

FINNS AND ALGEBRA IN TIMSS 1999

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There has been discussion in Finland about the role of algebra in comprehensive school-mathematics. Results of national and international assessments have shown that achievement on algebra is low at the upper level of comprehensive school (Grades 7-9, ages 13-15). This has led to some suggestions about how to improve the situation. The most extreme proposals have included the idea that abstract algebra should no longer be taught to all students. (Korhonen 2001; Soro & Pehkonen 1998.)

Finland participated in TIMSS 1999 (Third International Mathematics and Science Study), and algebra was one of the five content areas examined more closely within mathematics. The Finnish overall results for 13-year-olds (Grade 7) were clearly above the international average, but algebra turned out to be a problematic content area for the Finnish students (Kupari et al. 2001.). This study examines the Finnish TIMSS 1999 results in algebra more closely. A central issue addressed in the analysis concerns the effect of different kinds of curricular approach to algebra on learning outcomes.

During the last two decades the Finnish comprehensive school system has undergone a decentralisation process. Individual schools have received increased decision-making powers concerning, for instance, the curriculum, while central administration has defined general guidelines and regulations for education in the form of legislation and the national *Framework Curriculum*.. Since its publication Finnish schools have been expected to design themselves a new school-level curriculum. (National Board of Education 1994.)

The variation among the school-level curricula raises problems, when assessment results are analysed. In Finland describing a national mathematics curriculum that would regulate instruction at a certain grade level is very problematic. An analysis of the mathematics textbooks most commonly in use in Grades 5-7 was carried out to solve this problem.. The results of the textbook analysis indicated that there was an obvious difference in the discussion of algebraic contents. In one of the analysed textbooks (P), algebraic contents accounted for almost 30% of the textbook space, while in the other two textbooks (K and MM) the proportion was as low as about 5 %. It is also notable that the approaches taken in the textbooks vary considerably. Textbook P may be said to have adopted the *symbolic* approach focusing on manipulations of algebraic expressions and solving linear equations. In the other two

books the *patterns* and *functions* approaches are given more attention while the symbolic approach is ignored almost totally. (Törnroos 2001.)

In this study Finnish seventh-graders performance on the TIMSS algebra items was first analysed in international context. Secondly, variance in performance among the students using different mathematics textbooks during Grade 7 was examined.

According to the results Finnish students are not yet in Grade 7 familiar with using algebraic symbols. Finnish students performed very poorly on items involving algebraic expressions, while performance on some numerical problems which did not require knowledge of algebraic notations was fairly good.

The textbook results suggested that the students who used textbook P did slightly better than the students using the other textbooks. There was a clear difference regarding algebraic expressions and equations, but in other topics such as representing situations algebraically the difference was insignificant, or as in proportionality and patterns, the students using textbooks K and MM had better scores.

An international assessment study like TIMSS 1999 offers an opportunity to take a look at the national system in a worldwide context. In this study it opens up new perspectives on the question of when and how algebra teaching should begin in Finnish schools. The findings of the study were highly consistent with the results of the textbook analysis. At the end of Grade 7 there is great variance in the students' algebra performance depending on the textbook they have used during the grade. However, the differences are mostly restricted to the topics where algebraic notation and procedural skills are needed. In topics where students are required, rather, to find rules and engage in mathematical reasoning without using specific notations the differences shrink or disappear.

The findings imply that Finnish mathematics education can and should include teaching algebra during Grade 7. While the employment of algebraic notations and procedures appears to be a weakness of Finnish mathematics education, the users of textbook P seemed to perform at least at the international average level on these topics. However, the symbolic approach applied in textbook P does not seem to succeed in developing other competencies related to algebra. A natural way of improving this situation would be to add elements of the patterns and functions approaches to the symbolic approach of textbook P. Combining the three approaches in a meaningful way seems in any case necessary if Finland wants to reach the international top in algebra.

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