus on students' metaphors. Inbar (1996) asked more than 400 students for metaphors on 'being a student' and on 'teachers'. A great proportion of metaphors was related to feeling imprisoned in school, showing largely negative emotions towards school. Marsch (2009) analysed high school students' metaphors of biology learning. She found that most students conveyed an idea of learning as intake of knowledge. In a longitudinal study with students from educational science, Wegner and Nückles (2015b) found that students adapted their metaphors of learning to university learning culture in the course of their first year of studying. While in the first year, the most frequently used metaphor of learning was "collecting", the most frequently used metaphor in the second year described learning as "discovering".

Even though empirical studies do indicate that different views on teaching or learning are visible in metaphors, and there are theoretical arguments for a close relationship between metaphors and conceptions, there are few studies which really validate whether different metaphors also account for differences in underlying conceptions, and even less, whether they also account for differences in actual practice. Moreover, all of the existing validation studies are case studies with very small samples, or just report data on selected cases illustrating their hypotheses (e.g. Mahlios, Massengill-Shaw, & Barry, 2010; Bullough, 1991; Marsch, 2009; Thomas & McRobbie, 1999). Some larger studies link metaphors of teaching to other self-reported data, but not to practice (Wegner & Nückles, 2015a; Löfström & Poom-Valickis, 2013). Thus, there is a need for empirical studies validating whether metaphors of learning can indeed be an indicator for conceptions of learning, and whether students' metaphors of learning really relate to how students learn in terms of which learning strategies they use and what their motivation is.

1.4 Summary and aims of the study

In sum, we can conclude that students' learning patterns are influenced by the individual understanding by students of what learning is, that is, their conceptions of learning. First evidence from studies on conceptions of teaching indicates that metaphors might also be an appropriate and helpful tool for assessing conceptions of learning, and that differences in metaphors of learning are also associated with differences in students' learning practice. However, so far there are only few studies analysing the relation between metaphors and practice, and studies are only based on small sample sizes. In our study, we aimed at closing these gaps by *(a)* exploring whether the different conceptions of learning as they have been described in the literature are also visible in the metaphors that students use to describe learning, and *(b)* examining whether differences in the conceptual content of the metaphors account for differences in learning practice, such as the use of learning strategies, study motivation, and epistemological beliefs.

2. Methods

2.1 Participants and procedure

Ninety-one students of Educational Science from a German university took part in the study (78.1% female and 21.9% male, $mean_{age}$ =23.81 years, SD_{age} =3.38). All students were first given a short example of what we meant by metaphor, and were then asked to write down their metaphors of learning. Afterwards they filled-in questionnaires on learning-related measures. All measurements took place in university courses in the Institute of Educational Science and were set at the beginning of a lesson.

2.2 Questionnaires

For assessing learning-related measures, we chose questionnaires on motivation, learning strategies and epistemological beliefs which are well established for German language speakers and which address central aspects of learning patterns and approaches to learning (for an overview of the scales and their reliabilities, see Table 1).

Table 1

Scales of the questionnaires, scale reliability (Cronbach's a), mean values (M), standard deviation (SD) and number of items.

	Sample item	α	M	SD	No. of items
Intrinsic motivation	I don't need a reward for completing the study tasks because they are fun.	. 734	4.96	0.91	5
Extrinsic motivation	I will be quite proud when I have completed my degree.	.726	5.82	0.96	3
Organisation	I draw tables and graphs in order to structure the contents of the subject.	.791	3.68	0.61	8
Elaboration	I try to relate new concepts or theories to familiar concepts or theories.	.742	3.67	0.55	8
Critical thinking	I examine whether theories, interpretations or conclusions are sufficiently grounded.	.873	3.11	0.68	8
Rehearsal	I re-read my notes again and again.	.827	3.14	0.75	7
Metacognitive strategies	Before I start with learning, I try to plan which contents I do need to know and which I don't.	.745	3.59	0.47	11
Time management	I schedule time slots for studying.	.897	2.99	0.95	5
Learning with others	I work on texts and tasks together with my colleagues.	.849	3.41	0.77	7
Relativism	Scientific research shows that there is one right answer to most problems.	.635	1.69	.40	6
Dualism	If two scientists have a different opinion on a matter, one of them has to be wrong.	.613	1.68	.43	4

The use of learning strategies was assessed by seven scales of a German questionnaire (LIST; Wild & Schiefele, 1994) which is based on the Motivated Strategies for Learning Questionnaire (MSLQ; Pintrich, Smith, Garcia, & McKeachie, 1993). Participants rated on a five-point rating scale how often they engage in certain learning activities (*"In the following, we would like to know about **how** you learn. You will find a list of learning activities. Please indicate for **each** activity, how often it occurs when you are learning. You can rate the frequency between very seldom (1) and very often (5)"*). The selected activities addressed four cognitive strategies (organization of contents, elaboration of contents, rehearsal, critical thinking), metacognitive strategies, use of time management strategies and the frequencies of learning with others.

Motivational orientation was assessed by two scales of the Intrinsic Motivation Inventory (IMI; Deci & Ryan, 2003), one on intrinsic motivation and one on the extrinsic value of studying in a version adapted to the context of higher education. Students were instructed to rate the items on their seven-point rating scale ranging from *completely disagree* to *completely agree* (*"Please indicate for each statement how much you agree. [...] These questionnaires are not evaluated! There are no "right" or "wrong" answers."*)

Epistemological beliefs in general were assessed by a German questionnaire on epistemological beliefs (Köller, Watermann, Trautwein, & Lüdtke, 2004). It comprises two dimensions, "dualism" (sample item: "If two scientists have a different opinion on a matter, one of them has to be wrong.") and "relativism" (sample item: "Scientific insights that seem true today can turn out to be wrong"). Participants had to rate the statements on a four-point rating scale ranging from totally disagree (= 1) to totally agree (= 4).

2.3 Assessment and analysis of metaphors

Following Saban (Saban et al., 2007), students had to answer the questions "Learning is like… because…". In order to enrich the answers, we added the question "The goal of learning is…". Metaphors were analysed following Chi's recommendations on coding verbal data (1997). Two metaphors were excluded from the analysis because they were only fragments. One metaphor as a whole was defined as the unit of analysis, that is, the complete answer consisting of the source and explanation of the metaphor, because sometimes the same source was associated with different kinds of explanations (e.g. "learning is like food: you need it for survival" vs. "Learning is like eating food: if you eat too much, you get sick"). We then inductively developed a system of categories within a team of two researchers. All decisions were also discussed within a larger research team, consisting of four researchers in total. As in other studies (e.g. Inbar, 1996; Leavy, McSorley & Boté, 2007) , we found a large amount of metaphors without conceptual content, but merely related to aspects of regulating one's own learning and motivation, such as in "Learning is like jumping into cold water. Usually you don't want to do it, but once you get started, it's always good". Therefore, regulation-related metaphors were first separated from other metaphors. In the second step, the remaining metaphors were classified according to the conceptual content. We distinguished three different kinds of metaphors: learning as acquisition of knowledge vs. learning as problem solving vs. learning as development of personality (see Table 2). For each category, a short description was written down with examples. Then,half of the metaphors (N=43) were coded by a second independent person. Interrater-reliability as measured by Cohen's κ was very good (κ = .81).

3. Results

Conceptions of learning as described in literature were visible in our metaphors. Of the four categories of metaphors, knowledge acquisition was the most common (30.3%), followed closely by regulation-related metaphors (28.1%). Personality development metaphors were described by 25.8% of the students, and only 15.7% of the students used metaphors which focused on learning as a prerequisite for solving problems (Table 3).

Table 2

Categories of metaphors, description and anchoring examples for each category of metaphor

Category	Description	Example	N
Regulation-related metaphors	The metaphor and its explanation refer to self-regulation aspects and do not contain any information about cognitive processes or further goals in learning.	"Learning is like jumping into cold water. Usually you don't want to do it, but once you get started, it's always good." "Learning is like climbing a mountain. Some hills are steep, and others are easy to walk."	25 (28.1%)
Acquisition of knowledge	Learning consists of the acquisition of something (=knowledge). There is no further indication that the acquired knowledge is used for something.	"Learning is like building a library with your own books. You start with one shelf and while you get more and more books you also need more shelves." "Learning is like solving a jigsaw puzzle … the goal is to solve the jigsaw puzzle and to get the complete picture."	27 (30.3%)
Problem solving	Learning consists of the acquisition of something (= skills and knowledge) which are necessary to solve certain problems, to be prepared for future challenges or to be able to work in a certain job.	„Learning is like food – you need it for survival. Without it you cannot deal with new problems." "Learning is like getting a closet with lots of clothes. At the beginning of your life you have only a few pieces of clothes, later you get more and more […]. The goal is to buy, to select, to sort, to categorize the clothes so you can use them and wear them when you need them."	14 (15.7%)
Development of personality	Learning consists of developing something existing further, in order to develop one's own personality or new perspectives.	"Learning is like exploring other countries. You get to know new cultures and new perspectives, and you widen your horizon." "Learning is like a plant that is growing, because you thrive and prosper inside."	23 (25.8%)
Total			89 (100%)

In the next step, we determined whether students with different kinds of metaphors differed with regards to their epistemological beliefs, their study motivation, and their learning strategies. An overall MANOVA with type of metaphor as independent measure, and epistemological beliefs, motivation and learning strategies as dependent measures showed a significant multivariate effect of metaphor type, $F(33, 231) = 2.31$, $p < .001$, $\eta^2=.25$ (see Table 3 for an overview of the descriptive data for the four kinds of metaphors). Separate univariate ANOVAs revealed significant differences for intrinsic motivation, $F(3, 85) = 4.31$, $p < .01$, $\eta^2=.13$, for dualism $F(3,85) = 2.78$, $p < .05$, $\eta^2=.09$, and the use of rehearsal strategies, $F(3,85) = 4.31$, $p < .01$, $\eta^2= .14$. Students with problem solving and development metaphors indicated a higher intrinsic motivation than students with regulation-related or knowledge acquisition metaphors (see Table 3). Students with personality development metaphors had the lowest scores on the dualism scale, while students with knowledge acquisition metaphors had the highest, indicating that students with knowledge acquisition metaphors believed much stronger that knowledge is either true or false than students with personality development metaphors. Students with knowledge acquisition metaphors also had the strongest tendency to use rehearsal strategies, followed by students with regulation-related and personality development metaphors. Students with problem-solving metaphors had the lowest scores on this scale.

Table 3

Means and standard deviation for study motivation, epistemological beliefs and learning strategies for each group of metaphors

	Regulation-related	Acquisition of knowledge	Problem solving	Development of personality
Intrinsic motivation	4.70 (0.76)	4.66 (0.98)	5.36 (0.90)	5.33 (0.81)
Extrinsic motivation	5.70 (1.11)	5.91 (0.89)	6.11 (0.66)	5.70 (1.03)
Relativism	1.77 (0.42)	1.80 (0.44)	1.63 (0.42)	1.52 (0.29)
Dualism	1.66 (0.37)	1.82 (0.46)	1.75 (0.38)	1.49 (0.43)
Critical thinking	3.06 (0.75)	3.01 (0.58)	3.01 (0.71)	3.35 (0.71)
Learning with others	3.42 (0.68)	3.50 (0.86)	3.00 (0.62)	3.58 (0.80)
Elaboration	3.70 (0.53)	3.69 (0.54)	3.57 (0.48)	3.68 (0.65)
Organisation	3.53 (0.37)	3.80 (0.58)	3.68 (0.83)	3.71 (0.71)
Rehearsal	3.05 (0.75)	3.52 (0.57)	2.70 (0.82)	3.06 (0.75)
Metacognitive strategies	3.57 (0.43)	3.75 (0.55)	3.43 (0.46)	3.52 (0.42)
Time management	2.73 (0.78)	3.29 (0.95)	3.30 (0.92)	2.75 (1.06)

To better understand the overall differences between the groups, and the patterns of motivation, epistemology and learning strategies for each group, we performed a discriminant analysis with epistemological beliefs, motivation, and learning strategies as predictors and the kind of metaphors as criterion. It resulted in three discriminant functions. The first discriminant function explained half of the variance, 56.8%, canonical $R^2 = .38$; the second discriminant function explained one third of the variance, 33.2% canonical $R^2 = .26$. The third discriminant function explained the remaining 9.9% of the variance, canonical $R^2 = .09$. Together, the three functions significantly differentiated between the metaphor types (Wilk's $\Lambda = .41$, $\chi^2(33) = 71.89$, $p = .000$). After removing the first function, the remaining two functions still contributed significantly to the classification of the metaphors (Wilk's $\Lambda = .66$, $\chi^2(20) = 33.12$, $p = .03$). However, the last function on its own could not differentiate between the metaphors. Figure 1 shows the distribution of the four metaphors among the two separating functions. Correlations of the predicting variables with each canonical discriminant function are given in Table 4.

A closer look at the discriminant functions revealed that the first function separated the students with regulation-related and with knowledge acquisition metaphors from the students with personality development and problem solving metaphors, whereas the second function mainly separated the students with problem solving metaphors from the students with personality development metaphors, see Fig. 1. The first function was associated with high beliefs in the certainty of knowledge (i.e., low relativism), and with a low intrinsic motivation, see Table 4 and Fig. 2), thus indicating that students with knowledge acquisition and regulation-related metaphors were less intrinsically motivated and believed to a higher extent that knowledge is certain and unambiguous. The second function correlated positively with extrinsic motivation and the belief in the dualism of knowledge, and negatively with an extra preference for critical thinking, for learning with other students and for elaboration of contents (see Table 4). This indicates that students with problem solving metaphors were more extrinsically motivated, believed more that knowledge was either wrong or right, and were less inclined to critically think about the contents or to discuss them with colleagues, than students with personality development metaphors.

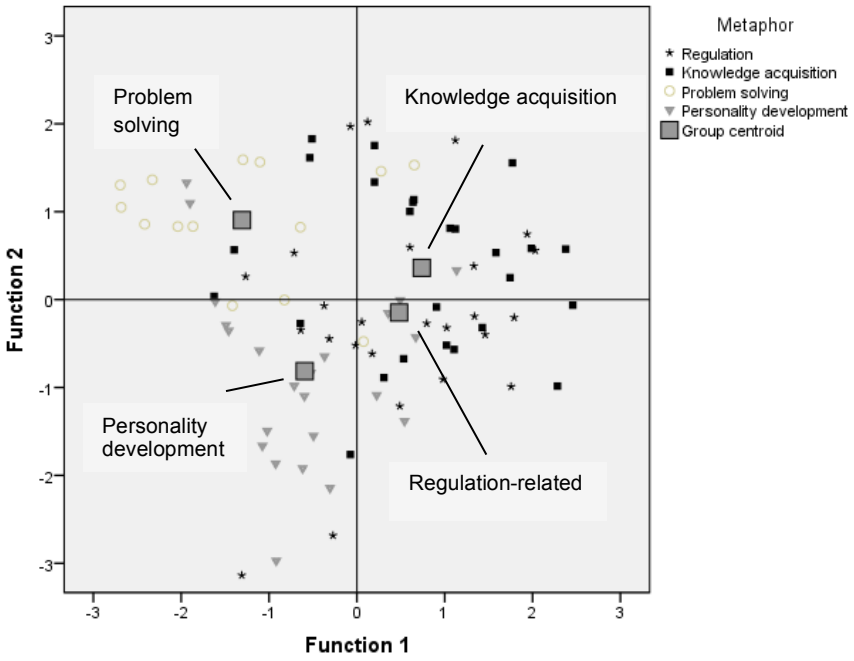

Figure 1. Plot of the group centroids of the four metaphors with regard to the two discriminant functions. Function 1 separates problem solving and personality development metaphors from the regulation-related and knowledge acquisition metaphors. Function 2 separates personality development from the problem solving metaphors.

Table 4

Correlations between discriminant functions and the predicting variables. Bold print indicates the highest correlating function for each predictor variable

	Function 1: Instrinsic motivation (-) and variability of knowledge	**Function 2:** Extrinsic motivation Deep processing (-), dualism	**Function 3:** Structured learning
Instrinsic motivation	**-.467**	-.144	.191
Relativism (general certainty beliefs)	**.299**	.250	-.198
Dualism (beliefs in simple knowledge)	.179	**.460**	.140
Learning with others	.172	**-.316**	.263
Critical thinking	-.107	**-.309**	.140
External motivation	-.068	**.253**	.149
Elaboration	.062	**-.097**	-.078
Rehearsal	.424	-.003	**.702**
Organisation	-.008	.051	**.475**
Time management	-.002	.421	**.461**
Metacognitive strategies	.269	.060	**.357**

The last canonical discriminant function helped to differentiate the four groups only together with the second function. On this function, we found high loadings of measures indicating structured learning, such as the strategies of organization and rehearsal, metacognitive strategies and time management (see Fig. 2). The function differentiated between regulation-related metaphors and knowledge acquisition metaphors, with students with knowledge acquisition metaphors showing more use of structured learning than students with regulation-related metaphors, that is, students with metaphors which just focus on aspects relating to the regulation of their learning or their motivation rather than on the results or the process of learning. However, as noted above, the third function could not discriminate between the groups on its own.

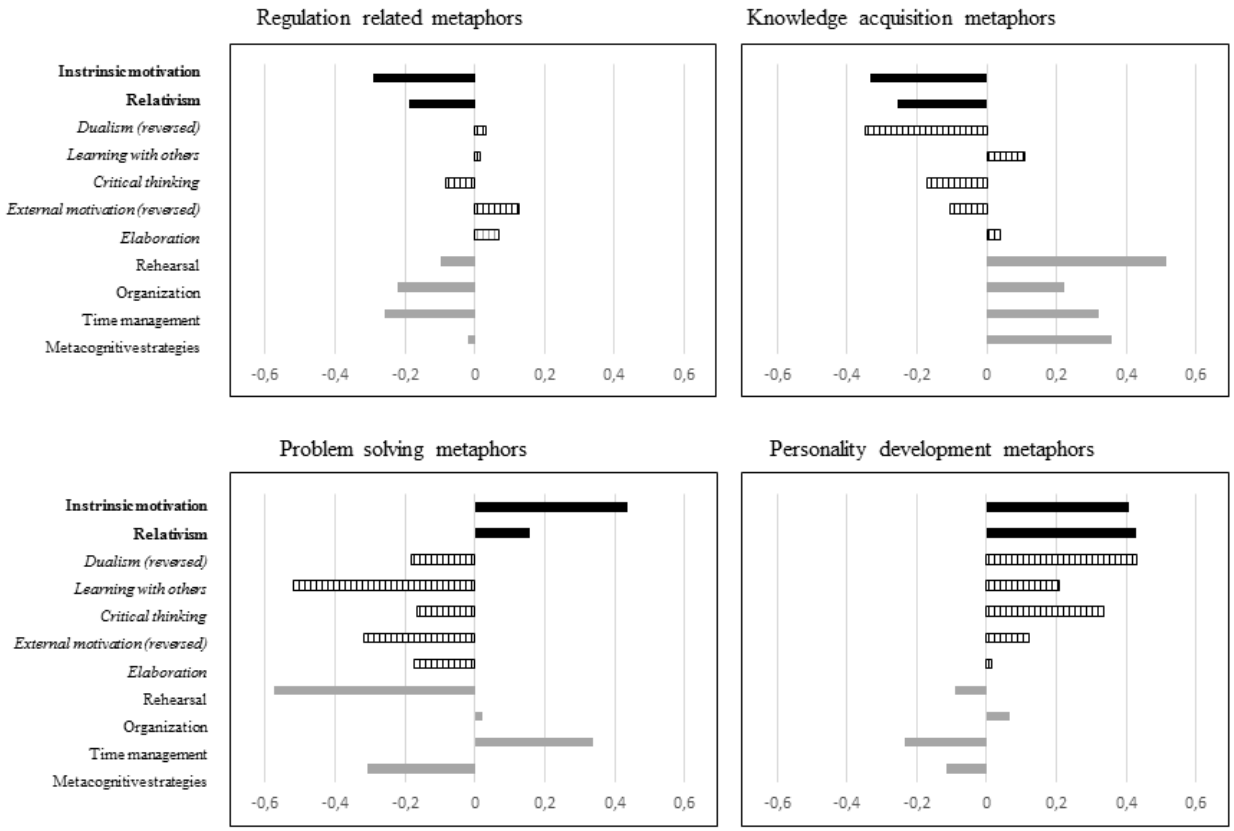

Figure 2. z-standardized mean values for each of the metaphor categories. The variables of the first function are printed in black/bold (discriminating between the regulation-related and knowledge acquisition metaphors on the one hand, and the problem-solving and the personality development metaphors on the other hand). Variables of the second function are given in hatched/italics (discriminating between problem solving metaphors and personality development metaphors).

4. Discussion and Conclusion

In our study, we could distinguish four kinds of metaphors of learning, namely metaphors focusing on regulation aspects of learning, metaphors expressing the idea of learning as knowledge acquisition and the idea of learning as personality development, and metaphors focusing on learning as a prerequisite for problem solving. Students' metaphors of learning predicted different patterns of motivation, epistemology and use of learning strategies. Students with problem solving and with personality development metaphors differed in their intrinsic motivation and their awareness for the tentativeness of knowledge from students

with knowledge acquisition and with regulation-related metaphors. Students with personality metaphors could be separated from students with problem solving metaphors by their use of deep processing strategies, their belief in the dualism of knowledge and their extrinsic motivation. Finally, students with knowledge acquisition metaphors had a tendency to engage more in structured learning activities than students with regulation-related metaphors, though not significantly so.

Metaphors of learning predicted study motivation, epistemological beliefs and learning strategies. This implies that metaphors can be used to detect differences in conceptions of learning. The predicted learning patterns mirror in some respects both the learning patterns and the approaches to learning model. Personality development metaphors seem to predict a meaning-directed learning pattern or a deep approach, because students with personality development metaphors displayed a high intrinsic study motivation, a high awareness for the tentativeness and the complexity of knowledge and indicated to make much use of deep processing strategies. This finding confirms results from Entwistle and McCune (2013), who found that there is a certain group of students that have a 'disposition to understand for oneself'. This disposition seems to be based on the view of learning as development of personality.

Students with problem solving metaphors have similarities with students with an application-directed learning pattern as described by Vermunt (1996), because the application directed mental model of learning is based on the use of knowledge as well. Problem-solving metaphors were also associated with strong extrinsic motivation for studying, but were, other than students with the application-directed learning pattern, also more intrinsically motivated. On the other hand, students with problem-solving metaphors made only average use of concrete processing strategies such as elaboration of contents, which would have been expected in an application-directed learning pattern.

Knowledge acquisition metaphors seem to be similar to Vermunts' rehearsal-directed learning pattern, because they are also characterized by a mental model of intake of knowledge. As students with a rehearsal-directed learning approach, students with knowledge acquisition metaphors had an extrinsic study motivation and believed in the stability of knowledge. However, other than students with a rehearsal-directed learning pattern, students with knowledge acquisition metaphors in our sample also described the use of deep learning strategies and structured their learning activities strongly. In this respect, they seem more similar to the strategic approach described by Biggs (1987), which is characterized by good organization, good time management, and alertness to the assessment requirements and criteria. This would indicate that acquisition and elaboration of knowledge are seen as the dominant requirement within the degree under consideration.

Finally, regulation-related metaphors have a great overlap with the undirected learning pattern. The metaphors did not convey a mental model of learning, students had little intrinsic motivation and they did not engage in deep or structured learning activities. This is interesting in several respects. On the one hand, these findings mirror those of other studies in which participants described metaphors with no apparent match to conceptions of teaching or learning. For example, in Inbar's (1996) study with high school students, most metaphors were related to emotional aspects of learning and did not reveal anything about underlying conceptions of learning. Similarly, in their study on teacher candidates' metaphors of teaching, Leavy et al. (2007) report a great number of metaphors that did "not refer to components central to the practice of teaching, but referred to what teaching meant to the individuals themselves (e.g. 'teaching is like running a marathon; you train, sweat, and prepare for this great race but once you're in it, you just keep going strong until the end')" (p. 1226). In one group of the sample, 30% of the metaphors were 'self-referential'. Such self-referential metaphors can be found in many studies using metaphors (e.g. Leavy et. al., 2007; Zapata & Lacorte, 2007; Löfström & Poom-Valickis, 2013). Findings from our study might be a first indicator that the participants who use such self-referential, emotional or motivational metaphors have not yet developed a differentiated explicable conception which can be communicated by a metaphor. Considering the unorganized use of learning strategies in this group, the finding could be interpreted in the way that a lack of an elaborated conception of learning is a major problem for developing adequate learning strategies. Consequently, to these students challenges of self-regulation are the most distinct experience of learning. However, further research is needed to confirm this hypothesis.

Of course, some limitations have to be born in mind. Again, our study only assessed self-report data on participants' use of learning strategies in general. Therefore, we do not know how students' answers relate to their actual practice of learning or on what they *think* they should do. Also, course requirements, which influence strongly how students actually learn, need to be considered (Vermetten, Lodewijks & Vermunt, 1999). However, if students were biased in their answers on their learning strategy use, the differences in self-report data between the four kinds of metaphors indicate at least that students differ in what they think is a socially desirable answer. Another limitation is that we assessed metaphors just in one context at one point of time. So we cannot draw conclusions about whether metaphors are stable across contexts or over time, as conceptions would be. Nevertheless, metaphors seem to be a promising research tool which should receive further attention for research on conceptions of learning, because it seems indeed to matter whether students see learning as a matter of training their brains or tending their gardens.

Keypoints

- Students' "metaphors of learning" discriminated between different profiles of motivation, epistemological beliefs and use of learning strategies.
- Different categories of metaphors could be linked to both learning patterns and approaches to learning.
- Students describing learning in terms of personality development shared similarities with deep approach learners and meaning-directed learners.
- Students focussing in their metaphors on only the regulation aspects of learning shared similarities with undirected learners.
- Students describing learning in terms of knowledge acquisition shared similarities either with rehearsal-directed learners or with learners with a strategic approach.

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