FINNISH MATHEMATICS TEACHERS’ BELIEFS ABOUT THEIR PROFESSION EXPRESSED THROUGH METAPHORS

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The purpose of this study was to investigate Finnish mathematics teachers’ beliefs about teaching and teachers as expressed through metaphors. Because teachers’ beliefs play a significant role in their teaching, it is important to recognize those beliefs. Metaphors provide insights into beliefs that are not explicit or consciously held. Metaphors allow making implicit knowledge explicit. In this study we investigated what kind of metaphors Finnish mathematics teachers in different schools and in different stages of their careers use. This study focused on Finnish 7-9 grade mathematics teachers’ (n=70) metaphors about teacher. The metaphors were classified into five categories: teacher as a subject specialist, teacher as a pedagogue, teacher as a didactics expert, self-referential and contextual metaphors. Teacher as a didactic expert was the most frequently used metaphor (49%). The information gained from this metaphor analysis show teachers’ beliefs about themselves. Changing their beliefs can help to change teachers’ behaviours and in such way improve teaching and learning process.

INTRODUCTION

Teachers’ beliefs play a significant role in their teaching. They affect on what gets taught, how it gets taught and what gets learned in the classroom. Beliefs shape how teachers think and feel about mathematics and its teaching and learning. As teachers beliefs affect their teaching, it is important to recognize those beliefs.

Metaphors provide insights into beliefs that are not explicit or consciously held (Beijaard, Verloop and Vermunt 2000). 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. A metaphor can transfer a lot of information and describe phenomena in familiar terms so that the understanding may be deepened. Using metaphors of teaching and learning provides a focus from which to begin looking at teacher change processes. According to Tobin (1990) by conceptualizing teachers’ beliefs and roles through metaphors they use, teacher change can be implemented.

Metaphors are a tool for teachers to understand their work and to create meanings which are difficult to access in literal language. Therefore, metaphors are a valid source for gaining insights into teachers’ thoughts and feelings regarding their teaching. (Zhao, 2009)
This study focused on mathematics teachers' metaphors about teachers. The purpose is to investigate Finnish mathematics teachers’ beliefs about teaching and teachers as expressed through metaphors.

The respondents were 94 Finnish mathematics teachers, teaching grades 7-9. The youngest teacher was 26 years old and the oldest 61 years old. The average age was 46 years. Teachers professional age was between 1-35 years (1-5 years of teaching n=23, 6-20 years of teaching n=18 and over 21 years of teaching n=26).

The teachers were asked to write a metaphor describing a teacher and an explanation: “Teacher is like ... My brief explanation of the metaphor is as follow.”

The results were analysed by the Manual for NorBa Project (Löfström, Poom-Valickis and Hannula, 2011) which is based on the Beijaard model (2000). The metaphor categorization was judged on a case-to-case basis using two independent raters whose coding was compared at the end.

THEORETICAL FRAMEWORK
Since 1970 there has been a considerable amount of research on teachers’ beliefs based on the assumption that what teachers believe is a significant determiner of what gets taught, how it gets taught, and what gets learned in the classroom. Beliefs reflect in which way mathematics and its teaching and learning is conceptualized by teachers.

Beliefs
Pehkonen and Törner (1998) summarized that an individual’s mathematical beliefs are compound of his subjective, experience-based, implicit knowledge on mathematics and its teaching and learning. The spectrum of an individual’s beliefs is very large, and its components influence each other.

Op’t Eynde, De Corte, and Verschaffel (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. This view is shared by Leder, Pehkonen & Törner (2002), who define beliefs as an individual construct.

Mathematics teachers’ beliefs
Today mathematics teachers’ beliefs and their impact are seen as ability and tendency to change (Wilson and Cooney, 2002). Also Lerman (2002) underlines that there is a strong link between beliefs and practices: changing teachers’ practices will depend on changing their beliefs and changing beliefs will lead to change in practices. Teacher change consist changes in classroom behavior but also in the very art of teaching.

The importance of reflection in changing teachers’ beliefs has also being recognized. Reflective thinking about teaching can change the teaching behavior and actions. In addition to reflection, teachers’ ability to attend to students’ understanding of mathematics and to base given instructions on what and how students are thinking is also important.
Metaphors

Metaphors enable people to understand one phenomenon by comparing it to something else. Metaphors affect our way of conceptualizing the world and reality whether we are aware of this phenomenon or not. It is suggested that metaphors do not of themselves prove or demonstrate anything new, but merely enable us to see in a new light what we are doing or experiencing. (Ahmet, 2006)

According to Bullough (1991), metaphors reflect teachers’ beliefs about teaching and the teacher’s role. What a teacher believes about learning and knowledge can have no direct effect on how students actually learn, but it is important to know teacher’s belief. Beliefs about teaching and learning are associated with teaching roles and metaphors are used to conceptualize teaching roles (Kasten, 1997). A metaphor can be seen as a “blueprint” of professional knowledge of teachers’ thinking (Martinez, 2001).

Metaphors and Teacher Change

The potential power of metaphors as a “master switch” to change teachers’ beliefs was realized in 1990. Tobin (1990) investigated how the use of metaphors 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. First the metaphors are used to conceptualize teaching roles. The conceptualization of a role, and the metaphor used to make sense of it, is dependent on the context in which teaching and learning occurs. A metaphor used to conceptualize a teacher role can be changed in a process of changing the role. Teachers can explore and reconstruct new metaphors of teaching as a transformative route of teacher development, which leads to improvements in practice. (Tobin, 1990)

Exploring mathematics teachers’ beliefs with metaphors

Beijaard model (2000) 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. Lofstrom, Anspal, Hannula and Poom-Valickis (2010) studied what metaphors first, third and fifth year university students’ in Estonia use and how much agreement is there 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 Beijaard model further to include metaphors categorized as self-referential metaphors and contextual metaphors. Hybrids may include elements of more than one of the above categories. Unidentified metaphors could not be classified in any of the categories presented above. In this study was used The Manual for NorBa Project - Categorisation of Teacher Metaphors (Erika Lofstrom, Katrin Poom-Valickis & Markku S. Hannula, 2011).
The new extended Beijaard model makes the metaphor classification more clear. Self-referential and contextual metaphors can be sorted in separate groups. For example the following metaphor describes teacher as person, not as a pedagogical, didactics or subject expert: “Teacher is like an ironwire: twists and turns and bends but doesn’t brake.”

**RESEARCH QUESTION**

1. What kind of metaphors and explanations do Finnish 7-9 grade mathematics teachers use when they describe a teacher?
METHODOLOGY

Instrument
The present research is made in connection with an international comparative NorBa study (Nordic-Baltic Comparative Research in Mathematics Education) which uses a quantitative questionnaire elaborated by project participants. A piloting of the questionnaire was carried out in three participating countries (Estonia, Finland, Latvia) at spring 2010; the total number of respondents was around 60. The questionnaire was revised according to teachers’ responses and reliability calculations. Several items were removed or rephrased.

The revised questionnaire includes eight parts, seven of which are quantitative. In quantitative parts, there are 77 statements that have answering options of 5 or 4-point Likert or Likert type scale. Part A includes items for background information.

Procedure
The data collecting process in Finland took place in two phases: during spring 2010 and between November 2011 and February 2012. First, informative letters and E-mails were sent to schools all over Finland inviting mathematics teachers to participate in the polling. Teachers who wished to participate in the polling filled in applications and sent them back to the university, or used an electronic form to inform about the willingness. Participation in the polling was voluntary. Respondents’ identity and records were kept confidential: the report did not disclose teachers’ personal data (name, school).

Sample
The sampling of mathematics teachers of form 7-9 consisted of 94 mathematics teachers from different regions of Finland. The sample includes teachers of different ages, education level and teaching experience. Teachers filled in the survey and 70 of them (74%) 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 metaphors and their explanations were analyzed as a unit, as the metaphor itself may be used to express different meanings.

83% (58/70) of the metaphors were categorized identically. Additionally in case of 13% (9/70) the metaphors were coded partly identically. In these cases the category used by both raters became the final category. Only 4% (3/70) were coded differently. Those three metaphors were removed (finally n=67).

The categories were the followed, based on the manual for NorBa project and the researchers’ interpretations: teacher as subject expert, didactics expert or pedagogical expert, self-referential and contextual metaphors.
RESULTS

Distribution of metaphors used by Finnish teachers is presented in the following and in the figure (1). *Teacher as didactics expert* was clearly the most common metaphor used. Almost half of the teachers (46%) saw the teacher as a didactics expert.

![Figure 2. Distribution of metaphors used by the Finnish 7-9 grade mathematics teachers.](image)

*Teacher as didactics expert (49%)*

Teachers need knowledge about how to teach specific subject-related content so that pupils can capitalise their learning. This is kind of knowledge is referred to as knowledge of didactics, and is integrated with an understanding of how learning experiences are facilitated in a particular subject. The teacher was described as the person who is responsible for designing her pupils learning process. In this category the typical metaphor was *guide*. Examples of didactical metaphors included *coach, motor, lighthouse*.

Teacher is like a *catalyst*: helps students to produce knowledge in their heads.
Self-referential metaphors (15 %)
These metaphors focus on what teacher represents for the respondents as individuals. These metaphors described features or characteristics of the teacher’s personality, with reference either to the teacher’s characteristics (self-referential) without reference to the role or task of the teacher. One might say that the metaphors described who the teacher is. The most common self-referential metaphors were connected to multi-functionality of teacher’s role and the need to fulfil several tasks simultaneously. The metaphors used: wire, ameba, clown, stand-up actor.

Teacher is like an ironwire: twists and turns and bends but doesn’t brake.

Teacher as pedagogical expert (13 %)
The understanding of human thought, behaviour, 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. The most common metaphors for pedagogical expert were a safe adult. They all stress teacher’s role to raise or educate the child.

Teacher is like a safe adult: in the classroom happens a lot more than just mathematics learning.

Hybrids (9 %)
In addition, we found that metaphors may include elements of more than one of the above categories. Typically, the hybrids include the subject aspect with either pedagogical or didactical aspect.

Teacher is like an apple. (S)he has the knowledge and (s)he knows all the facts based on the curriculum, but (s)he can also motivate students to learn.

Teacher as subject expert (6 %)
Teacher has a profound knowledge base in his/her subject(s) Typical metaphors in the subject expert category described the teacher as a source of knowledge. Teaching is concerned with getting across information to the students.

Teacher is like a book, from which a students draw new information.

Contextual metaphors (4 %)
These metaphors described 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, organisationally) or in what kind of setting or environment the teacher works. Both examples below indicate the teacher in a social context (class with pupils), but do not
reflect any specific aspects of the teacher’s knowledge base. These metaphors mostly described teachers’ work as too demanding, multifunctional, including too many responsibilities (pupils, parents, colleagues, heads, society).

Teacher is like *eager beaver*, because of the amount of work.

Unidentified metaphors (3%) could not be categorized in any of the categories presented above.

The differences between the three professional-age-groups (1-5 years of teaching n=23, 6-20 years of teaching n=18 and over 21 years of teaching n=26) were not statistically significant. Also gender differences were not statistically significant.

**DISCUSSION**

The results indicate that the extended Beijaard model can be used when categorizing teacher metaphors. Only two metaphors could not be identified. *Teacher as didactics expert* was clearly the most common metaphor used in this group of Finnish mathematics teachers. Almost half of the teachers (46%) saw the teacher as a didactics expert. 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.

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. Constructivist teaching is interactive and student-centered. The most common didactical metaphor was “guide”. Guide leads and motivates students but lets them to make new findings.

Presence of hybrid metaphors could be explained by complexity of a teacher’s job. Six of all Finnish mathematics teachers provided *hybrid metaphors*. The teacher is regarded to be a person with high moral values, good interaction skills and the goal of working for the good of others.

The differences between the three professional-age-groups (1-5 years of teaching n=23, 6-20 years of teaching n=18 and over 21 years of teaching n=26) were not statistically significant. In all three groups *teacher as didactics expert* was the most common used category. Also gender differences were not statistically significant.

Finnish mathematics teachers’ beliefs seem to be constructivist according to the metaphor analysis. However, despite the good PISA-results, the recent national assessment shows reduction in students’ mathematical skills (Hirvonen, 2011). If teachers’ beliefs are constructivist, what kind of teaching approach they actually use and how are their classroom practices? As the NorBa-project continues, we will find answers to this question.
REFERENCES


