ÐÏ à¡± á> þÿ ‹ • þÿÿÿ Šÿÿÿÿÿÿÿÿ…
$é1R ;4Ö 0 Ä …

ON GUIDING SECOND LANGUAGE LEARNERS IN THEIR NUMERACY DEVELOPMENT: THE IMPORTANCE OF BELIEFS AND ATTITUDES

Irene Rönnberg and Lennart Rönnberg
Fittjaskolan i Botkyrka, Sweden

Regardless of where they grow up, all children develop basic mathematical concepts and strategies to solve a variety of mathematical problems before even starting school (Allardice & Ginsburg 1983). Many researchers emphasize how universal these experiences are (Carey et al. 1995; Hiebert et al. 1997). Others point out the influence of the cultural environment on which concepts children develop (Allardice & Ginsburg 1983; Charbonneau & John-Steiner 1988). For example, children have different amounts of experience in quantifying their environment, and the need for precision in calculations, measurements, and punctuality varies between cultures. Moreover, the skills and concepts that children developed before starting school and outside school are tied to their own language and experiences from their personal environment. Mathematics is often regarded as an accessible subject for minority students because of the universal symbolic language. But this is the language of traditional university mathematics—it does not appear in compulsory school. On the contrary, compulsory school mathematics requires a greater, and completely different, language proficiency than other subjects. The language used to communicate mathematics and to express mathematical concepts is not a part of the students' everyday language. It lacks the redundancy and paraphrasing that facilitate comprehension in everyday communication. Mathematics instruction also demands that the students can learn and express themselves using the mathematical register, which includes the expressions and terminology of communicating mathematics. Because of the mathematical register, teachers are more likely to demand that the students express themselves correctly in mathematics than in other subjects. This may inhibit the students' attempts to express their own thoughts, since the formulation of thoughts and ideas often conflicts with the structure of language (Cf. Adler 2001). The language of mathematics is specialized and therefore rarely appears in other school subjects. For the students to learn it, teaching must focus on communicating mathematical concepts, processes, and applications. Word problems, or story problems, without illustrations are common in traditional textbook teaching. To solve them, students must use the language in a cognitively demanding, situationally independent, and often contextually reduced form of communication (Chamot & O'Malley 1987). Word problems are a special kind of text, which differs from other text genres in school. Understanding the tasks calls for more than just reading and literal understanding. Students need language proficiency before they can "read between the lines." Word problems also require the ability to alternate between various discourses. A discourse is a systematic way of thinking, speaking, and reasoning about a phenomenon—for example, a week may include five or seven days depending on the context (Riesbeck, Säljö & Wyndhamn 1999). This means that the student must have acquired enough language proficiency to communicate things that are not tied to the here and now, and are not supported by correlation, context, or nonverbal interaction. Säljö (2000) uses the term school related language proficiency to describe this competence. Cummins (1996) calls it Cognitive Academic Language Proficiency, CALP. These skills are more advanced than those used in everyday communication, which is supported by body language and context. It takes five to seven years to develop such skills in a second language, according to Cummins (1981). Many students who are taught mathematics in a second language may have difficulties not because they do not master the mathematical concepts, but because they have not yet acquired enough of the teaching language. Since they are formulated by somebody else, the language and context in word problems often have no connection to the students' language and world of experience, which may make them difficult to understand. When students do not share the cultural frame of reference of their teachers or textbook authors , the gap between the context of the tasks and the students' experience may become insurmountable.

Mathematics for Everybody?

Many studies from several countries show that students with a different culture and linguistic background achieve poorer results in mathematics than the majority students (Secada 1992; Heesch, Storaker & Lie 1998; Skolverket 1999). If we consider mathematics skills important for all students, then minority students must have a different kind of instruction so they can achieve equivalent results to those of the majority students. If citizens are to be able to protect their rights and participate in democratic processes in an economically and technologically advanced society, they must have not only good literacy skills, but also good skills in mathematics. From the perspective of society, it is also crucial that young people receive qualified education in mathematics, science, and technology to meet the existing great demand for such skills in the workforce. In the past decade, such terms as quantitative literacy and numeracy have been used to denominate the necessary mathematical skills. Evans (1991) provides a range of definitions of numeracy, from a broad concept including familiarity with scientific method, thinking quantitatively, and avoiding statistical fallacies—to a narrow view, including only the ability to do basic arithmetic. The International Adult Literacy Survey (1995) is based on three scales: prose, document, and quantitative literacy. The quantitative literacy tasks in the survey include performing multiple operations sequentially, and locating and extracting the features of the problem from the given material (Literacy, Economy and Society 1995). The report also employs the term "the practice(s)" of literacy and numeracy. Baker, Clay & Fox (1996) also use this term in an effort to avoid the narrow definition of numeracy and at the same time eliminate the dichotomies of literate/illiterate and numerate/innumerate. The report states that in the six participating countries—Canada, Germany, the Netherlands, Sweden, Switzerland and the United States—58–77% of those born in the country achieve the highest level of quantitative literacy, while only 31–53% of immigrants reach such levels. Mogens Niss rejects the notion that the task of mathematical education for the population at large should be confined to generating mathematical expertise and the skills needed for everyday private and social life:

> …[W]e have seen that mathematics is instrumental in the shaping of society. Combined with the fact that mathematical competence is a much-demanded resource, which is scarce because it is difficult and demanding for the individual to acquire, this contributes to the creation of expert rule in society. Those not in possession of mathematical competence beyond what is used in everyday life will be excluded from influencing important processes in society that have a considerable impact on their lives as individuals and citizens. If we want to stimulate a democratic development of society—as distinct from both an authoritarian and a populist one—the fostering of intelligent and concerning citizenship is of crucial importance. … I have argued … for the key role of post-elementary mathematical qualifications for the exercise of such citizenship. (Niss 1994:367)

Niss does not mean that everybody should become mathematical professionals, but that it is both desirable and possible to provide the common citizen with an insight into the experts' expertise. For example, model validity is crucial for the use of mathematical models in many extra-mathematical fields. Cummins (1996) emphasizes the need for teaching that develops the critical literacy of second-language students. Drawing on trials with society-oriented thematic studies in mathematics, Skovsmose (1994) believes that it is possible to develop critical mathematics education, which leads to mathemacy for all students. This corresponds to literacy and has the same key role for the citizens in a well-functioning democracy. In order to develop a desirable Mündigkeit (cf. Cummins' concept of empowerment), Skovsmose believes that teaching must be conducted in more democratic forms where students participate in deciding such things as which themes to study. There is a great deal of research about, and experience in, how to redesign mathematics instruction to achieve better results than today's (see NCTM 2000 for references). The instruction should start from the level of knowledge that the students bring with them to school and should communicate meaning and importance instead of transmitting a message. With minority students, such factors as the importance of language, the interaction in the classroom, the content of the instruction, the methods to be used, and the grouping of the students must be considered. To what extent these factors actually are considered depends to a great deal on the teacher's attitude toward minority students and opinions on the subject of mathematics.

Experience as the Basis for Learning

To make it possible for children to develop their mathematical skills in school, the teaching must relate to the experiences and concepts the children acquired before starting school, and outside school. The relationship between the new concepts being introduced and what the student already knows must also be evident to the students if they are to learn mathematics with understanding (Hiebert & Carpenter 1992; Carey et al. 1995). When children start school, they meet a formal mathematics that has often lost its ties to a concrete, linguistic environment. Many students feel lost in the school's arithmetical environment. Their own language and experiences are no longer relevant (Kilborn 1991). If the teachers take for granted that all children have the same experience and think in the same way, and minority students lack those concepts and experiences, this may be construed as a failing in these students. One way to make mathematics instruction understandable to students is to start with the mathematical experiences they bring with them to the teaching situation, instead of letting them work with tasks from a publisher-produced textbook. Another way is to investigate how the students think and take that as the point of departure for teaching. If the tasks are formulated so that students can use their own experiences and way of thinking to solve them, their solution strategies can be illuminated and discussed. When instruction is organized this way, the students are treated as individuals with resources. They feel respected and affirmed. If the students do not understand the concepts they are studying, or the language employed in teaching, their ability to learn is drastically impaired. The basic principle in teaching second-language students must be to teach new concepts using the language they know best, and to start with concepts they already know when expanding their language with things like the mathematical register. Concurring international research about teaching in a second language shows that as a rule bilingual teaching is more effective in subject studies than teaching only in the second language (Hyltenstam & Tuomela 1996; Cummins 1996; Thomas & Collier 1997). Even if the teaching is in a second language and the teacher does not know the students' language, the students should be allowed to use the language they know best when they solve problems. If they speak and write in their own language, the students can concentrate on the cognitively arduous task of solving the problem without being distracted by calls for linguistic correctness. Later, when they translate to the teacher how they have solved the problem, they can concentrate on language, since the thoughts are already formulated. In many Swedish schools, however, students are discouraged from using their own language in the classroom, with the reasoning that all opportunities to learn Swedish must be utilized. This negatively affects the students' opportunities for developing their mathematical skills. Saville-Troike's study (1984) shows positive effects on learning when the students are allowed to communicate in their own language about the concepts they are learning in the subject studies. When students have difficulty understanding the language of instruction, it is important that the instruction be organized in such a way that they concretely experience the concepts, before the terms for the concepts are introduced. Concrete teaching material is important for all students, regardless of age, and is all the more important if the students do not know the teaching language. If teachers and students draw pictures to help understand mathematical problems and solutions, it is easier not only for the students to think about their work and explain their solutions, but also for the teacher to see how the students think. Children must experience mathematics before they can understand it. To a great extent, these experiences emerge from experimenting with the language. The students need to produce language actively, both orally and in writing, in order to understand the significance of the language and of mathematics.

The Need for Reflection and Communication

To develop understanding, students must have opportunities for reflection and communication. Reflection means consciously considering your own experiences and ideas and trying to see phenomena from different perspectives. This creates mental connections between ideas, facts, and procedures, and therefore increases understanding. Communication means participating in a social interaction where you challenge and share your thoughts with one another, and ask for explanations and clarifications. This stimulates the consideration of your own ideas so you can argue them. To facilitate communication in mathematics and to formulate and develop their thinking skills, the students must be allowed to use a language that they know better than a typical second language. It may be their own language or even an informal version of the second language. Working together in smaller groups, cooperative learning, gives students greater opportunities to reflect on and work at mathematical concepts in communication with others than they have in a whole-class teaching situation. Big groups call for more formal language, which, according to Barnes (1976), inhibits exploratory talk and, consequently, reflection. In smaller groups, the students can use their own informal language in an informal fashion. It is also more probable that the students dare to try out new words, ideas, and concepts in a small group. If the students are divided into language groups, they can help each other to grasp the explanations of classmates and teachers. The teacher's authority, which, according to Barnes, inhibits student communication, is less restraining if the students work in smaller groups that are uncontrolled by the teacher. Teaching becomes more effective if the tasks that the students work with are designed with regard to the variety of experiences in the class, for example, the strategies that the students use to make various calculations. The students have the chance to reflect on their own and their classmate's solutions as well as negotiate openly with each other about meaning and understanding. This makes the variation of conceptual notions and ideas existing in a multicultural class into an asset instead of a liability. Pimm (1987) emphasizes the importance of writing when reflecting on notions and concepts in mathematics. Writing something makes it clearer to the writer, which in turn makes it easier to reflect on your own way of thinking. Writing externalizes thinking more than speaking because it calls for higher precision. Most students find this difficult; speaking is more natural than writing. Huinker and Laughlin (1996) emphasize the significance of conversation as a means to help students learn to reflect through writing. One purpose of using written documents, such as logbooks or mathematical journals, in teaching is that rewriting concepts gives the students the opportunity to reflect on the subject and process it linguistically. Another purpose may be to make students and teachers aware of when, how and why students use mathematics outside school. The teacher can connect to this in the teaching.

The Need for Changed Perspectives

What happens if minority students do not have the specific experience and knowledge that the school presupposes? Either the teachers focus on the failings or they ask for the experiences the students actually have and recognize them as resources to use in modified teaching. How teachers elect to react, says Sjögren (1996), depends to a great deal on their attitudes toward students with another linguistic and cultural background. Majority-population teachers with multicultural classes often disregard the differences and instead emphasize what the students have in common (Ladson-Billings 1994).

> My own experiences with white teachers, both pre-service and veteran, indicate that many are uncomfortable acknowledging any student differences and particularly racial differences. Thus some teachers make such statements as "I don't really see color, I just see children" or "I don't care if they're red, green, or polka dot, I just treat them all like children." However, these attempts at colorblindness mask a "dysconscious racism," an "uncritical habit of mind that justifies inequity and exploitation by accepting the existing order as given." … [B]y claiming not to notice, the teacher is saying that she is missing one of the most salient features of the child's identity and that she does not account for it in her curricular planning and instruction. (Ladson-Billings 1994:31-33)

In her research about multicultural classrooms in Sweden, Ann Runfors (1997) has found that teachers, in trying to counteract social differences, disregard cultural differences. In a cultural perspective on equality, cultural differences should be highlighted rather than squelched. Teachers, however, aim for social sameness and inclusion in a totality, defined in advance by the majority. Runfors believes that by disregarding cultural differences while emphasizing the Swedish language and "Swedishness," the teachers obstruct their own objectives. Before teachers can change their attitudes toward students from other cultures, they must first become aware of their own ethnocentric ideas and values regarding migration and integration. Denis McKeon thinks that the first thing teachers of second-language students should do to help their students achieve better results in school is to examine and recognize their own perceptions and behaviors toward children from different linguistic and cultural backgrounds (McKeon 1994). Their own perceptions must also be confronted with other perceptions or with another reality than their own. Such reflexivity is necessary for individuals to scrutinize the premises they take for granted and on which they base their own attitudes and teaching. Lahdenperä (1997) believes that it is impossible for us to discover our own ethnocentric perspective on our own. We need help from people with other perspectives. In Lahdenperä's view it is easier for individuals from other cultures to understand and reveal what is ethnocentric in statements and attitudes.

A Plea for an Intentional View of Mathematics

Your view of mathematics influences how you teach

How teachers organize their mathematics instruction is influenced by their own views on mathematics as a subject. If the teacher believes that mathematical knowledge is unchangeable, absolute, hierarchic, and culturally unconnected, with a conceptual and logical content that is independent of human beings, that person's teaching style will be what we call "conveyance." If, on the other hand, the teacher thinks that mathematics is a social and cultural construction, a dynamic science in flux, and that various mathematical models and systems can develop differently in different cultures through social arrangements, that person is more likely to use a teaching style based on the students' existing knowledge and characterized by communication about meaning and significance (Nickson 1991, 1992; Ernest 1991, 1994; Dossey 1992; Cf. Thompson 1992). The last two centuries have witnessed a sweeping evolution in the field of mathematics. Several new research areas appeared during the 19th century, like theory of sets and non-Euclidean geometry. Old areas were consolidated. Toward the end of the 19th century, these developments accelerated and still more research areas were created. The 20th century is characterized by a great diversification of the approaches to mathematical research. At the same time, new theoretical relations were discovered and many classic problems were solved (Kiselman & Roos 1994). A paradigm shift occurred in the philosophy of mathematics over the last three decades, partly due to the difficulties arising from various attempts to establish the foundation of mathematics during the early days of the 20th century, partly because of the perspective of other disciplines on mathematics (sociology of science, anthropology, and education). This shift has not had any significance for this development and has according to Sfard (1998) still not been accepted among mathematicians. Studying the development, particularly during the last century, of the philosophy of mathematics, or a selection of ideas from the philosophy of mathematics, may be one way to help future and current teachers define their own views on mathematics. Pehkonen (2001) thinks that it is important that the teacher's view is challenged. Bauersfeldt (1998) stresses the importance of reflection if the teachers are to avoid transferring their views of mathematics to their teaching unreflectingly.

How you are taught influences your views of mathematics

If we leave the Western philosophical discussion on the nature of the subject of mathematics and take a closer look at the kind of mathematical instruction that has dominated and still dominates a large part of the Western world, we see that there is a clear tradition as to how mathematics instruction is organized. Stigler and Hiebert (1999) stress that teaching is a cultural activity.

> Such activities do not emerge from nowhere. They take a long time to develop in agreement with a stable web of ideas and premises embedded in the culture. The scripts for teaching in each country appear to rest on a relatively small and tacit set of core beliefs about the nature of the subject, about how students learn and about the role that the teacher should play in the classroom. (Stigler & Hiebert 1999)

According to Hiebert et al. (1997), students base their opinions of the subject on the tasks that they work with, not on what the teacher tells them about the subject. If the teacher uses the lessons to demonstrate methods of solving problems and admonishes the students to practice only prescribed procedures, they will think that mathematics means following instructions on how to move symbols around. If the teacher wants the students to perceive mathematics as solving problems, they must instead devote much time to doing just that. If student teachers and active teachers do not have the opportunity to reflect and become aware of their own views on mathematics, their own mathematics experiences from school will probably have a significant impact on their teaching of mathematics. Hence, the scripts prevailing inside and outside the educational system are passed along.

Concluding Remarks

In addition to the opportunity to reflect on their own views of mathematics, teachers should also have the chance to learn about and test alternative teaching methods under controlled circumstances. Japan has a special system of teacher education in addition to the in-service teacher training like that in Sweden and the U.S.—Konaikenshu (School-Based Teacher Development). The most common activity carried out during Konaikenshu is Jugyokenkyu, which is usually translated as Lesson Study. In Lesson Study, a group of teachers collaborate to carefully craft a lesson or a sequence of lessons (Yoshida 1999). First, the teachers plan the lesson together. Then one of the group members is chosen to conduct the lesson in the presence of the other teachers. The lesson is evaluated, revised, and then repeated. Finally, the result is reported to other groups of teachers in their own school or in other schools. In recent years, Swedish teachers have been offered courses about the importance of cultural exchanges in school. Most of these courses have been voluntary and short. But in the 2002/2003 academic year, a full intercultural teacher training course will start at the University College of South Stockholm (Södertörn), characterized by a pervading intercultural perspective. One of the first semesters will be entirely devoted to studies of cultural patterns. This new course is aimed at student teachers specializing in language, history and social studies. A similar course would be ideal for future teachers of mathematics. It is a challenge for the Swedish teacher-education institutions to develop an environment and design a teaching content that stimulate future teachers of mathematics to reflect on and reconsider ingrained views—both on minority students and on mathematics and how to teach it. It is probably an even greater challenge for local and municipal school management to offer similar chances to already active teachers. But both of these challenges must be met if we are to prevent more and more students with minority cultural and linguistic backgrounds from falling by the wayside.

References

Adler, J. 2001. Teaching Mathematics in Multilingual Classrooms. Dordrecht: Kluwer Academic Publishers.
Allardice, B. & H. Ginsburg 1983. Children's Psychological Difficulties in Mathematics. In The Development of Mathematical Thinking, ed. H. Ginsburg. Orlando: Academic Press, Inc.
Baker, D. et al., eds. 1996. Challenging Ways of Knowing: In English, Mathematics and Science. London: Falmer Press.
Barnes, D. 1976. From Communication to Curriculum. Harmondsworth: Penguin.
Bauersfeldt, H. 1998. Radikalkonstruktivism, interaktionism och matematikundervisning. In Matematik och reflektion, ed. A. Engström. Lund: Studentlitteratur.
Carey, D. et al. 1995. Equity and mathematics education. New directions for Equity in Mathematics Education, ed. W. G. Secada et al. Cambridge: Cambridge University Press.
Chamot, A. U. & J. M. O'Malley 1987. The Cognitive Academic Language Learning Approach: A Bridge to the Mainstream. TESOL Quarterly 21(2), 227-249.
Charbonneau, M & V. John-Steiner 1988. Patterns of Experience and the Language of Mathematics. In Linguistic and Cultural Influences on the Learning Mathematics, ed. R. R. Cocking & J. P. Mestre. Hillsdale: Lawrence Erlbaum Associates Publishers.
Cummins, J. 1981. Age on arrival and immigrant second language learning in Canada. A reassessment. Applied Linguistics 11:2 (pp. 132-149)
Cummins, J. 1996. Negotiating Identities: Education for Empowerment in a Diverse Society. Ontario, CA: CABE.
Dossey, J. A. 1992. The Nature of Mathematics: Its Role and Its Influence. In Handbook of Research on Mathematics Teaching and Learning, ed. D. A. Grouws. New York: Macmillan Publishing Company.
Ernest, P. 1991. The Philosophy of Mathematics Education. London: The Falmer Press.
Ernest, P. 1994. The Philosophy of Mathematics and the Didactics of Mathematics. In Didactics of Mathematics as a Scientific Discipline, ed. R. Biehler et al.. Dordrecht: Kluwer Academic Publishers.
Evans, J. 1991. The Politics of Numeracy. In Mathematics Teaching. The State of the Art, ed. P. Ernest. London: The Falmer Press.
Heesch, E. J. et al. 1998. Språklige minoriteter prestasjoner i matematikk og naturfag. En komparativ studie av TIMSS-resultatene i matematikk og naturfag till språklige minoriteter og barn av norske foreldre. Universitetet i Oslo, Institutt for lærerutdanning og skoleutvikling.
Hiebert, J. & T. P. Carpenter 1992. Learning and Teaching with Understanding. In Handbook of Research on Mathematics Teaching and Learning, ed. D. A. Grouws. New York: Macmillan Publishing Company.
Hiebert, J. et al. 1997. Making Sense, Teaching and Learning Mathematics with Understanding. Portsmouth, NH: Heinemann.
Huinker, D. & C. Laughlin 1996. Talk Your Way into Writing. In Communication in Mathematics, K-12 and Beyond. 1996 Yearbook, ed. P. Elliot & M. Kenney. Reston, VA: NCTM.
Hyltenstam, K. & V. Tuomela 1996. Hemspråksundervisningen. In Tvåspråkighet med förhinder, ed. K. Hyltenstam. Lund: Studentlitteratur.
Kiselman, C. O. & J-E. Roos 1994. Matematik. In Nationalencyklopedien. Band 13 (s.142-143). Höganäs: Bokförlaget Bra Böcker.
Kilborn, W. 1991. Matematikundervisning och hemspråk. Nämnaren 18(3/4), 54-62.
Ladson-Billings, G. 1994. The Dreamkeepers. Successful Teachers of African Children. San Francisco: Jossey-Bass Publishers.
Literacy, Economy and Society. Results of the first International Adult Literacy Survey, 1995. OECD. Ottawa: Statistics Canada.
McKeon, D. 1994. Language, culture and schooling. In Educating Second Language Children, ed. F. Genesee. Cambridge: Cambridge University Press.
NCTM 2000. Principles and Standards for School Mathematics. Reston, VA: NCTM
Nickson, M. 1991. What is Multicultural mathematics? In Mathematics Teaching. The State of the Art, ed. P. Ernest. London: The Falmer Press.
Nickson, M. 1992. The Culture of the Mathematics Classroom: An Unknown Quantity? In Handbook of Research on Mathematics Teaching and Learning, ed. D. A. Grouws. New York: Macmillan Publishing Company.
Niss, M. 1994. Mathematics in Society. In Didactics of Mathematics as a Scientific Discipline, ed. R. Biehler et al. Dordrecht: Kluwer Academic Publishers.
Pehkonen, E. 2001. Lärares och elevers uppfattningar som en dold faktor i matematikundervisningen. In Matematikdidaktik—ett nordiskt perspektiv, ed. B. Grevholm. Lund: Studentlitteratur.
Pimm, D. 1989. Speaking Mathematically Communications in Mathematics Classrooms. London: Routledge.
Risbeck, E. et al. 1999. Matematisering i en mångtydig verklighet. En studie av elevers förståelse av relationen mellan modell och omvärld. In Miljöer för lärande, ed I. Carlgren. Lund: Studentlitteratur.
Runfors, A. 1997. Integration as a language issue. Processes of exclusion and inclusion in Swedish suburban schools. In Language and Environment. A Cultural Approach to Education for Minority and Migrant Students, ed. A. Sjögren. Botkyrka: The Multicultural Centre.
Rönnberg, I. & L. Rönnberg 2001. Minoritetselever och matematikundervisning. En litteraturöversikt. Stockholm: Skolverket.
Rönnberg, I. & L. Rönnberg 2002. Matematik en social och kulturell konstruktion? Om matematik och matematikundervisning i modern och senmodern tid. Föredrag vid 12:e Matematikbiennalen i Norrköping.
Saville-Troike, M. 1984. What really matters in second language learning for academic achievement? TESOL Quarterly 18(2), 199-219.
Secada, W. G. 1992. Race, Ethnicity, Social Class, Language, and Achievement in Mathematics. In Handbook of Research on Mathematics Teaching and Learning, ed. D. A. Grouws. New York: Macmillan Publishing Company.
Sfard, A. 1998. The many faces of mathematics: Do mathematicians and researchers in mathematics education speak about the same thing? In Mathematics Education as a Research Domain: A Search for Identity. An ICMI Study Book 2, ed. A. Sierpinska & J. Kilpatrick. Dordrecht: Kluwer Academic Publishers.
Sjögren, A. 1996. Bygga en ny värld utifrån olika referenser. In Den mångkulturella skolan, ed. E-S. Hultinger & C. Wallentin. Lund: Studentlitteratur.
Skolverket 1999. Ämnesproven skolår 9, 1999. Dnr 99:502. Stockholm: Skolverket.
Skovsmose, O. 1994. Towards a Philosophy of Critical Mathematics Education. Dordrecht: Kluwer Academic Publishers.
Stigler, J. W. & J. Hiebert 1999. The Teaching Gap. Best Ideas from the World's Teachers for Improving Education in the Classroom. New York: The Free Press.
Säljö, R. 2000. Lärande i praktiken. Ett sociokulturellt perspektiv. Stockholm: Prisma.
Thomas, W. & E. Collier 1997. School Effectiveness for Language Minority Students. NCBE Resource Collection Series, No. 9. George Washington University. Downloaded from NCBE web address: HYPERLINK "http://www.ncbe.gwu.edu/ncbepubs/resource/effectiveness/" www.ncbe.gwu.edu/ncbepubs/resource/effectiveness/ .
Taylor, C. 1994. Assessment for measurement or standards: The peril and promise of large-scale assessment reform. American Educational Research Journal 2 (31), 231-262.
Thompson, A. G. 1992. Teachers' beliefs and conceptions. A synthesis of research. In Handbook of Research on Mathematics Teaching and Learning, ed. D. A. Grouws. New York: Macmillan Publishing Company.
Yoshida, M. 1999. Lesson Study: A Case Study of a Japanese Approach to Improving Instruction through School-Based Teacher Development. The University of Chicago, Department of Education.

This paper was first published in Gomes, N. B., Bigestans, A., Magnusson, L. and Ramberg, I., Eds., (2002) Reflections on Diversity and Change in Modern Society. A Festschrift for Annick Sjögren, The Multicultural Centre: Botkyrka Sweden. < HYPERLINK "http://www.mkc.botkyrka.se" www.mkc.botkyrka.se >

It is important for educators to know that evaluations and tests according to the psychometric "Measurement Model" are based on the assumption that such skills as reading comprehension and understanding mathematical concepts are psychological traits, which are distributed among the population in a similar way as height and other physical characteristics (see Taylor 1994).

For further information, see the Minoritetselever och matematikutbildning report (Rönnberg & Rönnberg).

This section is based on a talk at the 12th Mathematics Biennale (Rönnberg & Rönnberg 2002).

PAGE 1 … Normal … Heading 1 … Heading 2 … Heading 4 … Default Paragraph Font … Table Normal … No List … Formatmall3 … Formatmall6 … Formatmall7 … brödtext … Footer … Page Number … Footnote Text … Footnote Reference … Hyperlink … Emphasis … Strong … FollowedHyperlink … urn:schemas-microsoft-com:office:smarttags State … place … City … country-region … PlaceName … PlaceType … Root Entry … Data … 1Table … WordDocument … SummaryInformation … DocumentSummaryInformation … CompObj … Microsoft Word Document MSWordDoc Word.Document.8