MATHEMATICS TEACHERS' BELIEFS IN ESTONIA, LATVIA AND FINLAND

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The article presents results from a cross-cultural comparison of mathematics teachers' beliefs. We report how the nationality and language in Estonian, Latvian and Finnish schools are shaping their mathematics teachers' beliefs and the schools' microcultures and the relations between teachers' beliefs and their schools' microcultures. Results indicate cultural differences in school microcultures and teachers' beliefs as well as in how these variables are related to each other.

INTRODUCTION

Research on teacher beliefs has been motivated by the assumption that teacher beliefs largely determine the reality of teaching in classrooms. However, such naïve view has been challenged by case studies indicating inconsistencies between teacher's beliefs and practice suggesting that more emphasis should be paid to contextual factors. In this article we suggest an overall theoretical frame for the role of culture, school microculture, and teacher beliefs in the formation of actual classroom practices. Moreover, we present results of a cross-cultural survey of mathematics teacher belief structures in Estonia, Latvia, and Finland and how these beliefs are influenced by school microculture.

Teacher beliefs

Teaching in schools is orchestrated by teachers. They interpret the curricula and local policies and implement them in the classroom. Based on this perspective, there has been extensive research on teachers' teaching beliefs. Teachers' beliefs about mathematics and its teaching and learning reflect teachers' priorities for the practices of mathematics classrooms and play a significant role in shaping teachers' characteristic patterns of instructional behaviour (Thompson, 1992). Beliefs are seen to be factors shaping teacher's decisions (Schoenfeld, 1998). There is still considerable debate about the definition and characteristics of beliefs (see, Furinghetti & Pehkonen, 2002). In this study the beliefs are understood broadly as conceptions, views and personal ideologies that shape teaching practice.

Research suggests that teachers' beliefs are very stable and resistant to change (Brousseau, Book, & Byers, 1988). However, survey studies that have been repeated years apart show that beliefs in a teacher population do change over time (e.g., Kislenko & Lepmann, 2011). Belief research in mathematics education has focussed on how teachers view the nature of mathematics, its learning and teaching, and teaching in general (Dionne, 1984; Ernest, 1991; Liljedahl, Rösken, & Rolka, 2007). Currently it is widely assumed that teachers' beliefs about the nature of teaching and learning include both "direct transmission beliefs about learning and instruction" or,

so called, “traditional beliefs” and “constructivist beliefs about learning and instruction” (OECD, 2009).

Contextual influences on beliefs

The implementation of teacher’s beliefs into the practice is influenced by the context: pedagogical traditions in the country, school culture, social background of the students, etc. This makes the relationship between teachers’ beliefs and their teaching practice not linear; research often reports inconsistencies between teachers’ beliefs and their actions (Cooney, 1985; Skott, 2009). There are two levels of contextual factors. One important factor of the overall cultural milieu is the official educational policy, including the national curriculum. However, also the unofficial aspects of the culture impact schooling, influencing the values of education and the teacher-student relationships. Such influences do not always follow the national borders, but, for example, religion, and language may be more relevant determinants. An individual teacher must largely take these for granted and just adjust to them.

Another level of context is the local microculture in the school, which is reflected in the school rules and norms and in the way teachers collaborate. The teacher is an important actor of this microculture and may influence its development over time. The importance of school microculture has been found repeatedly in intervention studies. For example, in an evaluation of one large professional development program within mathematics education (Bobis, Clarke, Clarke et al., 2005), the aspects that were considered most effective were the practical resources and activities, the assessment process, the influence of significant people, classroom support, and the opportunity to share ideas. On the other hand, significant barriers to teachers’ implementation of the program were time, resources, class management and information overload. Almost all of these can be influenced locally.

So far, there have been few studies that compare teacher beliefs across countries (e.g., Andrews, 2007; Andrews & Hatch, 2000; Felbrich, Kaiser & Schmotz, 2012). The survey TALIS explored conditions of teaching and learning in 24 OECD countries (OECD, 2009). Loogma, Ruus, Talts and Poom-Valickis (2009) constructed two factors for different teacher beliefs: 1) traditional beliefs and 2) constructivist beliefs. Their analysis showed that in some countries the teachers tended to choose one view over the other while in some other countries there was a strong positive correlation between these two perspectives.

Teacher beliefs and cultural influences in Finland, Estonia and Latvia

Since regaining their independences in 1991, Estonia and Latvia have gone through many changes that affected also the educational system. While natural sciences and mathematics were emphasised in the Soviet curriculum, the focus has shifted towards other topics. Also the attractiveness of teacher profession has fallen considerably.

In Estonia, there was also a concern of the mathematics education researchers that teaching was too much based on drill and practice-methods (Lepik, 2005). However,

TALIS indicated Estonia to be one of the countries with strongest support for constructivist teaching beliefs (Loogma et al., 2009). Although Estonian teachers believed more in a constructivist way of teaching they did not directly contrast this view to the direct transformation of knowledge, and could therefore believe in the combination of these two views.

Latvian teachers are more oriented toward the constructivism than teachers in USA (Ravitz, Becker, & Wong, 2000; Šapkova, 2011). Whilst both primary and secondary teachers support constructivist ideas, primary teachers report more implementation of constructivism in their classrooms than secondary teachers (Pipere, 2005). Recent study (Austers, Golubeva, & Strode, 2007) shows that teachers in Latvia, irrespective of language at school, stage of education and school subject, report symptoms of burnout syndrome. Right-wing authoritarianism was found to be above the median, especially in Russian-speaking schools and primary schools while social dominance orientation was found to be below the median and it was higher among the teachers from Latvian-speaking schools. In 2006 and 2008 new standards in basic and secondary education were introduced in Latvia. These reforms as well as the ESF project "Elaboration of the Content of Learning and Teacher Further Education in the Subjects of Natural Sciences, Mathematics and Technologies" (2008-2013) changed the philosophy of Latvian education system by introducing the fundamental principles of holism and constructivism. Yet, despite of these new standards the mathematics performance of Latvian students in international studies has not improved and is below the OECD average (Shapkova, 2012).

In Finland, the fall of Soviet Union was one reason for a serious economic crisis. Although this influences also the educational system in general, the national policy emphasised mathematics and sciences. A national LUMA-project (1996-2002) was set up to enhance the learning of mathematics and sciences (Ahtee, Lavonen, Parviainen, & Pehkonen, 2007). The national ethos of the time was inspired by the rise of Nokia, generating a vision of Finland as a high-tech economy. As a surprise for Finns, Finland scored to the top in PISA achievement scores in 2000 and the following measures. However, Finland was also characterised by less favourable results on the affective measures. (OECD-PISA, 2004).

Research questions

Based on the review of the literature, we consider cultural factors to be relevant for teachers' beliefs. In addition to country, we expect language of teaching to be relevant in our context. Based on our knowledge of local context, we consider the Russian speaking minorities of Estonia and Latvia as their own cultures. Hence, we assume teachers in our study to represent five different cultures: Finnish, Estonian speaking Estonian, Russian speaking Estonian, Latvian speaking Latvian and Russian speaking Latvian. Moreover, we acknowledge the importance of the local school microcultures. Whereas the nationality and language are considered to be independent variables, we see the local micro-culture of the school to be interrelated with teacher's beliefs. Firstly, we acknowledge that the teacher has significant

influence on the formation of that microculture. Secondly, our measure of school microculture is based on the self-report of the teacher, thus indicating as much the teacher's personal interpretation of that culture as the local culture per se (Figure 1).

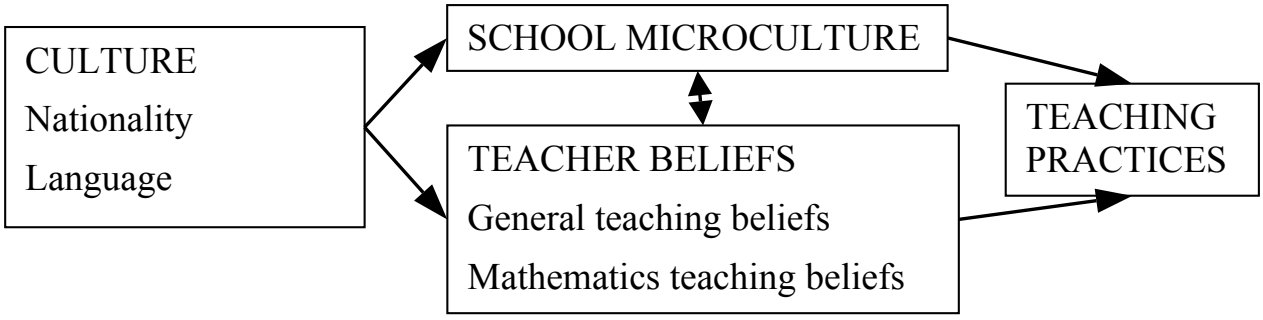

Figure 1. The theoretical framework for the study

In this paper we will explore the following research questions: 1) How are school microculture and teacher beliefs differentiated by nationality and language of the school? 2) What kind of relationships can be found between school microculture and teacher beliefs?

METHODOLOGY

Participants

The data was collected from the 7-9th grade mathematics teachers in Estonia (N=333), Latvia (N=390), and Finland (N=92). A subsample of teachers who teach in Russian speaking schools was collected in Estonia (N= 99 and Latvia (N = 96). Thus the overall sample size is 815 teachers. The data collection has been completed in fall and winter 2010/2011. The age of Estonian teachers ranged from 25 to 77 (M=47). Length of service of these teachers ranged from 1 to 59 years (M=22). The age of Latvian teachers ranged from 25 to 66 years (M=46). Length of service ranged from 1 to 44 years (M=23). The age of Finnish teachers ranged from 25 to 61 years (M=42). Length of service ranged from 1 to 35 years (M=14).

Instrument

A seven-module questionnaire was devised to explore aspects of teachers' views of mathematics teaching and their classroom behaviour. In this paper, we shall analyse and report four Likert modules: (1) teachers' overall job satisfaction; (2) their general beliefs on teaching and learning; and (4) their beliefs on mathematics teaching and learning. Teachers responded to each item using a 5-point Likert-scale.

First part of the instrument was designed as an indicator for teachers' overall job satisfaction. However, as many of the items relate to administrative support and teacher collaboration, we consider it to be a relevant indicator for school microculture. The dimension consisted of items for a factor "collaboration and recognition". It was measured using items, for example "In our school, staff members are recognized for a job well done".

Teachers' general beliefs on teaching and learning were measured using 16 Likert-items about teaching approaches identified as typical for constructivist (or non-constructivist) teaching philosophy, for example, "Teacher should direct students in a way that allows them to make their own discoveries" or "Effective/good teachers demonstrate the correct way to solve a problem".

The module measuring teachers' beliefs on mathematics teaching and learning was constructed using 26 Likert statements from Pehkonen and Lepmann (1994). Sample items for the different dimensions are: "Pupils should have an opportunity to independently develop their mathematical understanding and knowledge" (Process), "In a math lesson, there should be more emphasis on the practicing phase than on the introductory and explanatory phase" (Toolbox); "Working with exact proof forms is an essential objective of mathematics teaching" (Proofs).

Initially the questionnaire was devised in English and then translated into Finnish, Estonian, Latvian and Russian. The questionnaire was revised after a pilot study. Theoretical background, development and structure of the questionnaire are described more thoroughly in a previous paper (Lepik & Pipere, 2011).

Analysis

In order to reduce data into fewer, but more reliable variables, we used principle component analysis. We analysed the different modules of the questionnaire separately using *Varimax* rotation. We tested the following statistical criteria (see e.g., Leech, Barret, & Morgan, 2008): the determinant of the correlation matrix should be more than 0.0001; the Kaiser-Meyer-Olkin (KMO) measure should be greater than 0.70, and it is inadequate if less than 0.50; the Bartlett test should be significant ($p < 0.05$). We removed several variables due to low communality or multiple loadings. In order to determine the number factors we used different methods, such as scree-test, "eigenvalue grater than 1" rule, and parallel analysis. For clearer picture several solutions with different numbers of factors was also tested. The criteria to select the factors were reliability and easy interpretation of the factor.

Based on the factor analyses, we computed following sum variables. School micro-culture: *Collaboration and recognition* (α=.696; 5 items); General teaching beliefs: *Constructivist approach* (α=.730; 12 items), *Traditional approach* (α=.577; 4 items); Mathematics teaching beliefs: *Process* (α=.732; 9 items), *Toolbox* (α=.677; 6 items), *Proofs* (α=.592; 4 items).

We examined the possible differences of the five cultural groups (Finland-Finnish; Estonia-Estonian; Estonia-Russian; Latvia-Latvian; Latvia-Russian) by using Kruskal-Wallis and Mann-Whitney tests. In order to analyse the relationships between teacher beliefs and school microculture, we calculated the Pearson correlations for each subsample.

RESULTS

Cultural differences (Table 1) were statistically significant for all examined sum variables ($p < .001$). Those teaching in Russian reported higher collaboration and recognition in both Estonia and Latvia. Their responses were statistically significantly ($p < .001$) more positive than those of Finnish and Estonian speaking Estonian teaches. Also Latvian speaking Latvian teachers ranked higher than Finnish teachers in this respect ($p < .001$).

Group	Collaboration and recognition	Constructi-vism	Traditional-ism	Process aspect	Toolbox aspect	Proof aspect
LR	4.05	4.18	3.26	4.24	3.35	3.53
LL	3.88	4.20	3.21	4.14	3.25	3.21
ER	3.97	4.20	3.37	4.31	3.51	3.79
EE	3.75	4.10	3.39	4.13	3.48	3.30
FF	3.60	3.96	3.02	3.92	3.16	2.92

Table 1: Means for examined sum variables according to country-language group, highest means bolded. LR = Latvia-Russian; LL = Latvia-Latvian; ER = Estonia-Russian; EE = Estonia-Estonian: FF = Finland-Finnish.

Culture based differences regarding *constructivist* beliefs were similar to one with respect to collaboration and recognition: Both Latvian groups and, Russian speaking Estonians were high in their constructivism, and Finns had the lowest mean. Finnish scores were significantly lower ($p < .001$) than in any other cultural group. Also the difference between Latvian speaking Latvians and Estonian speaking Estonians was significant ($p < .001$). Estonian teachers agreed most with *traditionalism*, and Finnish teachers differed most clearly from the others. Finnish teachers differed significantly from Estonian teachers ($p < .001$) and also the difference between Estonian speaking Estonian teachers and Latvian speaking Latvian teachers was very significant ($p < .001$).

The Finnish teachers reported least emphasis on *process* in mathematics teaching making them different from all other groups ($p<001$). Russian speaking teachers in Estonia reported strongest emphasis, the difference to other Estonian teachers and Latvian speaking Latvian teachers being statistically significant ($p<0.01$). For *Toolbox aspect*, the strongest emphasis was in Estonia, their scores significantly higher ($p < .001$) than in Latvia or Finland. Regarding *Proof aspect*, we found several statistically significant differences between cultures. The Russian speaking groups had the highest means; Finnish teachers the lowest. The differences between all other groups were statistically very significant ($p<.01$) expect between Latvia-Latvian and Estonia-Estonian as well as Latvia-Russian and Estonia-Estonian.

The analysis of Pearson correlations between the variables confirmed some expected results, but also revealed some unexpected results (Table 2). In all of the countries we found a strong correlation between the constructivist view of teaching and process view of mathematics teaching. A similar strong correlation was found between traditional view of teaching and toolbox view of mathematics teaching.

	Constr.	Trad.	Process	Toolbox	Proof
Collab. LR	.353**	.053	.319**	.038	-.004
Collab. LL	.189**	-.014	.120*	.056	-.048
Collab. ER	.128	-.071	-.056	.048	-.005
Collab. EE	.275**	.037	.207**	.015	.065
Collab. FF	-.027	-.072	.164	.148	-.038
Constr. LR		-.163	.759**	-.006	.286**
Constr. LL		-.130*	.651**	-.005	.239**
Constr. ER		-.052	.522**	.160	.196
Constr. EE		.032	.586**	.116	.160*
Constr. FF		-.177	.695**	.075	.055
Trad. LR			-.088	.523**	-.023
Trad. LL			-.100	.562**	.127*
Trad. ER			.132	.532**	.301**
Trad. EE			.075	.498**	.207**
Trad. FF			-.152	.360**	.224*
Process LR				.007	.223*
Process LL				.124	.227**
Process ER				.197	.246*
Process EE				.136*	.229**
Process FF				.082	.041
Toolbox LR					.318**
Toolbox LL					.252**
Toolbox ER					.351**
Toolbox EE					.240**
Toolbox FF					.061

Table 2: Pearson correlations between collaboration, general teaching beliefs and mathematics teaching beliefs. LR = Latvia-Russian; LL = Latvia-Latvian; ER = Estonia-Russian; EE = Estonia-Estonian: FF = Finland-Finnish; ALL = Total sample.

Moreover, there was interesting variation between different groups regarding the way collaboration was related to teaching beliefs in different countries. For example, for both Latvian groups and Estonian speaking Estonian group of teachers – but not for

other groups – collaboration had a positive correlation with constructivist teaching beliefs and process view of mathematics teaching. Additionally, in all other groups except in Finland, the emphasis on proofs had a positive correlation with both the process aspect and toolbox aspect of mathematics.

DISCUSSION AND CONCLUSIONS

Teachers' beliefs reflect in which way teaching and learning is conceptualized in different countries. Cross-cultural differences in teachers' beliefs provide important information regarding teachers' inclination to different teaching approaches. TIMSS and PISA studies have shown that the mathematical attainment of Finnish, Latvian and Estonian pupils are different. Therefore, it would be relevant to assume that also the teachers' beliefs would somehow differ in these countries. The country comparison indicates that Latvian teachers to emphasize the constructivist teaching beliefs most, while Estonians were the strongest supporters for the traditional beliefs. On the overall level, Finland agreed the least with both of these approaches. We also identified differences within Estonia and Latvia according to the language of teaching, Russian speaking teachers putting more emphasis on proofs.

The results indicate that the mathematics teachers' overall teaching beliefs are related with their view of mathematics teaching. Those who believe more strongly in constructivist ideas also emphasize the process aspect of mathematics more. On the other hand, those teachers who hold a more traditionalist view of teaching also emphasize the toolbox aspect of mathematics in their teaching. Yet, it is important to notice that there was no negative correlation either between constructivism and toolbox-approach or between traditionalism and process-approach.

The school microculture – as reflected in teacher perception of collaboration and recognition – seems to have a clear relation with constructivist practices in both Latvian subsamples and in Estonian speaking sample from Estonia but not in the other groups. Such findings are bewildering and ask for further analysis of the data.

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