

## Teaching and Learning Mathematics in Patagonia

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A few years ago, I conducted a 4-day workshop for K-9th teachers in San Carlos de Bariloche, Río Negro, a southern province in my native Argentina. I was invited by Ana Bressan, a central figure in mathematics education in the region. The workshop focused on realistic mathematics education (RME), an approach developed in The Netherlands I had become acquainted with while working at the City College of New York in the NSF-funded Mathematics in the City. Within RME, a paradigm based on the ideas of Hans Freudenthal (1905-1990), mathematics is conceived of as a human activity that consists of organizing the world. Freudenthal conveys his viewpoint on teaching and learning through the notion of guided reinvention—"a subtle balance between the freedom of inventing and the force of guiding" (*China Lectures*, 1991, p.48). The idea is that rather than transmitting mathematics as ready-made knowledge, teachers ought to guide students into mathematizing realistic situations that beg to be organized by mathematical means. The term realistic is meant not in the sense of really existing but in that of realizable, that is, situations within which students may imagine themselves, think, and act. For more than three decades, RME specialists in The Netherlands and worldwide have designed realistic instructional sequences made up of problems whose solutions are likely to bring about, via reinvention, the targeted pieces of mathematical knowledge.

Many participants in the workshop began incorporating some aspects of RME into their practice, such as moving away from solely relying upon stereotypical word problems toward including open-ended problematic situations into their instruction; incorporating mental computation activities into their lessons; building upon students' own productions in the teaching/learning process; making room for smooth transitions between informal and formal levels of mathematizing; intertwining the various math curriculum strands; and linking mathematics with other subjects as well as with the world outside of school.

The high level of enthusiasm about these ideas and an interest in further studying and experimenting with RME gave rise in February of 2000 to the *Grupo Patagónico de Didáctica de la Matemática* (GPDM). In this study group, which I facilitate alongside with Ana Bressan, 20 teachers meet biweekly to develop and try out realistic instructional sequences, reflect on the results, and write up these experiences. A major task of the group has been to translate and re-contextualize RME-inspired materials to fit the realities of their local schools. Thus far, three publications and eight conference presentations have resulted from this work.

Bariloche, a town known for its high mountains and big lakes, has around 100,000 inhabitants, about 45 schools, approximately 1,200 (K-12) teachers, and almost 16,000 students. About half of the elementary teachers (400) in the local schools have been in contact with our project, via workshops, courses, or direct involvement in the study group. The GPDM includes faculty from the local Institute for Teacher Training in Mathematics Education, a fact that contributes to further institutionalizing our work.

Many of our group participants are routinely recruited by their school principals to organize workshops at their local schools. In these sessions, teachers present RME to their colleagues not as a set of expert recommendations, but as ideas emerging from their practice that rely on material gathered in their own classrooms. Another spin off of our work has been a series of workshops for parents. These events function as spaces for teachers to share with families what is happening in their math classes. More importantly, these sessions enable teachers to learn more about parents' occupations and interests, to then incorporate this as they plan their math lessons.

The group recently obtained funding to help strengthen the mathematical-didactical expertise of teachers from four schools located in 'high risk' areas of Bariloche. The students who attend these schools live in shantytowns, with inadequate nutrition, plumbing, and heat. Their parents, most of them unemployed, have little or no formal schooling. These institutions meet students' educational needs and also attend to matters of day care, health, and transition to work. We anticipate that RME will prove a fruitful approach to bridge the gap between students' informal mathematical knowledge and the mathematics they are expected to learn in school.

After the initial realistic turn, the GPDM is now experiencing a linguistic turn which is motivated by the following phenomenon: Teachers who use the same curriculum materials create different classroom cultures; in some cases, what results is a space open to fruitful exchanges of students' mathematical ideas, while in others it is more of the same ready-made school mathematics, albeit with a realistic touch. To account for this divergence, our analysis focuses on lesson transcripts from both GPDM and NYC classrooms using the functional grammar developed by M.A.K. Halliday and his disciples, results of which will be presented at an upcoming conference at the University of Comahue. Concurrent with this change of perspective was the incorporation to the GPDM of Sam Shreyar, from Lehman College, who contributes his expertise in activity theory and social semiotics. Our research is framed by a larger question: How can we use the functional-grammatical analysis of lesson transcripts as a tool for enhancing teachers' ability to orchestrate productive math discussions? We argue that teachers' role in structuring whole class interaction is paramount for all students to appropriate the ways of thinking, speaking, doing, and writing afforded to us by mathematics.

My involvement in the Patagonia project is crucial to the various facets of my work at Brooklyn College. First, my observations and work in the Bariloche schools provide me with invaluable experiences and insights which inform my methods and research courses. Second, my collaborative inquiry on classroom interaction with Bressan, Shreyar, and a sub-group of GPDM teachers has obvious implications for the critical examination of my mathematics education theory-in-action. Finally, this project is a reminder of what is possible in the apparently insurmountable task of making good mathematics teachers.