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Being a Mathematics Learner: Four Faces of Identity

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One dimension of mathematics learning is developing an identity as a mathematics learner. The social learning theories of Gee (2001) and Wenger (1998) serve as a basis for the discussion four "faces" of identity: engagement, imagination, alignment, and nature. A study conducted with 54 rural high school students, with half enrolled in a mathematics course, provides evidence for how these faces highlight different ways students develop their identity relative to their experiences with classroom mathematics. Using this identity framework several ways that student identities—relative to mathematics learning—can be developed, supported, and maintained by teachers are provided.

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Learning mathematics is a complex endeavor that involves developing new ideas while transforming one's ways of doing, thinking, and being. Building skills, using algorithms, and following certain procedures characterizes one view of mathematics learning in schools. Another view focuses on students' construction or acquisition of mathematical concepts. These views are evident in many state and national standards for school mathematics (e.g., National Council of Teachers of Mathematics [NCTM], 2000). A third view of learning mathematics in schools involves becoming a "certain type" of person with respect to the practices of a community. That is, students become particular types of people—those who view themselves and are recognized by others as a part of the community with some being more central to the practice and others situated on the periphery (Boaler, 2000; Lampert, 2001; Wenger, 1998).

These three views of mathematics learning in schools, as listed above, correspond to Kirshner's (2002) three metaphors of learning: habituation, conceptual construction, and enculturation. This paper focuses on the third view of learning mathematics. In this view, learning occurs through "social participation" (Wenger, 1998, p. 4). This participation includes not only thoughts and actions but also membership within social communities. In this sense, learning "changes who we are by changing our ability to participate, to belong, to negotiate meaning" (Wenger, 1998, p. 226). This article addresses how students' practices within a mathematics classroom community shape, and are shaped by, students' sense of themselves, their identities.

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Learning mathematics involves the development of each student's *identity* as a member of the mathematics classroom community. Through relationships and experiences with their peers, teachers, family, and community, students come to know who they are relative to mathematics. This article addresses the notion of identity, drawn from social theories of learning (e.g., Gee, 2001; Lave & Wenger, 1991; Wenger, 1998), as a way to view students as they develop as mathematics learners. Four "faces" of identity are discussed, illustrated with selected quotations from students attending a small, rural high school (approximately 225 students enrolled in grades 9–12) in the U.S. Pacific Northwest.

Method

The students in this study were participants in a larger study of students' enrollment in advanced mathematics classes (Anderson, 2006). All students in the high school were invited to complete a survey and questionnaire. Of those invited, 24% responded. Fourteen students in grades 11 and 12 were selected for semi-structured interviews so that two groups were formed: students enrolled in Precalculus or Calculus (the most advanced elective mathematics courses offered in the school) and students not taking a mathematics course that year. These students represented the student body with respect to post-secondary intentions, as reported on the survey, and their interest and effort in mathematics classes, as reported by their teacher. All of the students had taken the two required and any elective high school mathematics in the same high school. One teacher taught most of these courses. When interviewed, this teacher indicated the "traditional" nature of the curriculum and pedagogy: "We've always stayed pretty traditional. … We haven't really changed it to the really 'out there' hands-on type of programs." Participant observation and interviews with students corroborated this statement. Calvin, a high school senior, had enrolled in a mathematics class each year of high school and planned to study mathematics education in college. During an interview, he described a typical day:

> Just go in, have your work done. First the teacher explains how to do it. Like for the Pythagorean Theorem, for example, she tells you the steps for it. She shows you the right triangle, the leg, the hypotenuse, that sort of thing. She makes us write up notes so we can check back. And then after that she makes us do a couple [examples] and then if we all get it right, she shows us. She gives us time to work. Do it and after that she shows us the correct way to do it. If we got it right, then we know. She makes us move on and do an assignment.

Identity

As used here, identity refers to the way we define ourselves and how others define us (Sfard & Prusak, 2005; Wenger, 1998). Our identity includes our perception of our experiences with others as well as our aspirations. In this way, our identity—who we are—is formed in relationships with others, extending from the past and stretching into the future. Identities are malleable and dynamic, an ongoing construction of who we are as a result of our participation with others in the experience of life (Wenger, 1998). As students move through school, they come to learn who they are as mathematics learners through their experiences in mathematics classrooms; in interactions with teachers, parents, and peers; and in relation to their anticipated futures.

Mathematics has become a gatekeeper to many economic, educational, and political opportunities for adults (D'Ambrosio, 1990; Moses & Cobb, 2001; NCTM, 2000). Students must become mathematics learners—members of mathematical communities—if they are to have access to a full palette of future opportunities. As learners of mathematics, they will not only need to develop mathematical concepts and skills, but also the identity of a mathematics learner. That is, they must participate within mathematical communities in such a way as to see themselves and be viewed by others as valuable members of those communities.

Identity as a Mathematics Learner: Four Faces

The four faces of identity of mathematics learning are engagement, imagination, alignment, and nature. Gee's (2001) four perspectives of identity (nature, discursive, affinity, institutional) and Wenger's (1998) discussion of three modes of belonging (engagement, imagination, alignment) influenced the development of these faces. Each of the four faces of identity as a mathematics learner is described below.

Engagement

Engagement refers to our direct experience of the world and our active involvement with others (Wenger, 1998). Much of what students know about learning mathematics comes from their engagement in mathematics classrooms. Through varying degrees of engagement with the mathematics, their teachers, and their peers, each student sees her or himself, and is seen by others, as one who has or has not learned mathematics.

Engaging in a particular mathematics learning environment aids students in their development of an identity as capable mathematics learners. Other students, however, may not identify with this environment and may come to see themselves as only marginally part of the mathematics learning community. In traditional mathematics classrooms where students work independently on short, single-answer exercises and an emphasis is placed on getting right answers, students not only learn mathematics concepts and skills, but they also discover something about themselves as learners (Anderson, 2006; Boaler, 2000; Boaler & Greeno, 2000). Students may learn that they are capable of learning mathematics if they can fit together the small pieces of the "mathematics puzzle" delivered by the teacher. For example, Calvin stated, "Precalculus is easy. It's like a jigsaw puzzle waiting to be solved. I like puzzles."

Additionally, when correct answers on short exercises are emphasized more than mathematical processes or strategies, students come to learn that doing mathematics competently means getting correct answers, often quickly. Students who adopt the practice of quickly getting correct answers may view themselves as capable mathematics learners. In contrast, students who may require more time to obtain correct answers may not see themselves as capable of doing mathematics, even though they may have developed effective strategies for solving mathematical problems.

One way students come to learn who they are relative to mathematics is through their engagement in the activities of the mathematics classroom:

> The thing I like about art is being able to be creative and make whatever I want… But in math there's just kind of like procedures that you have to work through. (Abby, grade 11, Precalculus class, planning to attend college)
>
> Math is probably my least favorite subject… I just don't like the process of it a lot— going through a lot of problems, going through each step. I just get dragged down. (Thomas, grade 12, Precalculus class, planning to attend college)

Students who are asked to follow procedures on repetitive exercises without being able to make meaning on their own may not see themselves as mathematics learners but rather as those who *do not* learn mathematics (Boaler & Greeno, 2000). A substantial portion of students' direct experience with mathematics happens within the classroom, so the types of mathematical tasks and teaching and learning structures used in the classroom contribute significantly to the development of students' mathematical identities. In the quotation above, Abby expressed her dislike of working through procedures that she did not find meaningful. In mathematics class, she was not able to exercise her creativity as she did in art class. As a result, she may not consider herself to be a capable mathematics learner.

On one hand, when students are able to develop their own strategies and meanings for solving mathematics problems, they learn to view themselves as capable members of a community engaged in mathematics learning. When their ideas and explanations are accepted in a classroom discussion, others also recognize them as members of the community. On the other hand, students who do not have the opportunity to connect with mathematics on a personal level, or are not recognized as contributors to the mathematics classroom, may fail to see themselves as competent at learning mathematics (Boaler & Greeno, 2000; Wenger, 1998).

Imagination

The activities in which students choose to engage are often related to the way they envision those activities fitting into their broader lives. This is particularly true for high school students as they become more aware of their place in the world and begin to make decisions for their future. In addition to learning mathematical concepts and skills in school, students also learn how mathematics fits in with their other activities in the present and the future. Students who engage in a mathematical activity in a similar manner may have very different meanings for that activity (Wenger, 1998).

Imagination is the second face of identity: the images we have of ourselves and of how mathematics fits into the broader experience of life (Wenger, 1998). For example, the images a student has of herself in relation to mathematics in everyday life, the place of mathematics in post-secondary education, and the use of mathematics in a future career all influence imagination. The ways students see mathematics in relation to the broader context can contribute either positively or negatively to their identity as mathematics learners.

When asked to give reasons for their decisions regarding enrollment in advanced mathematics classes, students' responses revealed a few of the ways they saw themselves in relation mathematics. For example, students had very different reason for taking advanced mathematics courses. One survey respondent stated, "I need math for everyday life," while another claimed, "They will help prepare me for college classes." These students see themselves as learners of mathematics and members of the community for mathematics learning because they need mathematics for their present or future lives. Others (e.g., Martin, 2000; Mendick, 2003; Sfard & Prusack, 2005) have similarly noted that students cite future education and careers as reasons for studying mathematics.

Conversely, students' images of the way mathematics fits into broader life can also cause students to view their learning of further mathematics as unnecessary. Student responses for why they chose not to enroll in advanced mathematics classes included "the career I am hoping for, I know all the math for it" and "I don't think I will need to use a pre-cal math in my life." Students who do not see themselves as needing or using mathematics outside of the immediate context of the mathematics classroom may develop an identity as one who is not a mathematics learner. If high school mathematics is promoted as something useful only as preparation for college, students who do not intend to enroll in college may come to see themselves as having no need to learn mathematics, especially advanced high school mathematics (Anderson, 2006).

Students may pursue careers that are available in their geographical locale or similar to those of their parents or other community members. If these careers do not require a formal mathematics education beyond high school mathematics, these students may limit their image of the mathematics needed for work to arithmetic and counting. In addition, due to the lack of formal mathematical training, those in the workplace may not be able to identify the complex mathematical thinking required for their work. For example, Smith (1999) noted the mathematical knowledge used by automobile production workers, knowledge not identified by the workers but nonetheless embedded in the tasks of the job. When students are not able to make connections between the mathematics they learn in school and its perceived utility in their lives, they may construct an identity that does not include the need for advanced mathematics courses in high school.

The students cited in this paper lived in a rural logging community. Their high school mathematics teacher formally studied more mathematics than most in the community. Few students indicated personally knowing anyone for whom formal mathematics was an integral part of their work. As a result, careers requiring advanced mathematics were not part of the images most students had for themselves and their futures.

Alignment

A third face of identity is revealed when students align their energies within institutional boundaries and requirements. That is, students respond to the imagination face of identity (Nasir, 2002). For example, students who consider advanced mathematics necessary for post-secondary educational or occupational opportunities direct their energy toward studying the required high school mathematics. High school students must meet many requirements set by others—teachers, school districts, state education departments, colleges and universities, and professional organizations. By simply following requirements and participating in the required activities, students come to see themselves as certain "types of people" (Gee, 2001). For example a "college-intending" student may take math classes required for admission to college.

As before, students' anonymous survey responses to the question of why they might choose to enroll in advanced mathematics classes provide a glimpse into what they have learned about mathematics requirements and how they respond to these requirements. Students were asked why they take advanced mathematics classes in high school. One student responded, "Colleges look for them on applications," and another said, "Math plays a big part in mechanics." Likewise, students provided reasons for why they did not take advanced mathematics courses in high school, including "I have already taken two [required] math classes," and "I might not take those classes if the career I choose doesn't have the requirement." While some students come to see themselves, and are recognized by others, as mathematics learners from the requirements they follow, the opposite is true for others. Students who follow the minimal mathematics requirements, such as those for graduation, may be less likely to see themselves, or be recognized by others, as students who are mathematics learners.

The three faces of identity discussed to this point are not mutually exclusive but interact to form and maintain a student's identity. When beginning high school, students are required to enroll in mathematics courses. This contributes to students' identity through alignment. As they participate in mathematics classes, the activities may appeal to them, and their identity is further developed through engagement. Similarly, students—like the one mentioned above who is interested in mechanics—may envision their participation in high school mathematics class as preparation for a career. Mathematics is both a requirement for entrance into the career and necessary knowledge to pursue the career. Thus, identity in mathematics is maintained through both imagination and alignment.

Nature

> Q: Why are some people good at math and some people aren't good at math?
>
> A: I think it's just in your makeup… genetic I guess. (Barbara, grade 12, Precalculus, planning to attend vocational training after high school)

The nature face of identity looks at who we are from what nature gave us at birth, those things over which we have no control (Gee, 2001). Typically, characteristics such as gender and skin color are viewed as part of our nature identity. The meanings we make of our natural characteristics are not independent of our relationships with others in personal and broader social settings. That is, these characteristics comprise only one part of the way we see ourselves and others see us. In Gee's social theory of learning, the nature aspect of our identity must be maintained and reinforced through our engagement with others, in the images we hold, or institutionalized in the requirements we must follow in the environments where we interact.

Mathematics teachers are in a unique position to hear students and parents report that their mathematics learning has been influenced by the presence or absence of a "math gene", often crediting nature for not granting them the ability to learn mathematics. The claim of a lack of a math gene—and, therefore, the inability to do mathematics—contrasts with Devlin's (2000b) belief that "everyone has the math gene" (p. 2) as well as with NCTM's (2000) statement that "mathematics can and must be learned by *all* students" (p. 13). In fact, cognitive scientists report, "Mathematics is a natural part of being human. It arises from our bodies, our brains, and our everyday experiences in the world" (Lakoff & Núñez, 2000, p. 377). Mathematics has been created by the human brain and its capabilities and can be recreated and learned by other human brains. Yet, the fallacy persists for some students that learning mathematics requires special natural talents possessed by only a few:

> I'm good at math. (Interview with Barbara, grade 12, Precalculus class)

> I'm not a math guy. (Interview with Bill, grade 12, not enrolled in math, planning to join the military after high school)

> Math just doesn't work for me. I can't get it through my head. (Interview with Jackie, grade 12, not enrolled in math, planning to enroll in a vocational program after high school)

Although scientific evidence does not support the idea that mathematics learning is related to genetics, some students attribute their mathematics learning to nature. The high school student who says "I'm not a math guy" may feel that he is lacking a natural ability for mathematics. He is likely as capable as any other student but has come to the above conclusion based on his experience with mathematics and the way it was taught in his mathematics classes. Students who are not the quickest to get the correct answers may learn, albeit erroneously, that they are not capable of learning mathematics. They do not engage in practices that are recognized, in this case, to be the accepted practices of the community. As a result, they view themselves, and are viewed by others, to be peripheral members of the community of mathematics learners.

As shown by the provided responses from students, each of the four faces of identity exists as a way that students come to understand their practices and membership within the community of mathematics learners. I have chosen to represent these faces of identity as the four faces of a tetrahedron[1] (Figure 1). If we rotate a particular face to the front, certain features of identity are highlighted while others are diminished. Each face suggests different ways to describe how we see ourselves as mathematics learners although they are all part of the one whole. This representation of identity maintains the idea that, as Gee (2001) wrote, "They are four strands that may very well all be present and woven together as a given person acts within a given context" (p. 101). When considering the four faces of identity as a mathematics learner, this context is a traditional high school mathematics classroom.

While all four faces contribute to the formation of students' identities as mathematics learners, the nature face provides the most unsound and unfounded explanations for students' participation in the mathematics community. To allow for the development of *all* students to identify as mathematics learners, students and teachers must discount the nature face and build on the other three faces of identity.

Developing an Identity as a Mathematics Learner

To conclude this article, recommendations are offered to teachers for developing and supporting students' positive identities as mathematics learners—members of a community that develops the practices of

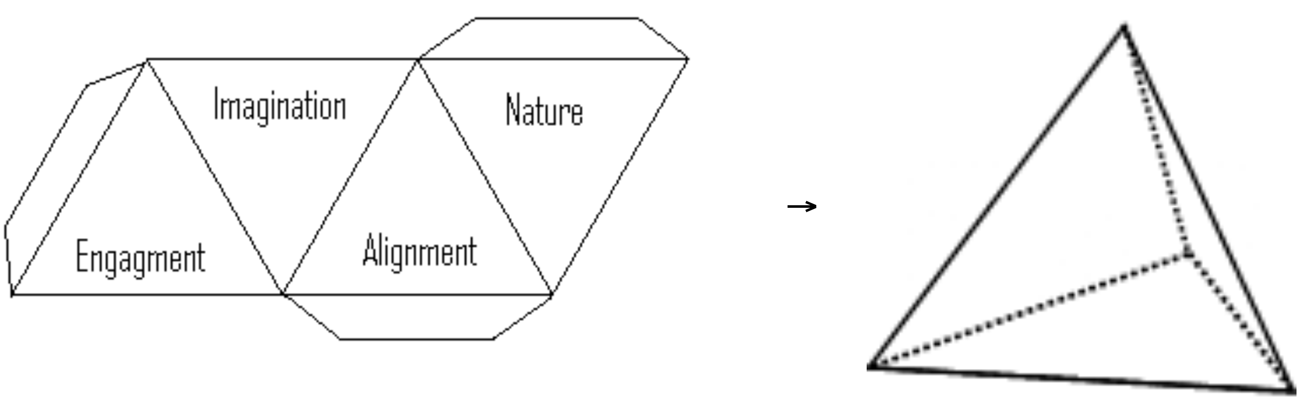

Figure 1. The four faces of identity

mathematics learning. The four faces of identity described here are used to understand how students see themselves as mathematics learners in relation to their experiences in the mathematics classroom and through the ways these experiences fit into broader life experience. Students' experiences will not necessarily reflect just one of the four faces described (Gee, 2001). In fact, some experiences may be stretched over two or more faces. For example, learning advanced mathematics in high school can contribute to a students' identity in two ways: (a) through imagination with the image of math as an important subject for entrance to higher education and (b) through alignment since advanced mathematics is required to attend some colleges. Taken together, however, we can see that a focus on a particular face of identity suggests particular experiences that can help to develop strong positive identities as a mathematics learner in all students. The engagement face of identity is developed through students' experiences with mathematics and, for most high school students, their mathematics experiences occur in the mathematics classroom. Therefore, the most significant potential to influence students' identities exists in the mathematics classroom. To develop students' identities as mathematics learners through engagement, teachers should consider mathematical tasks and classroom structures where students are actively involved in the creation of mathematics while learning to be "people who study in school" (Lampert, 2001). That is, students must feel the mathematics classroom is their scholarly home and that the ideas they contribute are valued by the class (Wenger, 1998). As indicated earlier, teacher-led classrooms with students working independently on single-answer exercises can cause students to learn that mathematics is not a vibrant and useful subject to study. Boaler (2000), for example, identified monotony, lack of meaning, and isolation as themes that emerged from a study of students and their mathematics experiences. As a result many of these students were alienated from mathematics and learned that they are not valuable members of the mathematics community.

Hence, mathematical tasks that engage students in doing mathematics, making meaning, and generating their own solutions to complex mathematical problems can be beneficial in engaging students and supporting their identity as a mathematics learner (NCTM, 2000). A good starting point is open-ended mathematical tasks, questions or projects that have multiple responses or one response with multiple solution paths (Kabiri & Smith, 2003). The mathematics classroom can also be organized to encourage discussion, sharing, and collaboration (Boaler & Greeno, 2000). In this type of classroom setting, teachers "pull knowledge out" (Ladson-Billings, 1995, p. 479) of students and make the construction of knowledge part of the learning experience.

With respect to imagination, the development of students' identities as mathematics learners requires long-term effort on the part of teachers across disciplines. The various images students have of themselves and of mathematics extending outside the classroom—in the past, present, or future—may be contradictory and change over time. Teachers and others in schools can consistently reinforce that mathematics is an interesting body of knowledge worth studying, an intellectual tool for other disciplines, and an admission ticket for colleges and careers.

Since students' identity development through imagination extends beyond the classroom, teachers can provide students with opportunities to see themselves as mathematics learners away from the classroom. For example, working professionals from outside the school can be invited to discuss ways they use mathematics in their professional lives; many students may not be aware of the work of engineers, actuaries, or statisticians. Another suggestion is to require students to keep a log and record the ways in which they use mathematics in their daily lives in order to become aware of the usefulness of mathematics (Masingila, 2002). This activity could provide an opportunity for assessing students' views of mathematics and discussing the connections between the mathematics taught in school and that used outside the classroom.

Although many of students' mathematical requirements are beyond the control of teachers and students, teachers can foster the alignment face of identity. Teachers can hold their students to high expectations so that these expectations become as strong as requirements. Also, knowledge of mathematics requirements for post-secondary education and careers can help students decide to enroll in other mathematics courses. Because students are known to cite post-secondary education and careers as reasons for studying mathematics (Anderson, 2006; Martin, 2000; Sfard & Prusak, 2005), teachers can facilitate this alignment face by keeping students abreast of the mathematics requirements for entrance to college and careers.

Students may commonly reference the nature face of identity, but this face is the least useful—and potentially the most detrimental—for supporting students as they become mathematics learners. As mentioned earlier, the ability to learn mathematics is not determined by genetics or biology (Lakoff & Núñez, 2000). All students *can* become mathematics learners, identifying themselves and being recognized by others as capable of doing mathematics. Thinking about the tetrahedron model of identity, if the other faces are strong and at the fore, the nature face can be turned to the back As suggested above, the other three faces of identity can sustain mathematics learners' identities—through engaging students with mathematics in the classroom, developing positive images of students and mathematics, and establishing high expectations and requirements—regardless of students' beliefs in an innate mathematical ability. Gee (2001) points out that the nature face of identity will

> always collapse into other sorts of identities. … When people (and institutions) focus on them as "natural" or "biological," they often do this as a way to "forget" or "hide" (often for ideological reasons) the institutional, social-interactional, or group work that is required to create and sustain them. (p. 102)

Teachers need to be aware of the four faces of identity of mathematics learners and of how their students see themselves as mathematics learners and doers. Detailed recommendations for developing students' identities as mathematics learners are provided in Figure 2.

The four faces of identity discussed in this article contribute to our understanding of how students come to be mathematics learners. Through consistent and sustained efforts by mathematics teachers to develop positive identities in their students, more students can come to study advanced mathematics and improve their identities as mathematics learners. As I have pointed out throughout this article, identities are developed in relationships with others, including their teachers, parents, and peers. We cannot assume that all students will develop positive identities if they have experiences that run to the contrary. We must take action so each face of identity mutually supports the others in developing all students' identities as mathematics learners.

Developing and Supporting Students' Identities as Mathematics Learners

Engagement

- Use mathematical tasks that allow students to develop strategies for solving problems and meanings for mathematical tools.
- Organize mathematics classrooms that allow students to express themselves creatively and communicate their meanings of mathematical concepts to their peers and teacher.
- Focus on the process and explanations of problem solving rather than emphasize quick responses to single-answer exercises.

Imagination

- Make explicit the ways mathematics is part of students' daily lives. That is, help students identify ways they create and use mathematics in their work and play.
- Have working professionals discuss with high school students ways in which they use mathematics in their professional lives, emphasizing topics beyond arithmetic.
- Include mathematics topics in classes that relate to occupations, for example, geometric concepts that are part of factory work or carpentry (e.g., see Smith, 1999; Masingila, 1994).

Alignment

- Maintain expectations that all students will enroll in mathematics courses every year of high school.
- Take an active role in keeping students informed of mathematics requirements for careers and college and university entrance.

Figure 2. Recommendations

References

Anderson, R. (2006). Mathematics, meaning, and identity: A study of the practice of mathematics education in a rural high school. Unpublished doctoral dissertation, Portland State University, Oregon.

Boaler, J. (2000). Mathematics from another world: Traditional communities and the alienation of learners. Journal of Mathematical Behavior, 18, 379–397.

Boaler, J., & Greeno, J. G. (2000). Identity, agency, and knowing in mathematics worlds. In J. Boaler (Ed.), Multiple perspectives on mathematics teaching and learning (pp. 171–200). Westport, CT: Ablex.

Boaler, J., & Humphreys, C. (2005). Connecting mathematical ideas: Middle school video cases to support teaching and learning. Portsmouth, NH: Heinemann.

D'Ambrosio, U. (1990). The role of mathematics education in building a democratic and just society. For the Learning of Mathematics, 10, 20–23.

Devlin, K. (2000a). The four faces of mathematics. In M. J. Burke & F. R. Curcio (Eds.), Learning mathematics for a new century (pp. 16–27). Reston, VA: NCTM.

Devlin, K. (2000b). The math gene: How mathematical thinking evolved and why numbers are like gossip. New York: Basic Books.

Gee, J. P. (2001). Identity as an analytic lens for research in education. Review of Research in Education, 25, 99–125.

Kabiri, M. S., & Smith, N. L. (2003). Turning traditional textbook problems into open-ended problems. Mathematics Teaching in the Middle School, 9, 186–192.

Kirshner, D. (2002). Untangling teachers' diverse aspirations for student learning: A crossdisciplinary strategy for relating psychological theory to pedagogical practice. Journal for Research in Mathematics Education, 33, 46–58.

Ladson-Billings, G. (1995). Toward a theory of culturally relevant pedagogy. American Educational Research Journal, 32, 465–491.

Lakoff, G., & Núñez, R. E. (2000). Where mathematics comes from: How the embodied mind brings mathematics into being. New York: Basic Books.

Lampert, M. (2001). Teaching problems and the problems of teaching. New Haven, CT: Yale University Press.

Lave, J., & Wenger, E. (1991). Situated learning: Legitimate peripheral participation. Cambridge, UK: Cambridge University Press.

Martin, D. B. (2000). Mathematics success and failure among African-American youth: The roles of sociohistorical context, community forces, school influences, and individual agency. Mahwah, NJ: Lawrence Erlbaum.

Masingila, J. O. (1994). Mathematics practice in carpet laying. Anthropology & Education Quarterly, 25, 430–462.

Masingila, J. O. (2002). Examining students' perceptions of their everyday mathematics practice. In M. E. Brenner & J. N. Moschkovich (Eds.), Everyday and academic mathematics in the classroom (Journal for Research in Mathematics Education Monograph No. 11, pp. 30–39). Reston, VA: National Council of Teachers of Mathematics.

Mendick, H. (2003). Choosing maths/doing gender: A look at why there are more boys than girls in advanced mathematics classes in England. In L. Burton (Ed.), Which way social justice in mathematics education? (pp. 169–187). Westport, CT: Praeger.

Moses, R. P., & Cobb, C. E. (2001). Radical equations: Civil rights from Mississippi to the Algebra Project. Boston, MA: Beacon Press.

Nasir, N. S. (2002). Identity, goals, and learning: Mathematics in cultural practice. Mathematical Thinking & Learning, 4, 213–247.

National Council of Teachers of Mathematics. (2000). Principles and standards for school mathematics. Reston, VA: Author.

Sfard, A., & Prusak, A. (2005). Telling identities: In search of an analytic tool for investigating learning as a culturally shaped activity. Educational Researcher, 34(4), 14–22.

Smith, J. P. (1999). Tracking the mathematics of automobile production: Are schools failing to prepare students for work? American Educational Research Journal, 36, 835–878.

Wenger, E. (1998). Communities of practice: Learning, meaning, and identity. Cambridge, UK: Cambridge University Press.

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[1] Others have used the idea of "faces" to convey the many interrelated aspects of a topic. For example, Devlin (2000a) describes "The Four Faces of Mathematics."