



PERGAMON

Teaching and Teacher Education 17 (2001) 965–977

TEACHING
AND TEACHER
EDUCATION

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Metaphors as blueprints of thinking about teaching and learning

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Received 4 November 1999; received in revised form 5 July 2000; accepted 30 October 2000

Abstract

This study analyses the metaphorical conceptions of learning based on the reflections of 50 experienced teachers in an evening course on instructional psychology. The metaphors were achieved by collaboration in small groups. “Co-reflection” of group members was well suited to promote metaphorical reconstructions of teachers’ tacit theories about learning. The results show that the majority of these teachers shares traditional metaphors depicting teaching and learning as transmission of knowledge, followed by a smaller group of teachers expressing constructivist metaphors. Only a minority seems to conceive of teaching and learning as a social process. These results are compared with metaphors formulated by 38 prospective teachers without classroom experience participating in a course on curriculum design. In further collaborations these metaphors should serve as stepping stones to broader and more profound conceptions of the nature of teaching and learning. © 2001 Elsevier Science Ltd. All rights reserved.

Keywords: Metaphors; Experienced teachers; Prospective teachers; Conceptions of learning; Comparative study

1. Introduction

Metaphors are not just figures of speech, but constitute an essential mechanism of the mind. Arguing against positions which treat metaphors as trivial products of thinking, Lakoff and Johnson (1980, 1999) have emphasized that a major part of our conceptual system is structured by metaphorical relations. By these metaphors we become aware of essential similarities between

entities which otherwise might appear disparate. Thus, experts are the most effective constructors of metaphors because of their capacity to link any subject given to their field of knowledge in almost unlimited ways, as Gardner (1983, 1999b) points out in his theory of multiple intelligences. On the other hand, while a particular metaphor enables us to see a phenomenon from a specific point of view, it may disincline us to search for what may be more adequate or more promising perspectives (Phillips, 1996). That is, when we encounter an interesting phenomenon, we are apt to follow a train of thought provided by some prevailing metaphor and to base our hypotheses about the phenomenon, as well as our planning and decision-making, on a conceptual framework

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determined by this metaphor. Especially during this initial phase of facing a problem we may not be aware of the pervasive influence under which we act, because our prevailing metaphors usually represent the undisputed state of the art in our “community of practice” or our “scientific community”. In education as well as in other sciences, researchers and practitioners are unconsciously guided by images and metaphorical patterns of thought recurring in their field, which can be seen as “archetypes” of professional knowledge or from a merely functional point of view as blueprints of professional thinking. Phillips (1996, p. 1011) warns that we may be “insulated from ideas coming from outside” and “can easily get sucked into this self-sustaining whirlpool” of thinking guided by metaphors—as long as we are unable or do not try to get access to our metaphors.

We do not intend to advocate a particular theory of relationship between metaphors and thought, but we want to clarify the crucial role of metaphors in educational thinking by elaborating on different metaphorical perspectives. Lakoff and Johnson (1980, 1987, 1999) have explained that our fundamental abstract ideas are based on a diversity of complex metaphors, which are anchored in a set of primary metaphors mediated by physical experiences in the environment. These primary metaphors are the result of recursive coordinations of subjective experience and sensorimotor functions. Coordinated activations of psychological and physiological functions generate a disposition to apply words from the area of sensorimotor experience to name phenomena of subjective experience which are thus metaphorically conceptualized (Lakoff & Johnson, 1999; Lakoff, 1999a-c). That is, our primary metaphors are derived from the structure of our body and our mind, and from the characteristics of the world in which we are living (Narayanan, 1997).

Considering these general aspects of metaphorical thinking we assume that metaphors exert powerful influences on processes of analyzing and planning in education and, in particular, that they are profoundly affecting teachers’ thinking about teaching and learning. As blueprints of thinking, metaphors of learning will guide and facilitate teachers’ understanding of what it means to learn,

but these same tools of thinking may also limit the thoughts, attitudes and actions of prospective educators.

Prawat (1999, p. 72) takes an additional step in recommending that teachers reflect not only on the metaphorical bases of their own thinking, but “give a great deal of thought to the quality of the metaphors they present” in their classrooms. Describing the development of Peirce’s concept of abductive reasoning and the role of abduction in generating hypotheses, Prawat (1999) underlines the contribution of perceptual elements in thinking, which help to bridge the gap between the available, less complex knowledge and the new, more complex knowledge to be learned by using a “metaphorical leap” or a metaphorical projection. Abduction as a metaphorical process facilitates students’ understanding of a new phenomenon by suggesting that a metaphor linked to this particular phenomenon provides valid explanations. In other words, from the perspective of abductive thinking the core activity of learning something new consists in drawing conclusions from a surprising event or fact to a rule, which may explain it. At the outset this process involves a perceptual or iconic sign representing similarity, while more advanced stages of this process probe for index relations of event and sign, and finally—necessarily by means of discourse within the social community—establish symbolic generality (cf. Prawat, 1999).

Two aspects of this line of argumentation are especially important for our considerations. Firstly, the stage model of abduction applied to learning implies complementary linkages of individual and social learning. Secondly, as underscored also by Johnson (1987), knowledge is not only structured by propositions but seems to be primarily “embodied” in a literal sense by our sensorimotor experiences. The importance of “gestalts of experience” has also been pinpointed in the neurosciences by Damasio (1994), who reported that many scientists—for instance, Einstein, Feynman, Mandelbrot—confessed that sensorimotor-visual, auditive, and muscular images constituted the core content of their initial thoughts. Thus, essential “metaphorical leaps” seem to use physiological processes we are not

necessarily aware of as stepping stones to declarative thoughts, which may be made explicit by words or mathematical symbols.

We have only outlined the crucial role played by metaphors in generating new ideas and the specifics of learning them. There is no space to elaborate on central aspects of abductive thinking (e.g., Apple, 1999; Gee, 1999; Noddings, 1999), although its relation to learning needs further consideration. Instead, we concentrate our efforts on investigating educational metaphors and discussing how the results may contribute to the solution of problems that arise in teacher training.

2. Metaphors of learning and learning by metaphors: criteria of analysis

As necessary prerequisites of reflection on the metaphorical roots of their thinking about teaching and learning, teachers and prospective teachers need to get access to their metaphors and they need a shared system of interpretation and classification, which enables them to communicate their metaphors and to elaborate them cooperatively. Paradigms of learning can provide a suitable frame of reference, as was pointed out by Sfard (1998). This author differentiated two basic metaphors (Sfard, 1998): (1) the metaphor of learning as individual acquisition of knowledge and its subsequent transfer to new contexts outside the learning situation, and (2) the metaphor of learning as a participation in a community of practice. Sfard (1998) assigned behaviouristic and constructivistic notions of learning to the first family of basic metaphors, and notions of situated learning (Lave, 1988; Rogoff, 1990; Lave & Wenger, 1991; Brown & Campione, 1995; Greeno, 1997) to the second. Contrary to the widely accepted idea of learning as an individual process, the situated perspective of learning draws our attention to social processes and joint activities, by which common tasks are solved and relevant knowledge and skills are mediated. Our own reflections (Martínez & Saulea, 1998) following the lines of thinking of Sfard (1998), Solomon and Perkins (1998), and Cobb and Bowers (1999), let us doubt the dichotomy of metaphors of learning

of either the individualized or the socially situated type. The perspective on learning we adopt aims at integrating these two main paradigms of learning in a broader system of intertwined influences (cf. Anderson, Greeno, Reder, & Simon, 2000). For the purpose of learning from metaphors we consider at least an additional distinction of behaviouristic and cognitive points of view necessary. Consequently, we base the categorization of metaphors on three main dimensions of the learning space, which may be further differentiated (Greeno, Collins, & Resnik, 1996):

The *behaviourist/empiricist perspective* interprets knowledge as an accumulation of associations resulting from experience, while it considers the process of learning as generating new (*S – R*) connections between the units “sensory impressions” and “individual response”. In the empiricist tradition the mind is metaphorically interpreted as a wax plate onto which our experiences in the physical world are engraved. Under this perspective neither individual activity nor collaboration are of much significance, because the learning “agent” is a more or less passive individuum. We subsume behaviourism, associationism, and connectionism (also in terms of processes in neural networks) under this category.

From a *cognitive point of view*, knowledge consists of interrelated schemata, which are individually and actively constructed by transforming old schemata into new ones or by inductively developing new schemata from a series of varying experiences. Learning is the process of schema construction. This perspective includes approaches from gestalt psychology, constructivism, and processing of symbolic information. The mind is pro-active, problem-orientated, and interpretative.

The *situative or socio-historic perspective* conceives of knowledge as distributed among individuals in a social community and their artefacts, such as books, computers, etc. Knowledge is not only and completely located in individual minds. Learning as a product is the consequence of authentic participation in the activities of a community of practitioners,

and during the process of learning, the individuals as well as their community acquire knowledge and skills: “While the mind creates culture, culture also creates the mind” (Bruner, 1996, p. 166). Because the mind depends on dialogic exchanges, activity and collaboration are crucial from this point of view on learning and teaching. The concepts of “situated cognition” and “situated learning” are anchored within the socio-historic perspective—and criticized from the point of view of cognitivist approaches (cf. Greeno, 1997; Anderson, Reder, & Simon, 1996, 1997).

3. Empirical access to teachers’ metaphors of learning

This paper surveys and classifies teachers’ metaphors of learning. At the same time we hope to obtain some general and specific information on the sort of metaphors teachers maintain, and the similarities and differences between the learning metaphors of prospective and experienced teachers.

3.1. *Subjects and context*

The main study was established from a project with 50 teachers who studied for a degree in “Psicopedagogía” (psychopedagogics) and participated in an evening course on instructional psychology. All of these teachers had several years of professional experience in elementary schools (grades K—nursery-through 6) and took this course as part of an in-service training for a career as a school counselor (“asesor de centros escolares”). The authors of this study have constantly tried to establish methods of teaching and learning in their university seminars which could give the participants access to their own tacit theories and promote reflection on their actions. The exchange of ideas in small groups and confrontation with controversies seemed well suited to achieve these goals. Aside from provoking discussions and collaborative reflection, we also wanted the students to become involved in group processes and to become familiar with methods of

cooperative learning. Thus, the course was organized from the beginning in 11 small groups, each with 4–6 members. In the in-service training of these teachers, collaborative work was also a regular method of analyzing classroom practice. Information about their preferred metaphors of learning was gathered and exchanged in these small groups at the beginning of the course, because subsequent discussions about their teaching practices and their own learning experiences would begin with their tacit theories of learning and attempts to modify them—if necessary—as a requirement for the adoption of more differentiated points of view and a more ample repertoire of teaching.

To gain data for comparison, 38 prospective teachers, who were also studying for a degree in “Psicopedagogía” and participating in a morning course on curriculum design, were also asked to formulate their ideas of learning in metaphorical expressions. These prospective teachers had not yet had practical classroom experiences. Their seminar was also organized in small groups (8 groups of 4–6 members each), and all students were preparing to teach for grades K-6 (nursery and elementary classes).

3.2. *Procedures*

Both in our teaching and in this study we try to combine social learning approaches and individual learning. Phases of individual and collaborative reflection on metaphorical expressions of tacit knowledge alternate in our seminars in order to give our students access to their individual, implicit points of view as a condition to integrate explicit, scientific knowledge without distorting it. In their small learning communities the students investigate authentic points of view for them as individuals and for their group as a whole. Knowledge derived from practice—craft knowledge in the case of those participants who already teach in classrooms—and propositional knowledge are integrated.

The first part of the main study—eliciting metaphors and subsequent discussions about their ideas of learning—started with a group discussion about the team members’ individual metaphors of

learning. The teams were obliged to record the results of their discussions in (written) formulations of those metaphors, which represented best the team's notion of learning. One session of 2 h was dedicated to ground further studies of instructional psychology on the students' paradigmatic metaphors of learning.

In the comparative study with prospective teachers the subjects' formulations of metaphors of learning served as basis for analyzing various approaches of curriculum design. The teachers were asked "How do you understand 'learning'?" They were instructed that we did not expect definitions from textbooks, but were interested in their personal, subjective understandings. In addition, they were told that metaphorical formulations are well suited to convey tacit understandings. As an example they were told how a "vending machine" might be represented metaphorically: "... you put money in a box in order to obtain..."

The final notes of all groups were collected and analyzed. Some of the metaphors were "hybrids", revealing characteristics of more than one theoretical perspective. For example, we detected behaviourist metaphors which incorporated aspects of the cognitivist perspective: On the one hand, empirical roots of knowledge were underlined, while on the other hand, influences of internal (information-processing) activities of the learner were acknowledged. In only one case, however, were we unable to ascribe a metaphorical formulation to one of our three broad analytical categories.

3.3. General findings

The group products were analyzed and assigned to the criteria described above. We will first give an overview on typical metaphors of learning and afterwards we will comment on them.

The majority of metaphors (57%) formulated by experienced teachers in our main study represent a notion of learning which is based on *behaviourist/empiricist* ideas. These teachers interpreted learning as a process of individual growth through the acquisition of knowledge in the form of new associations. They described the teacher's role as a

transmitter or trainer of skills, that is, the main task of teachers is organizing routines. Knowledge was conceived as an externally determined product. Finally, the learner was seen as a mere recipient of knowledge, a sort of empty slate or container.

Most metaphors attributed to the behaviourist/empiricist domain refer to knowing and understanding in terms of visual perception. They are clearly rooted in the experience of obtaining information by vision, experienced since childhood (Lakoff & Johnson, 1980, 1999). Typical examples are the metaphors 1a and 1b within the behaviourist family quoted in Table 1. The emphasis on vision and light corresponds to tendencies of social traditions, which unfold the basic idea that the eye is the essential organ of knowledge—however, this misses the fact that what "the eye" captures is the result of its social education (Popkewitz, 1999). The influence of social traditions on metaphors, and thus on the tacit bases of socially shared ideas, is an additional reason for our interest in this study.

Another group of metaphors expresses the notion of learning as the result of inscriptions on a *tabula rasa*, caused by experience and/or the teacher (examples 2a–c). In some cases the passive role of students is underlined, referring to the idea of absorption of knowledge (2c). Some teachers, however, formulated similar metaphors in order to express their disapproval of behaviourist points of view, adding remarks like "*Children should not be obliged to swallow information*" "*The child is not a container to be filled;*" "*The teacher should not violently penetrate the mind of the child...*" Metaphors of this type are particularly apt to provoke cognitive and emotional controversies in teams and to fuel fruitful discussions.

Conceptions of learning linked to the idea of stimulus-response connections and notions of teaching as training are not rare (see examples 3a–c). Expressions which interpret learning as a process of *digestion* (Dewey, 1933/1998), and which express the idea of teaching as *food for thought*, are relatively frequent (example 4) as well. Metaphors which compare learning and teaching to phenomena in the area of military, sports, economy or technology have been rare; example 3c

Table 1
Metaphors from a *behaviouristic* point of view^a

1a	Learning is like a traveller who comes to many countries and takes many pictures of everything he observes, which he then stores in different albums
1b	Learning is like a video camera which records the world
2a	Learning is like writing into a new notebook with a magic pencil that never wears out
2b	The teacher is like a poet who is writing his work on a sheet of white paper (student), S/he corrects what s/he writes, rectifies, modifies her/his words according to her/his experiences until the final product is reached: the complete work
2c	Learning is like a sponge, which soaks in the water
3a	Teaching is like taming a horse
3b	Teaching is like tuning an instrument
3c	Teaching is making sure that a electric circuit is “functioning”. We take care that finally the light bulb is burning (learning). We have to make the correct connections that everything functions well
4	Teaching is like eating, it satisfies a necessity
5	Teaching is a game of billiards. This game has many variables: balls of different colors, in different constellations, and you have to know how to aim, to push [...] at the right place in order to send it into the right direction

^a(1) Learning as obtaining information by vision; (2) learning as an inscription on a *tabula rasa*; (3) learning as training; (4) learning as a process of digestion; and (5) learning as a process of “direct” instruction.

was the only metaphor of this type. Nevertheless, we were somewhat surprised to find no references to the mind as a computer or as a processor of information. The notion of “direct” instruction and teacher-centred activities is obvious in most of these metaphors, sometimes—as in example 5—only teaching is described. We may assume that the author understands learning as a naturally occurring and necessary consequence of directive (“aiming”, “pushing”) teaching.

Fewer metaphors (38%) produced in the main study could be attributed to the *cognitivist/constructivist domain*. This is surprising, because the official curriculum of the Autonomous Community of Valencia (Generalitat Valenciana, 1992), where our subjects are teaching, is focused on the constructivist approach. The constructivist metaphors refer to notions of organization and elaboration of knowledge by students, to their active role in restructuring experiences and achieving conceptual coherence, to the understanding of theories and concepts, and to the development of general skills (i.e., solution of problems, reasoning, metacognition), intrinsic motivation, and transfer. The majority of these metaphors define learning as individual construction of knowledge, based on processes of interpretation of actual experiences, in which the context, as well as students’ available knowledge, play a crucial role. The teacher is

conceived of as a facilitator and coach, and the student is conceived of as a (re-) constructor, not as a more or less passive recipient. In most respects, knowledge is not seen as fixed and stable, but as a flexible, malleable construction.

Different metaphors of this group emphasize the determinants of learning as distinctly constructivist activity (see Table 2). The role of actively dealing with the environment is formulated clearly in examples 1 and 2. A subgroup of metaphors represented by example 2 stresses the process of empirical research activities, interpreting learning as an inductive process, which proceeds from scrutinizing many objects, cases, and specific events to general insights. Again, the certainty of knowing is based on understanding reality through direct sensory experiences (see example 2 in Table 2).

Metaphors applying the constructivist perspective in a literal sense, that is using words from the field of architecture, have been rare. The language of construction is not used systematically, probably for reasons suggested by Latour (1999, p. 281): “The paradox of constructivism is that it uses a vocabulary of *mastery* that no architect, mason, city planner, or carpenter would ever use.” Example 3 not only represents one of these exceptions, but reveals also remarkable insight into the dynamics of constructivism. Generally,

Table 2

Metaphors from a *constructivist* point of view

1	The student is like a silkworm that does not know the world which it is approaching, and that it is going to be converted in a long process step by step into something beautiful, where the beauty is like the fruit of something it has constructed from what it has eaten
2	Learning is a detective who looks for things and into things; teaching is creating intellects, searching for knowledge
3	Learning is like setting the bricks of a house. The student is the mason and the house at the same time. S/he is also the owner of the house. The teacher is the site foreman
4	The relation between learning and teaching: The one who learns is a person who cannot see well and who—thanks to the optician—discovers the light and the different realities, depending on the glasses s/he puts on
5	It is like learning to walk. When you are very young and you have no knowledge, it is like you will never succeed (you are not able to stand on your feet). [...] Later the parents help us to do our first steps—they correspond to the teachers who guide our learning process. Various forms of assistance, given by parents, relatives, etc. are necessary in the process of learning to walk until we are able to “walk” by ourselves

constructivist metaphors have not been too detailed. On the other hand, a group of impressive metaphors relies on the imagery of live beings, as in the case of the silkworm in example 1.

The interaction of self-regulated activities and social stimulation or social support is nicely grasped in the examples 4 and 5. Learners are prone to conceptual errors (they cannot *see* well or *stay upright* on their own feet), but thanks to social support (the optician and her/his lenses or the helping hand of parents) learners construct valid concepts (the *light* or how to walk). Example 4 formulates clearly the individualistic bias of constructivist notions of learning when referring to individually varying realities which depend on the cognitive lenses (*glasses*) through which learners perceive their environment.

Expressing *socio-historically based notions of situative learning* in coherent metaphors seems to be most difficult. A recently published metaphor on teaching (Tobin & Tippins, 1996) illustrates this problem drastically. The authors compare a teacher to a fencer, who provokes reactions by his or her actions, and explain that this metaphor represents “social constructivism, equitable distribution of power between the teacher and students, and an ethic of care” (p. 723) in many educational contexts. We experience some difficulties, when we try to relate the situation of a duel or a fight between teacher and student—never mind the militaristic connotations evoked by this concept—and the notion of a classroom as a

community of practice, where all participate in the search of knowledge, which is the idea underlying social constructivism. The same problem arises when we try to link a teacher’s task to provide *scaffolding* for the students and their learning processes to the fencer metaphor, although Tobin and Tippins (1996) state this relation. Anyway, a great number of those subjects in our study, who expressed notions of social support or social mediation of individual development, integrated this notion in metaphors classified as fundamentally constructivist (cf. examples 4 and 5 in the constructivist category).

Altogether and despite much discussion about situated learning, the results of our study do not show that the situative perspective has significantly influenced our subjects’ tacit theories of learning. Only two or about 5% of the metaphors produced in the main study could be ascribed to this category. The perspective of situated learning is by no means absent in teacher education. Throughout their teacher studies, our subjects had “received” much information on socio-historic points of view. For example, Habermas’ (1981a, b) construct of an ideal community of dialogue and its contribution to overcome highly subjectivist and individualist ways of life was part of their studies. Nevertheless, explicit metaphors referring to students as apprentices, to peripheral participation in a community of practitioners, etc. are almost absent in our data. In general, those metaphors which come close to the approach of

Table 3

Metaphors from a *situative/socio-historic* point of view

1	It is a joint work like the ants do it when they collaborate to achieve a result which is beneficial for all of them
2	Teaching is like a tourist guide who negotiates a route with the tourists
3	Teaching and learning are like an excursion for which the group decides on the most adequate route towards a barely known place and what they want to visit there. Within the whole group we have to come to terms in regard to an optimal itinerary and we will communicate everything new we will find on our way

situated, socially mediated learning are relatively vague or ambiguous, as the examples 2 and 3 in Table 3 demonstrate. The appraisal of knowledge as a cognitive product or as an aspect of joint practice and of discourse is really rare, appearing only in one example in our data (see item 1 in Table 3).

Reasons might be found in contradictions between the essence of this theoretical position and the teachers' practical experiences in classrooms or, generally, the idea of human individualism, which is deeply rooted in the Spanish culture. Neither types of experiences would support an understanding of the indispensability of social collaboration for the development of learning. This preliminary analysis suggests that a development towards considering the social nature of learning does not depend so much on a conceptual change (Posner et al., 1982), but rather on a process of restructuring the teachers' epistemological, ontological, emotional and social assumptions. Metaphorical and conceptual reconstructions depend on a *collage* of metaphors and "literal" conceptions which interact and support each other.

3.4. Comparison of experienced teachers and prospective teachers

Considering these results from a situative point of view, we were highly interested in finding out whether the training and professional context of the teachers in our sample have something to do with the overwhelming production of behaviourist metaphors (57%), markedly less references to constructivist metaphors (38%), and a definite lack of situative/socio-historically based metaphors (5%).

For comparison, we therefore chose the participants of a course on *Curricular design, innovation and development*, who were all prospective teachers in the fourth year of their studies (for grades K-6) without any practical experiences in teaching. Fig. 1 shows the proportions of metaphors which could be ascribed to the categories of behaviourist, constructivist, and situative thinking in both samples. It is obvious that the prospective teachers formulated many more constructivist metaphors (56%) than did experienced teachers (38%), while prospective teachers on the other hand were less inclined to describe learning in terms of behaviourist metaphors (22%) than experienced teachers (57%). References to behaviourist and to constructivist ideas when describing learning are almost in inverse proportion to each other in the two groups.

The two groups differ in the absolute number of metaphors formulated: 38 metaphors or 3.3 metaphors per small group were formulated in the experienced teachers' seminar, while prospective teachers produced only 9 metaphors or 1.1 metaphor per small group in their course. Reasons for this difference might be found in the learning context (see above: courses on "Instructional Psychology" vs. "Curriculum Design") or in the group dynamics during the discussions in small groups (richer experiences/insistence on individual experiences in the teacher groups vs. lack of experience/willingness to compromise in the prospective teacher groups). In any case, two things seem to be quite clear:

- (1) The fact that in recent years constructivist theories have received much attention in Spanish universities and the fact that the prospective teachers have been exposed

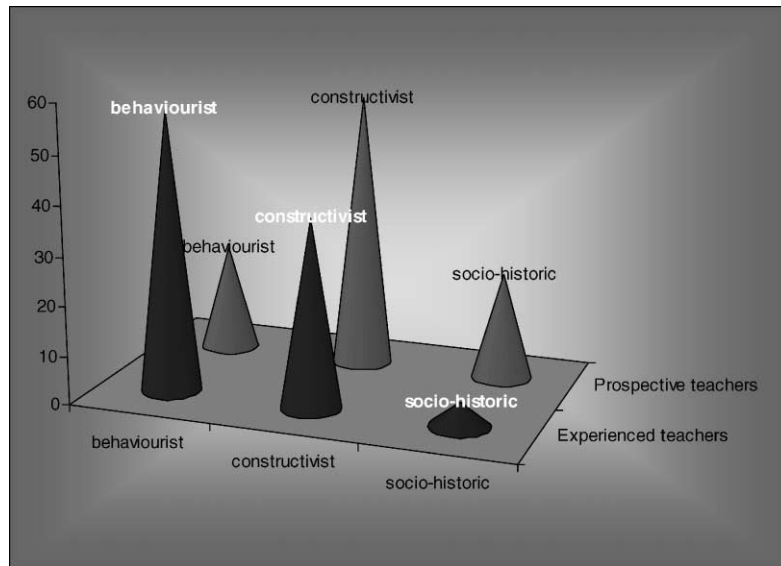


Fig. 1. Types of metaphoric descriptions of learning.

without “interruption” from school reality for four academic years to these theories, explains the high number of metaphors related to cognitive/constructivist ideas. On the other hand, the group of experienced teachers is continuing their (evening) studies after years of school practice without contacts to the university, and they are at the same time still working as nursery teachers or primary teachers. Constructivist ideas can be found realized only sparsely and by chance in Spanish nursery and primary classrooms (Pozo, 1997), while behaviourist thinking is predominant. These contextual conditions are depicted in the differences between experienced teachers and prospective teachers in our study.

- (2) The results clearly demonstrate that the situative perspective and, in general, the idea of social learning is not widespread among our subjects, neither among those with nor among those without practical classroom experience as teachers. We are especially concerned, because it seems to be problematic to reflect on learning and to decide about teaching approaches today without at least considering

the idea of situated cognition or socially distributed intelligence.

4. Discussion

The difference between experienced teachers and prospective teachers (see Section 3.1) with respect to behaviourist vs. constructivist metaphors of learning as well as situative metaphors is highly relevant for teacher education. By disclosing the metaphorical base of thinking about teaching and learning we hope to assist teachers in bridging the gap between their implicit and explicit knowledge. In the case of those teachers who bring the experience of years of classroom practice to the university course, this goal appears most difficult to achieve. In their classrooms they can rely on highly routinized *craft knowledge* derived and shaped according to practical experience, while discussions in the seminar setting demand *propositional knowledge*. Teacher training often succeeds in elaborating explicit knowledge, while the trainees’ tacit knowledge informing their routine actions appears to be unaffected. In addition, in the seminar setting the teachers as

students work on two levels throughout the course. On one level there is a “community of practitioners” for sharing and comparing ideas of learning and teaching experiences, and on another level in a small group situation, they investigate the individual cognitive and emotional connotations of their diverse images of learning in depth. In these small groups the teachers write down the metaphors which match their ideas of learning best, and they explain to each other how these metaphors are linked to their individual theories of learning.

It is especially this step and the processes involved in an interchange of implicit and explicit knowledge which needs further study. In this paper we have reported findings from our students’ *initial* reflections on metaphors of learning, and noted that students engage in these metaphors. An investigation of *how* metaphorical representations may be changed by these reflective and analytic experiences should be taken into account. The collection and the reconstruction of metaphors should not be limited to one short data collection period, but extended to an entire academic year.

We attempted to identify our students’ implicit theories of learning as represented by metaphors within a conceptual space determined by explicit theories summarized under the (1) behaviourist/empiricist perspective, the (2) cognitive/constructivist perspective, and the (3) situated/socio-historic perspective. It may be due to those frames of reference—aside from differences in the cultural settings—that our findings do not completely mirror the results of previous studies (e.g., Gurney, 1995; Tobin & Tippins, 1996). We suggest that a reason for this could be that even studies on educational metaphors may lack the ability to describe the inextricable ways in which metaphors are embedded in language.

Further studies on metaphors are worthwhile, because the impact of metaphors in the field of education is immense. As expressed in our “blueprint” metaphor, we assume that the atmosphere in the classroom is related to the teacher’s favored educational metaphor. For example, if a teacher prefers the captain metaphor, he or she will probably tend to practice strict control over the

students, while a teacher preferring the entertainer metaphor will be first of all friendly and humorous in the classroom (Tobin & Tippins, 1996). The inherent potential of metaphors to influence teachers’ educational practice makes them important tools for the education of teachers.

We propose collaborative approaches in contrast to individual strategies of conceptual change, which are the essential aspect of the education of teachers in Europe (De Jong, Korthagen, & Wubbels, 1998). That is, we prefer to promote educators’ professional development by—among other strategies—sharing their metaphors of education in collaborative groups of colleagues. We assume that a classroom situation will change if the teacher substitutes his/her preferred professional metaphor for another one. In this process, metaphors may function as stepping stones to a new vantage point from which a teacher can look at his or her own practice as educator from a new perspective. Moreover, metaphors may stimulate the teachers to explore new conceptual territories visible from an alternative point of view, a perspective of classroom practice which they might not have otherwise considered. Because of these potentially far-reaching effects of intensive co-reflection on metaphors, the trainers of these prospective or experienced teachers should be cautious about which metaphors are discussed in their education courses and which metaphors are elaborated collaboratively in small group work. We suggest approaching the study of metaphors of any educational topic by tracing its historical development and analyzing how these metaphors have influenced the evolution of basic ideas. Recently, Popkewitz (1999) has pointed out how metaphors from the realm of theology—like redemption, salvation of the soul, etc.—still continue to structure the current educational discourse.

We caution, however, that this approach might not go far enough in stimulating new orientations and insights, because this practice simply examines the metaphor. If we want to prompt in-depth analysis of subjective experiences and collaborative reflections on possible relations with a particular scientific theory, students (especially if they are teachers with practical experiences)

should receive some additional guidance. More direct support may be necessary to help students reflect about the coherence of their metaphors and their resulting actions. We assume they will most likely detect controversial aspects of their metaphors, which will lead not only to a refinement (or even reconstruction) of the initial metaphor, but also to an altered intention and finally to a reorganization of actions in the classroom. To this end, suggestions from trainers are helpful in order to draw the students' attention to the structural components of their implicit theories. By structural components, we mean typical classroom situations, routine teaching behaviour as well as situational alternatives, most likely outcomes of their behaviour, and resulting expectations and evaluations connected to these events.

In our opinion, it would be fruitful not only in educational science, but even in science education to motivate students to try to find out about those metaphors which may unconsciously shape their understanding of physical phenomena. Science education is expected to promote not only the acquisition of scientific knowledge, but also the development of (scientific) thinking itself. It seems to be necessary to pursue precision in the physical sense as well as in the metaphysical sense, i.e., on levels of thinking that influence our images of the world beyond rational awareness. Sometimes artists succeed in making us aware of these deep-rooted worldviews. We propose, in short, to broaden the concept of scientific education by establishing a complementary relation of logical-mathematical thinking and metaphorical imagery. This is by no means an exotic idea, but our suggestion can refer, for instance, to the notion of thinking in terms of mental models (Johnson-Laird, 1983), to the notion of qualitative physics in the approach of qualitative simulation or envisioning (De Kleer & Brown, 1984), or to qualitative process theory (Forbus, 1984). All of these modes of thinking are discussed as interesting contributions both to the understanding of knowledge acquisition and of human thinking at large. Metaphorical language thus could be seen as the missing link integrating an "everyday" thinking and a scientific thinking. Further support for the integration of metaphorical imagery comes

from the theory of multiple intelligences (Gardner, 1983, 1997, 1999a, b), which highlights the fact that some students learn better with stories, other via works of art, and others by means of manipulative experimental activities. The idea that people are characterized by different profiles of intelligence together with the idea that most problems can be solved in alternative ways, inspires us to conclude with Gardner that it is preferable for students to reflect on a few topics from distinct starting points, which are based on a diversity of metaphors and analogies, according to the different types of intelligence.

The implementation of teaching strategies focusing on collaborative reflection on metaphors seems to be just the solution to promote an understanding of the socially "situated" nature of learning. A collaborative reflection may help to rectify the problem of an almost complete lack of situative/socio-historic perspective in our students' metaphors. The prevailing individual constructivist strategies (e.g., Driver & Earsley, 1978) in Spanish teacher education favor notions of changes (Duschl & Hamilton, 1998), for instance, within an individual conceptual profile (Bachelard, 1974). What is needed, however, is a substitution of components, that is, a substitution of constructivist by situative ideas. Therefore, we recommend processes of learning based on collaborative reconstruction of individual points of view. Socio-cultural and individual influences would dynamically interact in learning processes with this method. The tension between individual learning and social learning (or "private" knowledge and "public" knowledge) could be resolved by having individual and social learning processes influence each other. In any case, whether situative metaphors are already at hand or not, critical points of teaching should be investigated from various angles. While we caution teachers to be aware of the metaphors discussed in their classrooms, we encourage teacher educators to promote the production of metaphors which grasp teaching and learning under situative perspectives (cf. Antil, Jenkins, Wayne, & Vadasy, 1997). Dewey (1933/1998) proposed learning that starts with activities which allow unconscious knowledge to emerge and is not constrained by an actual

topic, in order to create conditions which stimulate conscious reflection on these ideas. Alternations of projective and reflective processes in continuous interaction seem to be highly promising because they give room for spontaneity as well as guidance for reflection. This idea is very similar to our own suggestion (Martínez & Sauleda, 1998) of situating learning within the fine line between order and chaos. Too much order causes rigidity and blocks creativity, while too much chaos abolishes the possibility of comprehension.

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