

DG 23: Current problems and challenges concerning students with special needs

Team Chairs: *Ann Gervasoni*, Australian Catholic University, Ballarat, Australia
Jens Holger Lorenz, University of Education, Heidelberg, Germany

Team Members: *Ann Ahlberg*, College of Learning and Communication, Jönköping, Sweden
George Malaty, University of Joensuu, Finland
Elena Yurhenko, Moscow Center for Continuous Mathematics Education, Russia

Aims and focus

Prevention and intervention in early childhood is viewed widely in the mathematics education community as important for increasing the opportunities of children at risk of poor learning outcomes, and for ensuring the educational success and general wellbeing of young people (Doig, McCrae, & Rowe, 2003; McCain & Mustard, 1999; Ochiltree & Moore, 2001; Shonkoff & Phillips, 2000). This contention, as it relates to mathematics education, underpinned the work of DG 23 which gathered congress participants interested in exchanging ideas, and exploring and discussing substantial issues and dilemmas related to students with special needs in mathematics. The particular focus of the discussion group was primary and lower secondary students who have a specific difficulty learning mathematics rather than children who have a general learning disability, although the interests of participants extended to adolescent learners, adult learners and learners with visual disabilities. The group examined recent research and developments in the diagnosis and teaching of students, and the early identification of students needing special programs to enhance their learning of mathematics. The specific aims of the group were to

- gather information on current diagnostic procedures in identifying students with special needs in mathematics
- collect research outcomes on successful programs that help students with special needs in mathematics
- exchange information on how the problem of students with special needs is handled in different national and institutional contexts
- encourage participants in future common research development activities
- formulate recommendations to relevant desiderata.

Enhancing the learning of students who are vulnerable in learning mathematics

There are many factors that influence children's learning of mathematics. For example, participants in the discussion group noted the effect of attitudes, motivation, confidence, anxiety, persistence, language, culture and parental attitudes. These influences need to be considered when working with children who are vulnerable in learning mathematics. Another consideration is the content of mathematics programs for students who are vulnerable. Participants expressed the view that program content needs to emphasise the "big" ideas in mathematics and be relevant to children's life experiences and interests. The role of metacognition in learning mathematics was also highlighted. In conducting intervention programs with students, participants believe that it is important for teachers to identify and build on the existing mathematical knowledge of students, and create a



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bridge for the construction of new knowledge and skills. This is dependent on suitable assessment tools and instructional programs.

Classroom teachers' perspectives

The large number of classroom teachers participating in this discussion group highlighted many important issues and concerns in relation to children who have difficulty learning mathematics. These issues need to be considered when approaching the development of assessment tools for identifying 'at risk' students, and when developing intervention programs for students. The key points raised were:

- mathematics anxiety is high for many vulnerable students;
- children who are vulnerable in learning mathematics tend to have poor number sense;
- relevant contexts for learning mathematics are important, particularly for those students who are vulnerable;
- some 13-year-old students still use counting strategies to solve number problems and use few reasoning-based strategies;
- early identification of students who are vulnerable in learning mathematics is essential. This involves assessment of cognitive abilities, working memory, and disposition towards learning and mathematics;
- there is great need for classroom teachers to gain professional knowledge about learning pathways in mathematics and how to identify where students' current knowledge lies in reference to these pathways, and in how to diagnose students' difficulties;
- there is a need for professional development of teachers that focuses on strategies for identifying students who are vulnerable in learning mathematics, and effective instructional practices for assisting these students; and
- there is a need for specialist mathematics intervention teachers in schools. Extra teaching materials are not enough to assist students; specialist teacher knowledge is required to effectively support mathematical learning for vulnerable students.

Approaches to identification of vulnerable students

An important issue for participants was how to effectively accomplish the early identification of students who are vulnerable in learning mathematics. It was noted that many countries use formal national testing in mathematics, but participants argued that this approach was insufficient for informing teachers about the specific instructional needs of students, and did not enable the early identification of vulnerable students. Diagnostic tasks are used in Sweden for developing profiles of students' mathematical strengths and weaknesses. Participants noted that this form of assessment can be used by teachers to plan classroom instruction, but is insufficient for identifying students who are 'at risk'. A form of assessment that participants believed offers promise for the early identification of vulnerable students is the clinical interview. This form of assessment is widely used in Australia, and in association with a framework of growth points, may be used by teachers to identify children who are vulnerable in particular domains of mathematics.



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Approaches to intervention

During discussions, many participants described 13-16-year-old students who rely on counting strategies for solving arithmetic problems. They noted that the ability gap widens as students become older, and argued that strategies to prevent this situation are needed urgently. In discussing this issue, three particular approaches to intervention were described. In a German project, Lorenz and colleagues (Lorenz, 2004) tried to identify those cognitive factors in the preschool years that are relevant for (later) mathematics learning in the primary grades. The study showed that visual factors and certain factors of language reception significantly contribute to success in arithmetic learning. The findings suggest that understanding of prepositions, space and time relations, and the ability to operate with visual stimuli correspond to mathematics success or failure. Further, the study demonstrated that it is possible to identify students at risk as early as age 4 and 5, i.e., in kindergarten.

In a second study, Lorenz and his group (Kaufmann, 2003) gave those first graders who were identified as “students at risk” in the sense above at the beginning of schooling additional training units in the regular classrooms. The remedial units comprised training for the development of (deficient) cognitive factors as well as certain prenumerical tasks. The study showed that those students who were included in the remedial program not only had sufficient gains but did not differ significantly from their average classmates. In some mathematical areas they even showed results comparable to the high achievers. The students at risk who did not receive additional remedial units differed from all other groups and lagged behind in all areas. Thus it is possible to identify students at risk in the early weeks of schooling and prevent the development of mathematical learning difficulties.

The second approach to mathematics intervention discussed in DG 23 was an Australian intervention program *Extending Mathematical Understanding* (Gervasoni, 2004). This program was first implemented by specialist teachers in 24 Early Numeracy Research Program trial schools (Clarke, Cheeseman, Gervasoni et al., 2002). Children were identified for the program on the basis of their mathematics growth point profiles that were developed following a clinical interview. The *Extending Mathematical Understanding* (EMU) program comprised daily 30-minute sessions for between 10 and 20 weeks. Sessions focused on children’s learning in the domains of Counting, Place Value, Addition and Subtraction, and Multiplication and Division. Teachers worked with groups of three or four students or with individual students. The program targeted children in both Grade 1 and Grade 2 (7- and 8-year-olds) and was not remedial in nature, but was built upon constructivist learning principles. The EMU program was successful in accelerating the mathematical learning of participating students.

Another approach to enhancing the mathematical learning of ‘at risk’ students was developed as part of the Early Numeracy Project in Canada (Kelleher & Nicol, 2002). This project investigated ways to best enhance numeracy learning for young learners, particularly those at-risk in the area of mathematics. It had been recognised in Canada that although teachers knew that some children were having difficulty with learning mathematics, they did not know how to determine what type of difficulties children were experiencing, or what type of instructional practices would help. This dilemma is one that participants in DG 23 noted was common in all countries. Significant outcomes of the Canadian project were four tools for teachers: assessment items which teachers use to determine numeracy strengths and weaknesses; helpful suggestions for ways to

address early difficulties in numeracy, including activities to support small group intervention; helpful activities and suggestions for whole class support; and activities to support the development of children's numeracy at home.

Recommendations for further research

The participants in DG 23 firmly believe that international research programs and dialogue are urgently needed to provide clear advice to education stakeholders and classroom teachers about effective strategies for the early identification of students who are at risk of poor learning outcomes in mathematics, and effective mathematics intervention strategies for enhancing the learning of these students. In particular, the following research recommendations were endorsed:

- identifying effective assessment tools for identifying students who are 'at risk' in mathematics. The group highlighted the promise of clinical interviews for this purpose;
- developing effective diagnostic tools for mathematics that are teacher friendly, culturally appropriate and are not dependent on psychologists for administration;
- identifying effective mathematics intervention programs for enhancing mathematics learning for vulnerable students;
- identifying effective classroom-based strategies for enhancing mathematics learning for vulnerable students;
- identifying the type of professional knowledge, teaching strategies and professional learning courses that lead to accelerated mathematical learning for 'at risk' students;
- identifying environments that motivate and encourage students to learn mathematics; and
- identifying appropriate curriculum and teaching strategies for learning the 'big ideas' in mathematics.

Recommendations for key education stakeholders and governments

- fund programs of ongoing monitoring and support for 'at risk' children;
- educate and employ specialist mathematics intervention teachers in schools;
- introduce dedicated courses in universities that focus on supporting the learning of children with different levels of mathematical ability;
- introduce smaller class sizes to enhance learning opportunities for all students;
- produce materials for parents with children in the early years of schooling that suggest strategies for parents to assist the numeracy development of students; and
- fund research programs addressing the specific research recommendation listed earlier.

References

Clarke, D., Cheeseman, J., Gervasoni, A., Gronn, D., Horne, M., McDonough, A., Montgomery, P., Roche, A., Sullivan, P., Clarke, B., & Rowley, G. (2002). *Early Numeracy Research Project Final Report*. Melbourne: Australian Catholic University.



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- Department of Education Training and Youth Affairs. (2000). *Numeracy, a priority for all: Challenges for Australian schools*. Canberra: Commonwealth of Australia.
- Doig, B., McCrae, B., & Rowe, K. (2003). *A good start to numeracy: Effective numeracy strategies from research and practice in early childhood*. Canberra: Commonwealth of Australia.
- Gervasoni, A. (2004). *Exploring an intervention strategy for six and seven year old children who are vulnerable in learning school mathematics*. Unpublished PhD thesis, La Trobe University, Bundoora.
- Kaufmann, S. (2003). *Früherkennung von Rechenstörungen in der Eingangsklasse der Grundschule und darauf abgestimmte remediale Maßnahmen*. Frankfurt: Lang.
- Kelleher, H., & Nicol, C. (2002). Paper presented at the Ministry of Education British Columbia Education Research Symposium.
- Lorenz, J.H. (2004). Unterrichts begleitende Diagnostik: Mathematik. In R. Christiani (Ed.), *Schuleingangsphase: neu gestalten* (83-103). Berlin: Cornelsen.
- McCain, M., & Mustard, F. (1999). *Reversing the real brain drain: Early years study final report*. Toronto: Ontario Children's Secretariat.

This report was written by Ann Gervasoni and Jens Holger Lorenz. They are happy to be contacted at a.gervasoni@aquinas.acu.edu.au and Jens.Lorenz@t-online.de, respectively, for further information on the work of this DG.