ELEMENTARY EDUCATION STUDENTS' MEMORIES OF MATHEMATICS IN FAMILY CONTEXT

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This study looks at an interesting relationship that was found between elementary education students' advancement in mathematics and encouragement they felt to have received from home, the higher scoring students advancement correlating negatively with encouragement. In a qualitative analysis we identified different aspects of mathematics in family context and found some possible clues for explaining the negative correlation between encouragement and advancement: we found strong positive role models among those who advanced and conflicts with parent during mathematics tutoring among those who declined.

INTRODUCTION

Family background and mathematics

Studies have repeatedly confirmed the effect of family background in students' success in schools. In TIMMS study it was possible to predict a significant part of the test result variation of US and Western European students by only a few family background variables, such as parent's education, amount of books at home and presence of both parents in family. However, the effect of family background varied between countries (9% in Iceland; 26.4% in Switzerland). (Woessmann, 2004)

There is also evidence for the effect of parental attitudes and beliefs on child's attitudes and beliefs. Catsambis (2001) found a consistent conclusion across studies that parents' educational aspirations are strongly associated to students' levels of achievement in both primary and secondary education. She also found some negative relationships between parental supervision of children's homework and students' achievement. These results were confirmed in her study of 13 580 parents and their children. Multivariate analyses compared grade 12 students of similar socio-economic backgrounds, family configuration, student characteristics and prior achievement in the 8th grade. Catsambis' findings suggest that active encouragement for preparing for college may be one of the ways by which parents influence their adolescents' academic success. However her studies shed no light on the negative influence of some parental practices, which has been repeatedly attributed to parents' attempts to deal with already existing academic or behavioural problems.

In this report we will have a different perspective to this question and look at how teacher education students perceive retrospectively their childhood and family influence.
Mathematical identity

How students engage with mathematics is to a large degree determined by their mathematical identity (Kaasila, Hannula, Laine & Pehkonen, 2005). Mathematical identity is constructed on the basis of student experiences in mathematics and their interpretation of these experiences. The interpretation is largely a social phenomenon, and is influenced by mathematics teacher, friends, and family. Op 't Eynde (2004) suggests that students' identity emerges in the situation: learning in the mathematics education community is characterised by an actualisation of (mathematical) identity through interactions with the teacher, the books, and the peers one engages with. We further propose that different identities suggested by Sfard & Prusak (2005) may emerge in different situations. However, identities are not only situational but each person brings one's own history to the situation and that will influence to a large degree what kind of identities are likely to actualise in the situation.

People often develop their sense of identity by seeing themselves as protagonists in different stories. What creates the identity of the character is the identity of the story and not the other way around (Ricoeur, 1992). Sfard & Prusak (2005) define identities as collections of those narratives that are reifying, enforceable and significant. In this article we shall look at the kinds of narratives student teachers have about themselves and mathematics within family context. Furthermore, these narratives will be contrasted with their success in mathematics.

Project description

In teacher education, there is the problem of low mathematical competencies and negative affective disposition of many students who enter the education. In Finland, teacher education is a popular field of study and less than 10 % of applicants are accepted for the education (NBE, 2005). Yet, roughly one fifth of the accepted students have a negative affective disposition towards mathematics (Hannula, Kaasila, Laine & Pehkonen, 2005b) and 10 % have poor grades in mathematics. The problem remains for a number of those who finish their teacher education.

This report is part of a research project "Elementary teachers' mathematics" (project #8201695), financed by the Academy of Finland (see Hannula, Kaasila, Laine & Pehkonen 2005a; 2005b). The project draws on data collected of 269 trainee teachers at three Finnish universities (Helsinki, Turku, Lapland). In this report we shall look at students' mathematics achievement and their advancement since the first test. As possible predicting variables, we shall look at the mathematics achievement and beliefs in the beginning of studies and student's gender.

Earlier results

In earlier analyses (Hannula et al., 2005b) we had identified eight principal components of students' affect, the correlations between these components, and six typical affective profiles of student teachers. In the core of student affect there were three components that were closely correlated with each other: mathematical self-
confidence, liking of mathematics, and perceived difficulty of mathematics. Correlated to this core, were five additional components: positive expectation of future success, view of earlier teacher(s), perceived own diligence, insecurity as a teacher in mathematics, and encouragement from own family (in order of declining correlation with the core). Based on these components, six typical profiles were identified primarily according to their core affect (positive, neutral, negative), and, secondarily, mainly according to diligence and received encouragement. The two positive profiles were autonomous (hard working, not encouraged) and encouraged (hard working, encouraged). The two neutral profiles were pushed (encouraged, not hard working) and diligent (not encouraged, rather hard working). The remaining two negative profiles were lazy (not encouraged, not hard working, insecure as teacher) and hopeless (hard working, not encouraged, no positive expectation).

Affect was related to performance, a positive correlation was found between positive affective disposition and high scores in the test. The test result was also affected by gender (male students scoring higher), previous mathematics studies (better achievement and more advanced course selection predicting higher scores), and the enrolment procedure (students at different universities scored differently; for details see Hannula et al., 2005).

The six clusters did continue to have differences in their post-test results. That means that the clusters do reflect relevant student types with respect to their relationship with mathematics. There was even some difference in the advancement of clusters, although only one difference was statistically significant. The 'diligent' students had advanced and 'encouraged' students regressed so that their success was now on equal level. A closer analysis of the quantitative data revealed that the student encouragement from their family had a different effect on student advancement according to their achievement in the pre-test: among successful students the family encouragement was negatively correlated with advancement and among least successful students there was a positive correlation between encouragement and advancement (Hannula, Kaasila, Pehkonen & Laine, In print). We will now focus on the qualitative data in order to find some possible explanations to this finding.

**METHODS**

Two questionnaires were administered in autumn 2003 to measure students' situation in the beginning of their mathematics education course. The aim of the questionnaires was to measure students' experiences connected to mathematics, their views of mathematics, and their mathematical skills. Another mathematics test was administered next spring after the course. This post-test consisted of four tasks that measured understanding of infinity, division, scale and percentage.

According to the preliminary analysis of the first questionnaire, 21 student teachers were selected for a qualitative study. They represented different universities and three different student types with respect to mathematics: successful with high self-confidence, unsuccessful with low self-confidence, and average performers with
indifferent attitude towards mathematics. The focus students were interviewed in the beginning and at the end of their mathematics education course.

In the semi-structured interview we asked - among other topics - student teachers about their memories of mathematics in their home. If necessary, we specifically asked about their parents’ and siblings’ roles in their learning of mathematics. Many of them brought these issues spontaneously when they told about their mathematical school memories.

In this analysis we focus on a theme ‘mathematics and home’, which was identified in the quantitative analysis as an interesting issue (For details, see Hannula et al, In print). In the first phase we read all the transcribed interviews and coded all instances where they talked about home, parents, siblings or other relatives. These were read again to identify different aspects relating to home. Each focus student's relationship with home was summarised as a short memo. Finally, these analyses were contrasted with each student’s success in pre- and post-test.

RESULTS

From the interviews we identified the following six themes relating to home. Within each of the topics there was also variation between students.

1) Help from home. Most students had received some help from their family members at some stage of their mathematics education. Some parents had not been able to help - at least not all the way through. Some students had not wanted help.

   Interviewer: What kind of home-related mathematics experiences do you have, and, for example, parents and siblings.

   Heidi: Well, from childhood I do remember and, that's elementary school time, mother and father helped as much as, as, hah, they could.

   Interviewer: Uhm, yes.

   Heidi: And there was always help available.

2) Role models at home. Students had different opinions about their family members' mathematical competencies. Some family members were ‘positive’ role models of successful and interested mathematics learners/users, some ‘negative’ role models of unsuccessful mathematics failures or uninterested mathematics avoiders.

   Ella: Mother just told that she had never been good in mathematics, but had just worked insanely hard so she has been able to get good grades.

   Mia: My sister, she was a real top genius in mathematics [...] 

3) Value of mathematics at home. In some homes mathematics was highly valued, in others there was indifferent or even devaluing attitude.

   Sini: Father, being an engineer, is, is, appreciates mathematics, and mother is teacher, so in that sense also appreciates all subjects and mathematics among others.
4) Encouragement and/or demands from home. Some homes demanded student to put effort in schoolwork, some gave encouragement at the times of success or failure, and some did neither.

Ella: Father said that if I choose to take the more advanced mathematics in high school, then I would get like the most expensive graphic calculator available.

Aila: I’ve been always really diligent student [...] and had high demands from home [...] so father especially, hah, hah, would have demanded mathematics.

5) Independence from home. Some students expressed clearly that they took independently care of their studying, while others indicated clear dependence for the help available at home.

Kati: From primary grade I remember when we always did with my father the extra tasks from behind of the book. Then, I felt somehow embarrassed going to the board, because I knew that father had checked my work and I knew it to be correct. And then, eventually, I asked my father not the check my work, [...] not to say if it's wrong. I felt, somehow, dishonest going to the board.

6) Helping siblings with mathematics. Most students who had younger siblings had helped them with mathematics.

Interviewer: Have you spoken about mathematics with your siblings?
Leo: Sometimes helped my sisters with homework or with a topic; brother is so young that I have not helped him. Oldest of my sisters is two years younger. I’ve helped her somewhat. High school especially. [...] She is not as interested in mathematics as I am, so she chose the less advanced mathematics in high school, and she's had a lot of trouble with it. I felt it was nice that I could help her, but at times I felt it was very difficult to help her understand. When many things are clear as day for me but it was not the case with her.

When student interview data was contrasted with quantitative data, we noticed some interesting regularities. Most of the focus students who participated in both pre- and post-test achieved better in the post-test.

There were only three students whose relative achievement regressed from pre-test to post-test and one of them was only a minimal regression (from 1.44 to 1.14). Julia had scored well in the pre-test (1.75) and her success had dropped significantly by the post-test (0.12). She is especially interesting, because her family had been encouraging her strongly. Tina scored slightly below average in the pre-test (-0.20) and her performance dropped in the post-test (-0.66). Both Julia and Tina had experienced emotional conflicts with their family members when they tried to help them with mathematics.

Interviewer: You mentioned that your father helped you during high school.
Julia: Yes, somewhat, but, it's not, not very much, it's a bit like, you know, a difficult situation, because you so easily lose your nerves then
Interviewer: Uhm
Julia: both do, and if, if you start, if you really try to help, my older sister also sometimes, she was one year older, and she was really good in math, too, so she, like, also tried to help sometimes, so it, it became so easily a fight.
Tina: ...and because he [father] has never been good in school, so when he has tried, then, during elementary school to teach me, so, I lost my nerves a little bit, because he doesn't really know it himself, or he used words that were no longer used at school ...

There was another interesting regularity among those who achieved well in the pre-test and were able to improve for the post-test. Many of those had strong mathematical role models whom they respected a lot.

Interviewer: Why do you think that you can [do mathematics well].
Pekka: Don't know, hah, must be, well, genes do have their own effect.
Interviewer: Uhm.
Pekka: And then, must be father, father in his time, well, made me play and
Interviewer: Uhm
Pekka: and think and
Interviewer: Uhm
Pekka: he was a carpenter and mastered numbers and [...] from there has come the positive side...

DISCUSSION

The qualitative data revealed six major topics that appeared in students' narratives of home and mathematics: 1) getting help, 2) role models, 3) value of mathematics, 4) encouragement/demands, 5) independence, and 6) helping siblings. Each of these topics showed variation between students. However, it is difficult to tease out the causality. How much these differences in home experiences were due to the different affect and achievement of the student? How much these differences influenced the different development of affect and achievement of students? Nevertheless, the data does suggest some explanation to the different advancement of high achieving students.

One might hypothesize that the regression of encouraged high-achievers might relate to them leaving home and lacking the support they had earlier had. In this data there was no evidence for that. On the contrary, those two students who had a relative decline in their advancement from high pre-test score to average post-test had both experienced emotional confrontation with their family when they had been helped with mathematics during school years. This might be related with an inability to utilize the positive effect of working with a peer or acting as a tutor, which was identified as an important facilitator for development among teacher students (Kaasila, Hannula, Laine & Pehkonen, In Print).
On the other hand, among the students who had scored well in pre-test and advanced in the post-tests, many had strong positive role model at home and mathematical competence seemed to form an important aspect of their identity. As they had already internalised a positive disposition towards mathematics, they possibly did not experience any strong encouragement from home.

References


