VOICE AND SUCCESS IN NON-ACADEMIC MATHEMATICS COURSES: (RE)FORMING IDENTITY

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The certainty of the conviction in Canada and the United States that all high school students (ages 15 to 18) should succeed in mathematics (National Council of Teachers of Mathematics, 2000) stands in stark contrast to the uncertainty about what should be prioritized in mathematics for students who are not academically inclined. That uncertainty is reflected in the various ways that high school mathematics courses are organized for non-academic students.

In this article, we, firstly, inspect the historical underpinnings of one-size-fits-all high school mathematics reforms and their alternatives, giving special consideration to the needs and goals of non-academic students. These needs and goals are then explored through the voices of four non-academic students who, in their own terms, succeeded in high school mathematics. Their voices suggest that their experiences with success in mathematics class prioritized their quest for a more positive *sense of identity* in relation to school mathematics. Their statements, amplified and interpreted through narrative-inquiry research, legitimate efforts to design meaningful and effective mathematics curricula for non-academic students that fosters the emergence of students' voices while they engage in mathematics.

Historical attempts to scaffold mathematics for non-academic students

High school mathematics was not originally designed for all students. Eighty years ago, when "almost one in three of the children reaching their teens in the United States enters high school" (Thorndike, 1923, p. 3), Thorndike claimed that a student of average intelligence

> will be unable to understand the symbolism, generalizations, and proofs of algebra. He [*sic*] may pass the course, but he will not really have learned algebra. (p. 37)

But that was all right, because algebra was only intended to be used in the advanced studies of mathematics and science, and not by the general workforce. Algebra, formal mathematics, indeed high school in general - none of the above were important to the non-academic student, because the non-academic high school student did not exist.

Things changed, of course. If we move halfway to the present time from the days of Thorndike, the ideal of all students attending high school was born. Technical and comprehensive high schools offered courses and programs for non-academic students, including diluted versions of academic mathematics courses and remedial mathematics courses. However, in the eyes of many,

> The non-academic, or General, route is fine - for everybody else's son or daughter. In reality it is a dumping ground, piled high with the poor, the disabled, and the newly arrived. (Dryden, 1996, p. 51)

'Non-academic' emerged as a label for programs and courses and became a label for students, a label defined by exclusion: non-academic students were the students who were not taking or succeeding in academic courses.

Today, students entering high school will have logged 1500 hours or more of mathematics instruction. Even if they enter school with equivalent mathematical experiences (and they do not), it would be foolish to expect that after eight or more years of instruction, all students would have equivalent understandings of mathematics. How can high schools systematically deal with the range of readiness represented by today's students?

Streaming - the creation of academically homogeneous class groups by academic grouping - enabled teachers to offer watered-down versions of course content to low-achieving groups, and go more slowly through the material. However, classroom research in streamed classes for non-academic students found that instructional practices seldom reflected the needs of non-academic students to learn in different ways, and seldom did streamed classes provide non-academic students with opportunities to feel successful at mathematics. Zevenbergen (2003), who studied the perspectives and attitudes of academic and non-academic students in Australian schools with streaming for mathematics based on students' academic ability, is representative:

> The experiences of the students fell clearly into distinct categories, whereby the students in higher groups felt that they were blessed with high-quality experiences, while the students in lower groups reported that their experiences were quite negative. [...] The experiences of the students could be seen to affect their relationships with mathematics profoundly and, hence, their subsequent choices as to whether or not to participate in the practices of the classroom and further study in the discipline. (p. 7)

Streaming of students through ability grouping seems to be more about handling the challenges teachers face when working with a range of students, than the challenges faced by the students themselves.

What about the possibility of teaching non-academic students a different *kind* of mathematics, and teaching them

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through methods *distinct* from those used with academically inclined students? This is the premise of *tracking*. Manitoba, the authors' home province, offers an example of an extensively tracked high school mathematics program. After a one-size-fits-all mathematics curriculum for nine years, students in grade ten (ages 15-16, or older if retained in a grade) select among three different streams. There are two academic tracks, one more formal and symbolic and the other more technology- and application-oriented. (Many high schools differentiate even further, by offering an Advanced Placement or International Baccalaureate track for the top academic students.) There is also one non-academic track, called *Consumer Mathematics*, designed with the following rationale:

> In order to meet the challenges of society, high school graduates must be mathematically literate. They must understand how mathematical concepts permeate daily life, business, industry, government, and our thinking about the environment. They must be able to use mathematics not just in their work lives, but also in their personal lives as citizens and consumers. *Consumer Mathematics* has been designed to meet these challenges for those who may not use advanced abstract mathematics in their careers, but who, nevertheless, will be consumers and active citizens. They also will need to develop their cooperative, interactive, and communicative skills. (Manitoba Education, Training and Youth [METY], 2002, p. 3)

Consumer Mathematics recognizes the distinct needs and motivations of non-academic students - a stance in curriculum design that is not typical within educational reform. We will return shortly to look more closely at student success in *Consumer Mathematics*.

Currently, reform efforts in high school mathematics education feature *detracking*, the development of a one-size-fits-all mathematics course. However, this approach means that success-for-all must be achieved within the algebra-based curriculum designed for university readiness, an approach that is, at best, dangerously idealistic for non-academic students (Noddings, 2000). Proponents of detracking have acknowledged that mixed-ability classrooms require instruction that

> has to be much richer, more problem-oriented, and more engaging than even the curriculum of the high track. Students need a lot of opportunities to construct knowledge together as a group, to make meaning out of their experiences. (Oakes, in O'Neil, 1992, p. 21)

But such instructional approaches have not materialized following the structural reorganization that detracking requires (Elmore, 1995). It was and is unfair to expect teachers to generate strategies spontaneously that can simultaneously engage high-ability learners while remediating students who are weak at, or angry about, mathematics.

Even in terms of the social engineering goals that motivate detracking, early research results are not encouraging.

> The explicit goal of detracking is to contest race- and class-based inequalities in schools [...] Despite the best efforts of committed teachers, these inequalities were often reinforced rather than challenged. (Rubin, 2003, pp. 566-567)

To remain idealistic about mathematics-for-all, we must (we believe) focus our intentions for non-academic high school students on *their* educational needs and capabilities (Chazan, 2000). Non-academic students are entitled to mathematics they can learn meaningfully. They deserve opportunities to repair their sense of mathematics and to see themselves as capable mathematics learners.

Admittedly, non-academic students are not easy to teach. Their content knowledge is often weak. Their confidence as students is often poor. Their capabilities as learners are often under-developed. And their educational needs are not well-defined. That they are not going into engineering or the sciences at university some day tells us what mathematics they *do not* need, but it does not tell us what they *do* need. That they did not value or benefit from instruction in previous years based on practicing arithmetic does not tell us what they could value, appreciate, or benefit from. In general, it is not only the pedagogic pathway to success in mathematics for non-academic students that is undeveloped; the nature of success in mathematics itself for these students is as yet undefined. We now turn our attention to an empirical exploration of the nature of that success, conducted with students in a non-academic grade 10 mathematics course.

Success in students' words

The voices in this section are those of students in their first-semester [term] *Consumer Mathematics* class in a large high school in Manitoba, Canada. Approximately half of the students in this study had previously attempted and failed a grade 10 mathematics course, while the remainder were in their first high school mathematics course after marginal success in grade 9 mathematics. The students' voices were amplified through a practitioner-based, narrative-inquiry-framed (Clandinin and Connelly, 2000) research process. Data included *interactive journal writing* (Mason and McFeetors, 2002) and *portfolios* (Morgan and Watson, 2002) generated by the students and *field notes* generated by the teacher. From this data, the teacher-researcher constructed individual *narratives of success* that provided a starting point for *conversations* (informal interviews) with each participant. There were three cycles of stories and conversations, illuminating the processes by which the teacher and students constructed success in the mathematics course and determined the nature of that success in the students' terms.

The experiences of these non-academic students suggest that succeeding in school mathematics is less a matter of learning mathematics content than it is a quest for a more positive *sense of identity* in mathematics class. Students needed to see themselves as effective mathematics thinkers, as having the capabilities required for learning mathematics, as being persons whose individual qualities were suitable for learning mathematics, and as students who could succeed in mathematics as the school defined success. It seems to us that non-academic students are seldom heard when high school mathematics curriculum is being developed - in fact, we found that non-academic students needed to *develop*

their voices, not necessarily so that they could be heard within the curriculum development process, but as an essential part of achieving success in mathematics. In other words, the students developing the capacity to describe and name the procedures by which they achieved success in mathematics was, in their own view and ours, an essential part of that success. Below, four students each voice a particular aspect of what we now take as success for non-academic students in high school mathematics.

Erin: success as a mathematical thinker

Erin was a grade 11 student who was retaking a grade 10 mathematics credit because she had dropped out of school the previous year. Erin summed up her entry orientation to mathematics in the opening statement in her first journal of the year, "I'm bad at math." However, as her teacher (the first author) interacted with Erin, she noticed that Erin was thinking mathematically and was learning to describe her mathematical thinking. For example, consider Erin's solution to a unit price question on the sixth test of the semester (see Figure 1, italics denote student writing).

Serena wants to buy some T-shirts. Her favourite department store sells T-shirts individually, or in packages of two or three. One T-shirt sells for \$2.98, a package of two T-shirts sells for \$5.49, and a package of three T-shirts sells for \$7.89.

a. Find the unit price when T-shirts are sold:
   i. in a package of two. ii. in a package of three.

   $\frac{\$5.49}{2}$ = *2.74 per shirt* $\frac{\$7.89}{3}$ = *2.63*

b. Which package offers the best unit price?
   the package of the 3 for \$7.89 offers you the best unit price.

c. Suppose Serena wants to buy seven T-shirts. Which combination of packages will be the least expensive? Show your calculations and the total price.

   package of 3 + 2 package of 2 =
   7.89 + 5.49 + 5.49 = \$18.87
   2 packages of 3 + 1 package of 1 =
   *7.89 + 7.89 + 2.98 = 18.76 * Best Buy!*
   3 packages of 2 + 1 package of 1 =
   5.49 + 5.49 + 5.49 + 2.98 = 19.45

Figure 1: The T-shirt problem.

In the last part of this question, Erin systematically created possible combinations of T-shirt packages to determine which would be the least expensive. Erin used her calculations to show her thinking and support her reason for recommending a specific combination as the best buy. The NCTM (2000) defines systematic reasoning as trying all the cases for a given problem and using those cases to support an argument. As teachers, we could see what Erin failed to include - those combinations with more than one T-shirt purchased at the individual-shirt price. Yet, it is reasonable to assume that in answering Part A, Erin would recognize that there was no point to considering combinations that included more than one individually packaged T-shirt. If we accept that assumption, then all reasonable cases are worked out, and they are laid out in a logical and coherent manner. Erin successfully applied systematic reasoning in her problem solving and communicated her reasoning with the combinations of packages and the matching arithmetic.

A few days later, Erin selected that question as an example of good mathematical thinking. In her test reflection she wrote,

> On the T-shirt question I just got all the prices and then compared them to see which one was lowest, it was a pretty easy question.

Erin demonstrated confidence in her mathematical reasoning, even though many of her classmates found it difficult to construct various combinations of packages systematically. But her reflective statement revealed more than increasing confidence. Erin was beginning to recognize the quality of her mathematical thinking and value her success as a mathematical thinker, a type of metacognitive process. It is significant, but not enough, when a teacher sees cognitive growth in the quality of Erin's written work. What is important is that Erin herself sees and expresses certain cognitive-growth qualities evidenced in her written work. She sees and expresses the systematic structure of her thinking, rather than only describing the arithmetic she did, and she sees her approach as changing the mathematics from hard to easy. Her mathematical growth is both cognitive and metacognitive (Schoenfeld, 2002).

Erin no longer saw herself as "bad at math." Erin was (re)forming her *identity as a mathematical thinker* as she engaged in mathematical thinking, noticed her thinking, and was in discourse about the quality of her thinking. This is most apparent at the end of the course when, in her final portfolio, Erin made statements on multiple elements with the form, "This shows I am a good math thinker because ...". Afterwards, in the third conversation, Erin defined a mathematical thinker as "just what you think yourself [...] when you figure out ways to do it in your own way, you're a thinker." Erin's statements demonstrate growth along Chickering and Reisser's (1993) *moving through autonomy toward interdependence* vector, where

> students' overall sense of competence increases as they learn to trust their abilities, receive accurate feedback from others, and integrate their skills into a stable self-assurance. (p. 47)

As Erin began to trust her ability to think mathematically, she viewed herself as a mathematical thinker and valued her evolving identity as a success more significant than the mathematical thinking itself.

Karl: success as a mathematics learner

Karl, a grade 10 student, explained in his first journal that he had decided to take *Consumer Mathematics* because

> the other two math courses would be way to hard [*sic* students' authorships have been maintained in original form, including spelling and grammatical errors].

In contrast with Erin, Karl believed he could succeed in the

course he had chosen, and he worked diligently in class to complete assignments and learn mathematical ideas. Trigonometry, the second unit of the year, provided a context in which Karl could re-view a topic he had found too difficult in his previous mathematics course. Specific topics in this *Consumer Mathematics* unit included similar triangles, the Pythagorean theorem, finding sides and angles in right angle triangles with trigonometric ratios, and solving word problems involving right angles (METY, 2002). In his unit portfolio, Karl's new-found proficiency at trigonometry mattered to him because he saw trigonometry as "real math," with its symbols and formulas (conversation 1). Consider several of his reflections about assignments that he selected for inclusion in his unit portfolio:

> *Similar triangles activity*: This was our intro to trigonometry. It demonstrates how much I remembered from last year. This demonstrates my *Reasoning* ability in that I reasoned with my self as to what I should do.
>
> *Trigonometry assignment*: This Item was one of our first hand outs it shows my ability to make *connections*, the labels opp, hyp, adj with the correct side. It shows how much I improved over last year.
>
> *Hand-in assignment*: This was an assignment I was absent for. I did it the day I handed this in. It shows what I learned in trig. It shows my *Connecting* ability (what I learned and what to do).
>
> *Overview reflection*: All in all I'd say I had greatly improved in trig since last year. From mediocre marks to very nice marks in the 80's and 90's. I learnt and reviewed all of the things from the last cupple of years as well as learning new things. So in summery, I learnt many new things, reviewed older things and remembered many older things and had a blast with getting good marks.

As his reflections show, Karl used marks to define his mathematical success at the beginning of the semester, expressing pride in his "very nice marks in the 80's and 90's." However, Karl was also beginning to author a different kind of success that moved beyond the mathematics of trigonometry in his portfolio. Without offering any glimpses into what did not work for him the year before in a similar unit, Karl was identifying and describing the behaviours that he recognized as causing his success. Although he mentioned positive student behaviours such as completing missed assignments, Karl focused more on his cognitive processes. In part, he used key words provided by the teacher for portfolio reflections, including *reasoning* and *making connections*. However, the distinctions among *remembering* and *reviewing* previously seen material and *learning new things* were Karl's own understandings expressed in Karl's own terms. *Naming* (Freire, 2000) aspects of his learning allowed Karl an opportunity to identify himself as a successful learner - an individual who is aware of how he learns, intentionally identifying and refining strategies that support his learning. Karl was beginning to see himself as a capable *learner* of mathematics, able and entitled to voice what counted as success for him.

Karl was not just succeeding at the mathematics in the trigonometry unit; he was noticing and expressing cognitive aspects of that success. More than repairing his flawed understanding of trigonometry from the previous year, Karl was repairing his *identity as a learner of mathematics*.

Nadine: success as an individual

Nadine began *Consumer Mathematics* a month late, after moving from another province. This required her to read the textbook and practice questions from the *Wages and salaries* unit independently. When she struggled with questions regarding percentage wage increases, she came for extra help. Although she quickly learned how to do the questions in the one-on-one session, Nadine was intent on having the solution process "make sense," a phrase she used repeatedly during the session. Nadine found ways to express in her own words the significant idea that a percentage was a comparison of a portion to a larger whole, a significant mathematical concept (Hoyles, Noss and Pozzi, 2001) that had been absent in her mathematical cognition previously. Later, when she encountered wage increase questions, she explained how her understanding of percentages could be adapted to apply to this new kind of question. During the first cycle of teacher-authored narratives and one-on-one conversations, the teacher pointed to that original extra-help session:

> For me, a key moment was when you insisted that you should *say* the steps for the wage-increase questions. I'm wondering if it's really *your* words that make sense to you the best.

At the time, Nadine valued the idea, and searched for words to say why.

> 'Cause it just shows how I, like, make myself learn. Like, people learn at a different pace. I learn at a weird pace, but anyway. Like, people, like, they learn different than others.

Two months later, in the second conversation, Nadine felt the theme of voicing her mathematical thinking was central, not just to her success in mathematics but to her image of herself:

> Well, when I read [the story] yesterday, I noticed a theme about thinking in words. Like, that's the main theme of my own story. [...] It kind of describes how I, like, started using the thinking in words and moved on from there. [...] And so then, that's how I do my thinking. And I think that's generally the theme of my story. [...] I like my theme! 'Cause it's about me. It's how I learn. It's not how, like, Cynthia, well, I don't know. Well, Cynthia does the same thing. But just as an example, it's me. It's not Cynthia. It's not you or whoever else. It's just me. It's just about me. It's not about whoever else there is, like this. Yeah!

In her success with percentages, Nadine had been able to see a particular learning strategy as effective. On one level, then, Nadine's story is about the importance of student voice simply as a tool for mathematical learning - saying what is coming to make sense, negotiating the meaning of mathematics through social discourse. In this conversation,

however, Nadine's comments are not just about how she learned one particular idea or topic or even all of mathematics. When Nadine reflected on this process, she constructed an image not just of a general strategy that enabled her to learn mathematics, but an image of herself as a particular individual.

Nadine was (re)forming her *identity as an individual* when interactions about mathematical content also included discourse about processes for learning mathematics. Nadine was establishing herself as a unique person through her conversations with her teacher about the theme of her narrative of success, formed from experiences of exploring effective mathematical learning processes. Nadine became purposeful in her mathematical learning as she used her general learning strategy - saying things in her own words - as a strategy particular to her. In fact, she named this as a success in the course when she wrote in her final portfolio reflection, "the learning strategies that I used in Math class this semester is 'Thinking in words'." Succeeding in learning mathematics that had not yielded to independent study enabled Nadine to see and give voice to her capability as a learner and her sense of herself as an individual. A mathematics course where she could succeed was an opportunity for Nadine to (re)form her sense of who she was.

Susanne: success as a mathematics student

Susanne was repeating grade 10 *Consumer Mathematics* in part because she had not attended classes regularly the year before. But Susanne wanted a different outcome this time, and did more than come to class regularly. As the teacher had done with Nadine, when writing the first narrative of success for Susanne the teacher pointed to a positive moment that Susanne had initiated.

> One time that sticks out in my mind was a day when you had to leave class early. The next day was going to be the first test of the year. Before you left, you asked me what you could do to review for the test. I mentioned some textbook questions. I was really impressed that you were taking lots of responsibility - and I let you know. You had a surprised reaction, and I've seen the same reaction before from other students. Why are students surprised when I'm excited about their responsible behaviour? But, the key moment for me was the strategy you explained for doing well in *Consumer Math*: working hard, to stay on top of things.

Susanne's score of 85% on that first test was encouraging to her. Susanne's score meant different things to her and her teacher. To the teacher, the score indicated that Susanne had learned the content: she could calculate wages, deductions, and overtime pay, and she could provide rational arguments to support hypothetical employment decisions. To Susanne, the test score suggested that she could do this mathematics, and her approach to studying was a worthwhile process.

In the conversation about the narrative, Susanne credited her mathematical success to her decision at the beginning of the semester:

> 'cause other years before, like, I don't like math at all and I just completely given up. But now that I have had to retake it again, I thought that I should, like, try and learn that I can do it.

Susanne expressed a general no-nonsense strategy in her approach to mathematics class as, "pretty much stay focused. And just, do the work." She was more explicit about her approach to studying for tests:

> going through your tests from before and [...] I make sure from when we mark things in class that I get the right answers. It's better to study for it because you know you have the right answers.

While the test mark was encouraging for Susanne, it also validated her approaches to mathematics class. She recognized her general and specific strategies as effective in supporting her goal of mathematical success. For Susanne, these strategies were not aimed directly at learning, but at a related goal: to achieve success in the course as the institution defined success. In a word, these strategies can be understood as a function of Susanne's *studenting* - the way in which Susanne fulfilled her stance as a student in the classroom. For the most part, the stance of a student would include attendance and punctuality, engaging in classroom processes, acknowledging the authority of the teacher, completing homework and handing in assignments - in other words, generally applying oneself to achieve the marks that characterize the institution's definition of student success. Susanne's methods of studying and reviewing are indicative of a thoughtful and strategic commitment of time and attention toward her goal - to succeed this year as a high school student.

We rarely find students in *Consumer Mathematics* who independently commit to studying for tests. Rather than depending on the teacher to review the mathematical content with her, Susanne was intentionally finding and using strategies that would support her goals as a student. Susanne progressed from asking the teacher how to prepare for tests to discussing her steadily-developing studying strategies with the teacher, but the studying remained a matter of Susanne's initiative. Susanne was doing more than passively and obediently doing the work that the teacher assigned, and her conversations with the teacher came to reflect more than recognition of the teacher's authority. She was recognizing for herself what strategies made her studying effective, rather than relying on the teacher to tell her what strategies to use. Her stance as a student had approached and passed the

> point at which a person sees authority as an internal agent rather than as an external agent. [...] It is here that one begins crossing the bridge from a submissive orientation to a position in which one's voice is a significant determiner of what one believes. (Cooney, 1994, p. 628)

Susanne was in the process of (re)forming her *identity as a competent student of mathematics* - a much different stance than in the previous year in *Consumer Mathematics*. The confidence she developed as she used her strategies to complete assignments and tests correctly contributed to her authority over her studenting processes. One of the final statements Susanne made in the last conversation was,

> I'm a different student because I know now that I can do it. And so I feel more confident going into my classes. And, I want to do it. I want to understand it. I want to do it better.

Although Susanne experienced mathematical success, especially on the first test, the success she points to in the conversation moves beyond mathematics. The success that Susanne valued was her new-found sense of being an effective student in mathematics class. It was a success that Susanne believed would help in future mathematics courses because she would approach the course with confidence in her ability to be a student of mathematics.

Success for students in non-academic mathematics

As mathematics educators, we believe in pursuing

> the desired outcome of mathematical power for all students within the chaotic reality of real students in real schools. (Steen, 1992)

For too long, however, that belief has remained an undefined ideal for non-academic students. We have amplified the voices of four real students who increased their mathematical power in a non-academic mathematics course. These students have succeeded in their own terms, not only as learners of mathematics, but as adolescents needing to see themselves as effective participants in high school mathematics. Erin grew from opportunities to apply and develop her problem-solving skills. Karl benefited by successfully learning what he saw as real mathematics, mathematics that he had not been able to learn in a more academically-oriented environment. Nadine depended on opportunities to talk mathematically, with herself and with her classmates. And Susanne benefited from discussing with her teacher how she personally might succeed, and then developing her own strategies as a student. They each found significant opportunity for personal success in different elements of the same course.

We hope that the stories of Erin, Karl, Nadine and Susanne can speak for a larger constituency of high school students for whom academic mathematics is not an educationally viable opportunity to succeed. Success for these four students and their classmates can be characterized by the (re)formation of their identity as mathematics students and learners through the emergence of their voices. Moving away from silence (Belenky *et al.*, 1986), the students were concurrently learning about themselves and learning to say things about themselves. Through their emergent voices, the students declared and characterized their successes, establishing the relevance of their experiences to future opportunities.

It was with some reluctance that we came to characterizing the successes of these students in terms of (re)forming identity. It is a big idea, and these students saw their everyday engagement within the mathematics course in smaller terms. As researchers, we had hoped that the data's themes would shed light on the nature of mathematics for non-academic students. We had hoped that any emergent self-awareness would be about their mathematical cognition and ways of learning mathematics, informing us about the necessary nature of non-academic mathematics.

As researchers using a collaborative narrative inquiry method, we could not unilaterally determine the themes of the stories; the themes must be those that the data sources express for themselves. Each student emphasized those elements of their moments of success that they saw as particular to them, distinguishing them from peers in their roles as learners and students. It was a matter of identity. Furthermore, the students felt that they were forming impressions of themselves that were not similar to how they had previously felt when in mathematics courses. It was a matter of identity formation.

But was it simply *formation*? Was it *reformation*: the casting out of identities from the past as well as the formation of new ones? Was it *re-formation*: the forming again of something they had previously formed, and then lost or damaged?

We suspect that either "re" label, reformation or re-formation, would align our ideas more strongly with current curriculum theorizing than would "formation". Curriculum reform in mathematics is as much about the putting away of old teaching practices as it is about putting new ones in their place. Identity reformation could be about what was wrong with what was already in place, as well as being about what was right with what was being formed. And the accounts would be even more compelling if their plotlines described re-formation, the repairing of past damage and the healing of past traumas, with students describing each detail of their catharsis. But that is not how our students narrated their lives: they told us how they were making new senses of themselves as successful, vocal learners and students. They did not choose to tell us how it had come to pass that this (re)formulation of self had come to be necessary. The past tensions of past-tense accounts were not shared with us, and, we think, not spoken at all by these non-academic students. And so we 'bracket' the *re-* of their formations. It could have been identity reformation, or identity re-formation, or simply identity formation, and readers are welcome to choose a preference, but the narratives of the learners do not make clear which choice is best.

The research of Baxter Magolda (1992, 2001) provides us with an external perspective on this limitation to our data. In her work with individual university students over multiple years, Baxter Magolda also found voice and identity to be pivotal to students' characterizations of their successes:

> The struggle in the twenties with the 'who am I' question was one of finding, listening to, and constructing the internal self-authored voice as the source of self-definition and the internal compass to guide decisions about 'how I know'. (2001, p. 15)

Yet her learners were not just older than those we studied: they were more self-confident and more self-aware. Baxter Magolda's students stated explicitly what became her themes: "Thinking for self was described by many as 'finding a voice'" (1992, p. 149). With our students, it was only through the interpretive and interactive aspects of narrative inquiry that such a theme came to be expressed. For Baxter Magolda,

> [t]he act of listening alone would enhance students' expression of voice and perhaps prompt a reformulation of the role of authority. (p. 221)

For us, listening was crucial, but students needed first to be helped to put words to their mathematical activity before listening could amplify the self-making power of their words. We now hold these words to be true regarding internal communication about oneself, not just interpersonal conversation:

> If conversation is to be effective and conducive to learning, the art of communicating has to be taught. (Sfard, Nesher, Streefland, Cobb and Mason, 1998, p. 51)

But where's the mathematics? Although the mathematics content was not central to these stories of success, voice, and identity (re)formation, it was not irrelevant. It mattered to us as teachers: our desire for students to learn valuable and appropriate mathematics did not diminish because *Consumer Mathematics* was intended for non-academic students. And it mattered to the students, at least as context. The success of these students needed to occur in the context that had caused them to self-label themselves as "bad at math" (Erin, journal 1) - applications of ratios, trigonometry, and mathematical justifications of procedures. The students recognized the importance of the mathematics as the context of their successes, but the success they valued most was about themselves as individuals. The following words of Susanne describe the potency of her success with mathematics, how understanding something feeds the inherent desire every student has to understand even more. Susanne voices something we believe high school mathematics can enable all non-academic students to achieve.

> So, then you start, not liking it more, but liking the fact that you want to do it more. [...] If you get involved, you get more into it. You don't start liking it because you like math, you start liking it because you're able to understand more about it. And because you're understanding what to do and how to do that. And then you start to like it because you eventually start to understand it. (conversation 2)

Mathematics for non-academic students needs to be mathematics, but for these students their ends-in-view were not mathematical. Identity was (re)formed progressively, first through specific instances of succeeding at something mathematical. Students came to see such instances of success as attributable to themselves, to capabilities and actions and choices that they made. By expressing what enabled them to experience success, they obtained validation for their actions and their attributions. As students generalized across their separate instances of succeeding, they saw themselves as being successful at learning math, successful as mathematics students. Through the metacognitive reflective elements of the course, the students learned that they had learned mathematics, and how it was that they had learned. Yet they valued the mathematical knowledge and the mathematical capabilities that they had developed less than they valued their newly enriched sense of themselves as successful. It mattered that we teachers/researchers wanted it to be about mathematics, and it was. But for the students mathematics was (just) the context for something they valued more than the content itself. For them, "studying mathematics is a form of *self-knowledge*". (Huckstep, 2000, p. 11, original emphasis)

Success for high schools with non-academic mathematics

What might mathematics for self-knowledge mean for curriculum issues in high school mathematics? The discussion in the mathematics education community about what to do with non-academic high school students has been sincere, and dedicated to principles of social and educational justice (Kitchen, 2003). Research has often enough documented failed efforts to extend mathematical success to non-academic students, whether by streaming into dead-end remedial arithmetic programs, or detracking into mixed-ability classrooms with academic mathematics to be handled with an independence that non-academic students have yet to develop in their relationship with school mathematics. Unfortunately, programs that fail to achieve success for all students can tell us only what *not* to do in further curriculum and course development, and offers research details only about *barriers* to achieving mathematical understanding and success.

In contrast, this study supports the *legitimacy* of mathematical success for all students as a goal of high school mathematics. Non-academic students learned valuable and accessible mathematics, and redefined themselves as successes in high school mathematics. The students participated within a course with well-scaffolded access to content that was within their competence and suited their pragmatic interests. Within a relational pedagogy, students' voices were valued and encouraged. For the four students described in this article, experiencing and voicing success enabled them to (re)form their identities as mathematical thinkers, as mathematical learners, as individuals, and as capable students of mathematics.

It could be said that we began with David Wheeler's words:

> It may be a civil rights issue to give every student the opportunity to receive a high-quality education; it is also each students' inalienable right to take it or reject it. [...] The teacher's responsibility ends with providing the opportunity to learn, develop, change, to all his [*sic*] students - a different enough aim, in all conscience. (2001, p. 10)

For us, however, with a "different enough aim, in all conscience" for a different enough clientele, the teacher's responsibility included the fostering of mathematical success and the emergence of each student's voice so that their successes could be named. Along with Noss (1994), we

> view the curriculum as a site of struggle in which pupils, teachers, parents, as well as voices from industrial, commercial, and other settings have at various times competed in various ways and with varying relative strengths to assert their priorities. (p. 7)

In such a cacophony of competing voices, the quiet voices of non-academic students need to be nurtured and amplified,

within mathematics courses organized for their interests. Of most importance, perhaps, these students' voices lead us to agree with Alrø and Skovsmose (1998) that

> A person's dispositions make up the raw material for her or his intentions. [...] The student's dispositions for learning are thus indicative of the factual possibilities that the student has in a school system and for the student's interpretations of those possibilities. (p. 49)

Again we would go farther: because we found students' dispositions and interpretations to be malleable, we now consider the factual possibilities for non-academic students in high schools to include significant success in mathematics.

A final comment

For us, as researchers in mathematics education, this study has suggested that non-academic students may provide especially informative data about factors that affect the learning of mathematics. If

> it is time to shift our attentions in school mathematics away from the current emphasis on concept competency and toward anthropological interpretation (Davis, 2001, p. 23)

then listening to non-academic students in mathematics might be especially informative. We offer three benefits for non-academic students as data sources.

Firstly, since non-academic students need to express their nascent understandings to learn the mathematics and increase their capabilities as learners, mathematics curriculum design for non-academic students needs to incorporate communicative processes throughout the learning activities. In effect, opportunities for curriculum designers and researchers to *listen* to the successes of these students will be in place as part of the curriculum itself, as opportunities for the students and their teacher to listen.

Secondly, compared to more academic students, the success of non-academic students depends more directly on the scaffolding that teachers and curriculum developers build into their learning opportunities. As a consequence, the linkages between teaching practices and successful learning may be stronger and more readily apparent to researchers in mathematics teaching for non-academic students.

Thirdly, the barriers to success for non-academic students proved to be persistent in our work. Although this made pedagogic success harder to achieve, it also meant that the factors that enabled the dissolution of those barriers had their effects over time, time that can enable researchers to notice the interplay of curriculum and instructional factors with those barriers and with the evolving identity of the students.

We believe that non-academic students may inform researchers in ways relevant to improving the success of all students, which is precisely the goal at the core of the mathematics education community's efforts to improve the teaching and learning of mathematics.

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