TEACHER METAPHORS – DIFFERENCES BETWEEN FINNISH IN-SERVICE AND PRE-SERVICE MATHEMATICS TEACHERS

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This article reports what kind of metaphors do Finnish pre-service (n=72) and in-service (n=65) mathematics teachers use for teacher's role, how do these metaphors differ and do in-service teachers metaphors differ due teaching experience. Data was gathered via questionnaires in years 2010-2013. Metaphors provide insights into beliefs that are not explicit or consciously held and show teacher's beliefs about themselves. Changing teachers' beliefs can help to change teachers' behaviours and in such way improve teaching and learning process. Metaphors were classified into five categories. The most common metaphor used by pre-service teachers was self-referential 46% (n=33). In-service teachers used by far didactical metaphors (51%, n=33) and only 15% (n=10) presented a self-referential metaphor.

THEORETICAL BACKGROUND

Metaphors are not just words or expressions. They enable people to understand one phenomenon by comparing it to something else. Metaphors are also a valid tool for gaining insights into teachers' thoughts and feelings regarding their teaching (Zhao, 2009). According to Kasten (1997) metaphors would seem to have an important place in the provision of explanation. Metaphors capture and model teachers' understanding of teaching and learning and provide insights into beliefs that are not explicit or consciously held (Beijaard, Verloop and Vermunt, 2000).

The potential power of metaphors as a "master switch" to change teachers' beliefs was realized in 1990, when Tobin investigated how the use of metaphors helped teachers to conceptualize teaching roles. He found the possibility that significant changes in classroom practice are possible if teachers are assisted to understand their teaching roles in terms of new metaphors. When the teacher's role changes also the metaphor describing it changes. Reflection is assumed to play a key role in change of practice. Many researchers see a cyclical relationship between changing beliefs and changing practices. It is therefore important to study how pre-service and in-service mathematics teachers describe their views of mathematics teacher's role with metaphors and do these metaphors differ. (Kagan, 1992; Lerman, 2002; Wilson & Cooney, 2002)

Mathematics teachers' beliefs

Teachers' beliefs about mathematics, its learning and teaching are reflected strongly in their practice. Beliefs affect on what gets taught in the mathematics classroom and how. Pehkonen and Törner (1998) summarized that an individual's mathematical beliefs are compound of his subjective, experience-based, implicit knowledge on

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mathematics and its teaching and learning. The spectrum of an individual's beliefs is very large, and its components influence each other.

We base our construction of beliefs and referring terminology on the article of Op't Eynde, De Corte, and Verschaffel (2002), who have strived for making a synthesis regarding previous belief researches. In the paper Op't Eynde and others (2002) define mathematical beliefs to be implicitly or explicitly held subjective conceptions people hold to be true, that influence their mathematical learning and problem solving.

Exploring mathematics teachers' beliefs with metaphors

The Beijaard, Verloop, and Vermunt's (2000) model of teacher identity identifies three distinct knowledge bases of teacher knowledge. Teachers' professional identity can be described in terms of *teacher as a subject matter expert, teacher as a pedagogical expert,* and *teacher as a didactical expert*.

Löfström, Anspal, Hannula and Poom-Valickis (2010) studied what metaphors first, third and fifth year university students' in Estonia used and how much agreement there was between metaphors and the scores on the teacher identity measure by Beijaard model. The results indicate that the model by Beijaard and colleagues can be applied as an analytical frame of reference when examining metaphors, but that it would be useful to develop and expand the model further to include metaphors categorized as *self-referential* and *contextual metaphors*.

Oksanen and Hannula (2012) used the new Löfström et al. (2010) model of teacher identity to classify Finnish 7-9 grade mathematics teachers' (n=70) metaphors about teacher. According to these results the new model makes the metaphor classification more clear. Only 2 metaphors (3%) were not classified into any category. The most common metaphor used by in-service teachers, was by far teacher as *didactics expert* (n=33, 51%).

Portaankorva-Koivisto (2012) studied prospective mathematics teachers' metaphors (n=16) for mathematics, teaching and the teachers' role. She found out, that 44% of the pre-service teachers used *self-referential metaphors*. This indicated that further study and comparison to in-service teachers' metaphors was needed.

Metaphor categories

In this study we use the Löfström et al. (2010) model to analyse teachers' metaphors for their profession:

Teacher as subject expert. Teacher has a profound knowledge base in his subject(s). Teaching is concerned with getting across information to the students. Typical metaphors in the subject expert category describe the teacher as a source of knowledge. For example: a book, a radio, a computer.

Teacher as didactics expert. Teachers need knowledge about how to teach specific subject-related content so that pupils can capitalize their learning. This kind of knowledge is referred as knowledge of didactics, and is integrated with an

understanding of how learning experiences are facilitated in a particular subject. The teacher is described as a person who is responsible for designing her pupils learning process. For example: a coach, an engine, a lighthouse.

Teacher as pedagogical expert. The understanding of human thought, behavior, and communication are essential elements in the teacher's pedagogical knowledge base. Emphasis is on relationships, values, and the moral and emotional aspects of development. The teacher is seen as someone who supports the child's development as a human being. These metaphors stress teacher's role to raise or educate the child. For example: a mother, a second father, an older brother, a firm tree.

Self-referential metaphors. These metaphors describe features or characteristics of the teacher's personality, with reference to the teacher's characteristics (self-referential) without reference to the role or task of the teacher. One might say that the metaphors describe who the teacher is. For example: a machine, a candle.

Contextual metaphors. These metaphors describe features or characteristics of the teacher's work or work environment, or in other ways referred to characteristics of the environment (contextual). One might say that the metaphors described where (physically, socially and organizationally) or in what kind of setting or environment the teacher works. These metaphors mostly described teachers' work as too demanding, multifunctional, including too many responsibilities (pupils, parents, colleagues, heads and society). For example: a king or an actor.

Hybrids. These metaphors include elements of more than just one of the above categories.

Unidentified. Unidentified metaphors could not be categorized in any of the categories presented above.

RESEARCH QUESTIONS

- What kind of metaphors do in-service mathematics teachers and pre-service mathematics teachers use for teacher's role?
- How do pre-service teachers' metaphors differ from in-service teachers' metaphors?
- How do in-service teachers' metaphors vary across the length of their teaching experience?

METHODOLOGY

Instrument and procedure

Pre-service teachers. In Finland, secondary teacher education is a 5-year programme (3 BA and 2 MA, 300 ECTS). The students major in one school subject and minor in one or two others. Prospective mathematics teachers have pedagogical studies (60 ECTS) as their minor subject and these studies can be taken within one academic year.

Pedagogical studies combined to subject studies give qualifications to teach at the secondary level.

Data for this study was gathered from 81 mathematics teacher students in the University of Helsinki in two cohorts. The first cohort (n=38) had their pedagogical studies academic year 2011 – 2012 and the second cohort (n=43) a year later, 2012 – 2013. The data was collected after the spring semester at the end of teacher students' pedagogical studies.

The assignment was: the students were asked to write a metaphor and expand the statement "as a mathematics teacher I am ...", and to continue with explanation for their statement. Only the metaphors with students' permission to use as data were gathered for this study.

In-service teachers. A questionnaire with 77 statements was built in connection with an international NorBa study (Nordic-Baltic Comparative Research in Mathematics Education). The last part of the questionnaire is qualitative and includes one item: "Please think and write down a metaphor characterizing a teacher. Please explain your metaphor. Teacher is like … My brief explanation of the metaphor is as follows…"

The respondents were 94 Finnish mathematics teachers teaching grades 7-9 from different regions of Finland with different teaching experiences and ages. The average age of respondents was 41 ranging from 25 to 61 years of age. The average duration of teaching experience of the respondents was 14.5, ranging from 1 to 35 years (1-5 years teaching experience n = 23, 6-20 years teaching experience n = 19, over 21 years of teaching experience n = 26). Teachers filled in the survey and 70 of them presented also the metaphor.

Analyses

The metaphor categorization was judged on a case-to-case basis using two independent raters, whose coding was compared at the end. The three authors worked as two pairs, one pair coding the in-service teachers' metaphors and the other pair the pre-service teachers' metaphors. As the agreement rate was somewhat lower in the case of pre-service teachers' metaphors, the third author was invited to also code those metaphors where no consensus was found. The metaphors and their explanations were analyzed as a unit, as the metaphor itself may be used to express different meanings. The raters analyzed the metaphors "from pure towards complex".

83% (58/70) of the in-service teachers' metaphors were categorized completely identically. In case of 13% (9/70) the metaphors were coded partly identically. If the unit of analysis contained elements of two or more aspects, the one category used by both raters became the final category. It both raters used two or more same categories, were these metaphors classified as hybrids 9% (6/70). Only 4% (3/70) were coded differently and 2 metaphors (3%) could not be identified in any category. Those five metaphors were removed (finally n=65).

After categorizing the in-service teachers' metaphors, 77% (62/81) of the pre-service teachers' metaphors were categorized completely identically. In case of 5% (4/81) the metaphors were coded partly identically. In the case of no consensus 19% (15/81), the third rater was used. When at least two coders agreed on coding, their coding was recorder. At this stage four metaphors, where categorized as hybrids (5%, 4/81). Two metaphors (3%) were left unidentified in agreement and for seven metaphors 9% (7/81) no agreement was found. Those nine metaphors were removed (finally n=72).

RESULTS

When pre-service teachers were asked to describe themselves as mathematics teachers, the most common type of metaphor 46% (n=33) was *self-referential* (see Table 1). In comparison, only 15% (n=10) of in-service teachers presented a *self-referential* metaphor.

The most common metaphor used by in-service teachers was by far *didactics expert* 51% (n=33) and also 38% (n=27) of the pre-service teachers presented a metaphor in this category. In all three professional-age-groups (1-5 years of teaching n=20, 6-20 years of teaching n=17 and over 21 years of teaching n=28) teacher as *didactics expert* was the most commonly used category. After that *pedagogical expert* (n=9, 14%) and *self-referential* (n=10, 15%) metaphors were almost similarly used regardless of teaching experience.

Teachers	***n***	**Subject expert**	**Didactics expert**	**Pedagogical expert**	**Self-referential**	**Context-ual**	**Hybrids**
pre-service teachers	72	2/72 (3%)	27 (38%)	5 (7%)	33 (46%)	1 (1%)	4 (6%)
in-service teachers	65	4/65 (6%)	33 (51%)	9 (14%)	10 (15%)	3 (5%)	6 (9%)
1 – 5 years experience	20	0/20 (0%)	11 (55%)	3 (15%)	4 (20%)	0 (0%)	2 (10%)
6 – 20 years experience	17	2/17 (12%)	8 (47%)	2 (12%)	2 (12%)	2 (12%)	1 (6%)
21 years or more experience	28	2/28 (7%)	14 (50%)	4 (14%)	4 (14%)	1 (4%)	3 (11%)

Table 1: In-service and pre-service teachers metaphors categorized in 6 categories (no unidentified metaphors included)

A closer analysis of pre-service teachers' *self-referential* metaphors shows that these metaphors can be classified into four different categories. Metaphors describing *personality or characteristics* (n=8, 24%): "As a mathematics teacher I am a clock. Punctual." Metaphors describing *hesitation* (n=11, 33%): "As a mathematics teacher I am a ship in fog. Hopefully, I will find my way to harbor." Metaphors describing *a new*

beginning, a new era (n=6, 18%): "As a mathematics teacher I am a young foal. Bouncing around everywhere." Metaphors describing that *something "big" is waiting ahead* (n=8, 24%): "As a mathematics teacher I am a final leg runner, who has received the baton from my own teachers."

In-service teachers' *self-referential* metaphors differ a lot from pre-service teachers' *self-referential* metaphors. Only one big category was found when analysing these metaphors: over half (n=6, 60%) of in-service teachers' *self-referential* metaphors describe the *variability of mathematics teachers' job*. These teachers who presented a metaphor in this sub-category have all more than 6 years experience. For example, teacher with 17 years experience: "Teacher is like an amoeba. Adjusts into every situation. You can never know how your day at work will be." Teacher with 13 years experience: "Teacher is like a rollercoaster. He has good and bad lessons, success and failure even with parallel classes. Excitement is always present." The rest of the teachers (n=4, 40%), who only have 1-5 years teaching experience, presented a *self-referential* metaphor, which did not describe the variability of the job but instead something else: persistence or suitability to the job. It can be seen, that when teachers gain more experience their *self-referential* metaphors start to describe the variability of the job.

Metaphors describing teacher as *didactics experts* can be classified into two categories: *active* and *passive*. Those teachers who presented *an active didactic metaphor* among *didactical metaphors* (pre-service teachers n=17, 63% and in-service teachers n=23, 70%) are genuinely present in the learning process and constantly strive for better results both in teaching and learning. A pre-service teacher: "As a mathematics teacher I am a shepherd. Guiding my flock through varying terrain even when it is difficult. I lead the way to the new green pasture with my whistle." An in-service teacher, 26 years experience: "Teacher is like an actor, who changes the role when needed. There is not just one correct way to teach – it depends on the a) subject and theme b) students c) occasion and d) teachers' persona."

Teachers who presented a *passive didactic metaphor* among *didactical metaphors* (pre-service teachers n=10, 37% and in-service teachers n=10, 30%) see themselves mostly as someone who is there to support the students when needed. A pre-service teacher: "As a mathematics teacher I am a compass. Showing the way but can't take anyone there." An in-service teacher, 1 year experience: "Teacher is like a Guide. Gives information and helps to survive in problem situations, but the student and his parents decide where the student goes." At this time, in-service teachers' teaching experience did not have an influence whether an active or passive didactical metaphor was presented.

DISCUSSION

It is remarkable, that when in-service teachers gain more teaching experience, it does not change the metaphor describing mathematics teacher's role. In all three in-service teachers' professional-age-groups *teacher as didactics expert* was the most common

used metaphor (1-5 years of teaching n=11, 55%, 6-20 years of teaching n=8, 47% and over 21 years of teaching n=14, 50%) but only 38% of the pre-service teachers presented a metaphor in this category. This refers that the biggest change in metaphors and in such way also in teachers' beliefs occurs during teacher studies. This is an important result and message to those who plan prospective teachers' studies at the university level.

Presence of hybrid metaphors could be explained by complexity of the teacher's job. Four (6%) pre-service and six (9%) in-service mathematics teachers provided hybrid metaphors. The variability of teachers' job was expressed also in other categories. The number of unidentified metaphors was low, only 4 metaphors from 151 (3%) were not categorized into any category of the model extended from Beijaard, Verloop, and Vermunt's (2000) framework (Löfström et al., 2010).

Because the pre-service teachers were assigned to write a metaphor and expand the statement "as a mathematics teacher I am ..." it might have result into more *self-referential* metaphors. In-service teachers continued the following sentence "teacher is like …" which is not that subjective. Although a closer look into the *self-referential* metaphors reveals that pre-service teachers are more insecure and suspicious and maybe that's why they presented metaphors in this category. An experienced teacher focuses more on the didactical side of the job and concentrates on how to manage the varying situations every day.

Looking at all the respondents, teacher as "didactics expert" was the most common metaphor used (60/151, 40%). According to these teachers it is important to create learning environments that support the students learning process and to use different teaching and learning methods. Learning may occur when students are actively involved and critical thinking is pursued. According to this metaphor analysis Finnish mathematics teachers' beliefs seem to be constructivist. Also Wilson and Cooney (2002) pointed that students learn mathematics most effectively when they construct meanings for themselves, rather than simply being told. A constructivist approach to teaching helps students to create these meanings and to learn. However, the latest PISA (2013) and two recent national assessments show reduction in students' mathematical skills (Hirvonen, 2011 and Metsämuuronen, 2013). If teachers' beliefs are constructivist, what kind of teaching approach do they actually use and how are their classroom practices? As the NorBa-project continues, we will find answers to these questions. It would also be interesting to collect metaphors from applicants applying for mathematics teacher studies and to follow these students trough their studies and see how the metaphor describing mathematics teacher changes.

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