# Listening for Their Voices: A Study of Intermediate Students at Risk in Mathematics

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## Introduction and Rationale

During the 2005/06 school year, Grades 7–10 teachers at an Ontario school board were invited to participate in voluntary professional learning groups for mathematics, which met for a half-day a month (Kajander and Mason, forthcoming). During one of these meetings the topic of students at risk arose, and teachers expressed the desire for a better understanding of the needs of such students. This teacher interest spearheaded our work, and a study was planned to take place during the 2006/07 academic year. This article reports on the outcomes of that work.

The authors of this article (Ann Kajander, a mathematics educator and experienced classroom teacher, and Carly Zuke, a graduate student and experienced tutor of students at risk) comprised the research team, and planned the study with significant participant teacher input. Our research questions were as follows:

1. What does the literature tell us about the needs of students at risk in mathematics, and about best practices in teaching them?
2. What are at-risk students' apparent needs?
3. What are the perceptions of teachers regarding these students' needs?
4. What subsequent classroom practices do teachers adopt with such students?

## Literature Review

While space does not permit a full discussion,[1] the characteristics and needs of students at risk are well documented in the literature. The success of students at risk may relate to their motivation, which in turn potentially influences their behaviour (Hannula 2006). Hence, it is beneficial for teachers to understand students' motives if they are to fully understand their actions (Hannula 2006). The often-unsatisfactory levels of participation of at-risk students may be related to their needs (Sullivan, Tobias and McDonough 2006).

Intermediate students in particular have the need for identity, independence and social acceptance (Sullivan, Tobias and McDonough 2006). If the teaching methodology is one in which much routine and rote learning takes place, the need for independence cannot be met. In classrooms where teachers do not encourage communication and provide interactive activities, students cannot fulfill their need for socialization or develop a sense of acceptance (Hannula 2006).

The success of mathematics students can also be related to how much control they have over their own learning and the mathematical identity they are able to formulate (Sullivan, Tobias and McDonough 2006). This is important, because the attitude of a mathematics student is so influential in determining whether or not he or she will succeed; this is especially true for those who have been placed at risk (Sullivan, Tobias and McDonough 2006).

If students feel that the curriculum does not meet their needs, they tend not to participate (Daniels and Arapostathis 2005). Students who are unwilling to participate in learning mathematics often have the ability to be successful when offered a more relevant curriculum with less focus on extrinsic rewards (Daniels and Arapostathis 2005).

At-risk students have typically been subjected to previous negative school experiences, and such experiences are likely to affect their present and future learning of mathematics (McFeetors and Mason 2005). The negative experience has the potential to begin a cycle that is difficult to break (Marchesi 1998) because lack of confidence may be reinforced by continued poor performance, so the perception becomes self-sustaining.

Intermediate students are experiencing changing needs along with their concerns about social acceptance and independence (Fleener, Westbrook and Rogers 1995). Students will benefit the most from hands-on, active learning where they are free to explore and manipulate objects while solving problems they see as relevant (Fleener, Westbrook and Rogers

1995; Van de Walle and Folk 2005). Because socialization has become very important to students, they need to learn in a social environment, communicating with other students about mathematics to increase their own learning (Fleener, Westbrook and Rogers 1995). It seems reasonable that social needs can be met better in small group environments typical of the reform-based approach.

Much research indicates that students at risk will not benefit from rote learning or procedural practice alone (Fleener, Westbrook and Rogers 1995; Huhn, Huhn and Lamb 2006; Van de Walle and Folk 2005). Instead, their successful learning is dependent upon manipulating concrete objects, exploration and active problem solving (Fleener, Westbrook and Rogers 1995; National Council of Teachers of Mathematics [NCTM] 2000). Intermediate students in particular need to be actively involved in their learning, and be provided with many hands-on, relevant and engaging learning experiences to better support the development and retention of knowledge (NCTM 2000). The content and associated practice work not only need to be appealing and mathematically rich, but also must be connected with the student's real world. At-risk students may find learning only basic fundamental skills to be boring; students are more likely to practise incorrect methods with this type of rote learning, especially if they are working individually (Woodward and Brown 2006). Thus, more practice and volume alone do *not* guarantee success in mathematics (Woodward and Brown 2006).

To effectively learn in a group environment, students need some common ground to refer to and must be able to relate to one another socially (Wood, Williams and McNeal 2006). This implies that the teacher should allow some time at the beginning of the school year for social connections to be made through group activities and games. Acceptable ways of interaction and means to support or refute mathematical arguments must be developed and supported. In reform-based classroom environments, students are typically required to support their answers with an oral presentation defending the strategy they chose, which underscores the importance of being able to interact effectively in a social setting (Wood, Williams and McNeal 2006). Ignoring the development of such "social math norms" may seriously impair the success of an isolated reform-based lesson. The development of group and problem-solving skills may take several months. Students are not able to switch back and forth between a student-centred and a teacher-centred classroom; the transition to a student-centred learning environment must be gradual and consistent (Huhn, Huhn and Lamb 2006).

Hence, based on the literature, it would be fair to conclude that traditional practices do not provide strong support for the learning of students at risk. Practices that support active, interactive learning in environments that are interesting for students and support their needs for social contact, independence and self-concept development are beneficial. The support for such learning environments can be a considerable challenge for classroom teachers, especially those trained in more traditional methodologies.

## The Study

We wanted to examine students at risk in detail, using a case-study approach to gain as much insight about them as possible, but we also wanted to be sure that our study examined the issues more broadly. Hence we adopted an intensive case-study approach, supported by a written survey of a broader sample of more than 60 teachers. Teachers in the professional learning group that inspired the study opened their classrooms to us, and an initial cohort of 15 students in four different classrooms of Grades 7–9 were chosen for study based on teacher recommendation. Six of these students were studied in depth, and were observed for their entire mathematics class three times a week for four months. As well, a larger sample of teachers received a written survey that contained questions about their perceptions of students at risk and the choices they made in teaching such students.

Details of the case studies and survey analysis may be found in the full research report;[2] space here permits only a summary of our results.

## Results and Discussion

The case-study approach adopted with the students proved particularly revealing. The classroom researcher (Zuke) worked individually with the study students, supporting them, asking them questions and giving them extra help. As the research progressed, the students appeared to trust her more and more, and opened up to her to a significant degree. Although both of us had worked as teachers with at-risk students in classrooms in the past, we could not help but be surprised at the level of insecurity, low self-esteem and overall poor self-concept we found in all the case-study students as we got to know them. While individual issues surfaced with some students (poor reading ability, home issues such as parental health or drug dependency issues, a great number of different schools attended, or attendance issues), all of the students we studied seemed uninterested in the material, and seemed to feel that they wouldn't be able to do it anyway, even if they tried. Most students, in

fact, were highly unmotivated and almost completely disengaged during mathematics. Most avoided asking the teacher questions at all costs, even when she came by to ask them if they had any. But after the first few weeks of the study, they would turn to the researcher and tentatively ask her for help. While we knew that self-esteem was an issue for these students, neither of us realized the overwhelming significance it appeared to have. While we had observed other such students sitting quietly during our own math classes, we had been unaware of just how disconnected from our lessons they really were.

The teacher survey also revealed some surprises. Again, a more formal statistical analysis is available in the research report cited in Note 2. Briefly, however, teachers seemed well aware of the issues for students at risk, and generally cited the same issues related to students' difficulties as outlined in the literature and as observed in our study. These included motivation and behaviour issues, attendance, home issues, reading issues and so forth. However, when teachers were asked to describe how they worked with students at risk in their classrooms, significant differences from the best practices described in the literature emerged, consistent with the case-study classroom teacher observations.

While we did observe a few attempts by the teachers of the case-study students to use alternative lessons, these tended to be occasional, with no prior development of problem-solving skills or group processes. As a result, the teachers became discouraged, and did not try hands-on lessons again.

Significantly, the survey data showed that the teachers in the sample used traditional learning strategies to help students at risk. Teacher-directed instruction was the most favoured approach for teaching a student at risk, and more than 50 per cent of teachers reported using teacher-directed instruction more for students at risk than for other students. Fewer than 5 per cent of teachers reported using direct instruction less for at-risk students. Extra help during seatwork was selected by 82 per cent of the respondents as "usually" used to help a student at risk in mathematics, and the low variance found for this selection indicated general agreement on this strategy. Also, most teachers reported that they used rich tasks and projects either less than or to the same degree as they would for a student who is not at risk. The vast majority—more than 70 per cent—reported using tasks less, and fewer than 5 per cent of teachers reported using rich tasks or projects more frequently for students at risk.

The significant disconnect between best practices as described in the literature and teachers' everyday realities is a significant area of concern, and points to the need for considerable professional development. When teachers see their initial attempts at alternative lessons as unsuccessful, they tend to fall back on those practices that are most comfortable and with which they are experienced. Clearly, support is needed to develop the kinds of classroom practices and environments described in the literature, especially since initiating such practices with deeply mathematically disengaged students is a significant challenge for any teacher. Based on our work in this study, we have developed the fervent opinion that for some students' mathematical development, teacher training in best practices may be the only hope.

## Conclusions and Recommendations

We believe that our study underscores the urgency of the situation, and provides evidence that the status quo is simply not working for many students. Hence we end by making some direct and practical recommendations for individual teachers working with such students, even if professional development is not immediately available. These recommendations are based on examples of actual classroom practices (Kajander 2002).

Many at-risk students have become so because of particular procedural weaknesses; thus, an important first step is to remember that the visual element may be more powerful than a verbal or symbolic format for such students. Because of the typically short attention span and lack of interest of these students, any teacher-directed instruction needs to be kept to a minimum and focused, if at all possible, on examples based on highly engaging contexts and using concrete materials or real-world examples.

Beyond the briefest of teacher introductions, we believe that most mathematics must be learned in a hands-on, investigative manner. University-bound students may be willing to accept the explanation that content will be important for them in the future as a reason to learn it now; at-risk students are not. They need to be exposed to highly engaging contexts that will entice them to study right now—today. Time invested by the teacher in determining the interests of her students and then in using these interests as the basis of classroom mathematics tasks will more than pay off in the long run.

At-risk students who are not engaged will achieve little, as evidenced by the significant off-task behaviour we observed in the research. Therefore, the first step is to create tasks with which the students will engage. Often such hands-on investigative tasks are great starting points for learning by all students, and thus they can be assigned to the entire class. Beginning with a learning task is a good idea; once it is

completed it can be submitted to the teacher for constructive feedback (not marks). Having the students work individually or in pairs or groups at their own pace allows the teacher to circulate and work individually with students as needed. Then, after the students finish the learning task (while these can be done in pairs or small groups, we suggest individual write-ups) and discuss their work individually with the teacher, they can move on to an assessment task. Students move on only after completing the learning task, discussing their work with the teacher and receiving detailed feedback. Using a different context but the same curriculum expectations in both tasks subsequently allows the student to improve on the assessment task. The assessment task is then graded according to a provided rubric, and can be used to provide a significant portion of the student's grade. After completing the assessment task, faster students can be assigned the regular textbook homework that gives them the procedural fluency they need; this can be followed up with a quiz at the end of the unit that assesses procedural skill. In my (Kajander) experience, at-risk students who are working slowly on the tasks (and are often absent) may not get to do much of the procedural practice. However, based on what we saw and described in the research, in many cases they weren't doing it anyway! If the grading emphasizes the assessment task, and students get a good grade there, then often, even with a poorer quiz grade, a passing mark can still be achieved. But here's the really wonderful part that I have observed with my own students (Kajander 2002). Students at risk, who begin (often for the first time in a very long time) to engage with, understand and show success (in terms of marks) on mathematical tasks, *begin to see the value of developing better procedural skills.* They may start to realize that honing those skills will allow them to work more efficiently on the tasks. They may start to actually *do* their homework!

Above all, we must remember that students who are off-task are not learning. So an important starting point is to engage these students in mathematical contexts that have the potential to interest them. Only then can we hope to better support their learning.

## Notes

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1. The full research report can be found at http://noelonline.ca/depo/fdfiles/KajanderNOEL%20FINAL%20report%20APRIL%2030%202007.pdf.

2. See Note 1.

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