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Mathematics as "Gate-Keeper" (?): Three Theoretical Perspectives that Aim Toward Empowering All Children With a Key to the Gate

David W. Stinson

In this article, the author's intent is to begin a conversation centered on the question: How might mathematics educators ensure that gatekeeping mathematics becomes an inclusive instrument for empowerment rather than an exclusive instrument for stratification? In the first part of the discussion, the author provides a historical perspective of the concept of "gatekeeper" in mathematics education. After substantiating mathematics as a gatekeeper, the author proceeds to provide a definition of empowering mathematics within a Freirian frame, and describes three theoretical perspectives of mathematics education that aim toward empowering all children with a key to the gate: the situated perspective, the culturally relevant perspective, and the critical perspective. Last, within a Foucauldian frame, the author concludes the article by asking the reader to think differently.

My graduate assistantship in The Department of Mathematics Education at The University of Georgia for the 2002–2003 academic year was to assist with a four-year Spencer-funded qualitative research project entitled "Learning to Teach Elementary Mathematics." This assistantship presented the opportunity to conduct research at elementary schools in two suburban counties—a new experience for me since my prior professional experience in education had been within the context of secondary mathematics education. My research duties consisted of organizing, coding, analyzing, and writing-up existing data, as well as collecting new data. This new data included transcribed interviews of preservice and novice elementary school teachers and fieldnotes from classroom observations.

By January 2003, I had conducted five observations in 1st, 2nd, and 3rd grade classrooms at two elementary schools with diverse populations. I was impressed with the preservice and novice elementary teachers' mathematics pedagogy and ability to interact with their students. Given that my research interest is equity and social justice in education, I was mindful of the "racial," ethnic, gender, and class make-up of the classroom and how these attributes might help me explain the teacher-student interactions I observed. My experiences as a secondary mathematics teacher, preservice-teacher supervisor, and researcher supported Oakes's (1985) assertions that often students are distributed into "ability" groups based on their race, gender, and class. Nonetheless, my perception after five observations was that ability grouping according to these attributes was diminishing—at least in these elementary schools. In other words, the student make-up of each mathematics lesson that I observed appeared to be representative of the demographics of the school.

However, on my sixth observation, at an elementary school with 35.8 % Black, 12.8 % Asian, 5.3 % Hispanic, 3.5 % Multi-racial, and 0.5 % American Indian[1] children, I observed a 3rd grade mathematics lesson that was 94.4% White (at least it was 50% female). The make-up of the classroom was not initially unrepresentative of the school's racial/ethnic demographics, but became so shortly before the start of the mathematics lesson as some students left the classroom while others entered. When I questioned why the students were exchanged between classrooms, I was informed that the mathematics lesson was for the "advanced" third graders. Because of my experience in secondary mathematics education, I am aware that academic tracking is a nationally practiced education policy, and that it even occurs in many districts and schools as early as 5th grade—but these were eight-year-old children! Has the structure of public education begun to decide who is and who is not "capable" mathematically in the 3rd grade? Has the structure of public education begun to decide who will be proletariat and who will be bourgeoisie in the 3rd grade—with eight-year-old children? How did school

David W. Stinson is a doctoral candidate in The Department of Mathematics Education at The University of Georgia. In the fall of 2004, he will join the faculty of the Middle-Secondary Education and Instructional Technology Department at Georgia State University. His research interests are the sociopolitical and cultural aspects of mathematics and mathematics teaching and learning with an emphasis on equity and social justice in mathematics education and education in general.

mathematics begin to (re)produce and regulate racial, ethnic, gender, and class divisions, becoming a "gatekeeper"? And (if) school mathematics is a gatekeeper, how might mathematics educators ensure that gatekeeping mathematics becomes an inclusive instrument for empowerment rather than an exclusive instrument for stratification?

This article provides a two-part discussion centered on the last question. The first part of the discussion provides a historical perspective of the concept of gatekeeper in mathematics education, verifying that mathematics is an exclusive instrument for stratification, effectively nullifying the *if*. The intent of this historical perspective is not to debate whether mathematics should be a gatekeeper but to provide a perspective that reveals existence of mathematics as a gatekeeper (and instrument for stratification) in the current education structure of the United States. In the discussion, I state why I believe all students are not provided with a key to the gate.

After arguing that mathematics is a gatekeeper and inequities are present in the structure of education, I proceed to the second part of the discussion: how might mathematics educators ensure that gatekeeping mathematics becomes an inclusive instrument for empowerment? In this discussion, I first define empowerment and empowering mathematics. Then, I make note of the "social turn" in mathematics education research, which provides a framework for the situated, culturally relevant, and critical perspectives of mathematics education that are presented. Finally, I argue that these theoretical perspectives replace characteristics of exclusion and stratification (of gatekeeping mathematics) with characteristics of inclusion and empowerment. I conclude the article by challenging the reader to think differently.

Mathematics a Gatekeeper: A Historical Perspective

Discourse regarding the "gatekeeper" concept in mathematics can be traced back over 2300 years ago to Plato's (trans. 1996) dialogue, *The Republic*. In the fictitious dialogue between Socrates and Glaucon regarding education, Plato argued that mathematics was "virtually the first thing everyone has to learn…common to all arts, science, and forms of thought" (p. 216). Although Plato believed that all students needed to learn arithmetic—"the trivial business of being able to identify one, two, and three" (p. 216)—he reserved advanced mathematics for those that would serve as philosopher guardians[2] of the city. He wrote:

> We shall persuade those who are to perform high functions in the city to undertake calculation, but not as amateurs. They should persist in their studies until they reach the level of pure thought, where they will be able to contemplate the very nature of number. The objects of study ought not to be buying and selling, as if they were preparing to be merchants or brokers. Instead, it should serve the purposes of war and lead the soul away from the world of appearances toward essence and reality. (p. 219)

Although Plato believed that mathematics was of value for all people in everyday transactions, the study of mathematics that would lead some men from "Hades to the halls of the gods" (p. 215) should be reserved for those that were "naturally skilled in calculation" (p. 220); hence, the birth of mathematics as the privileged discipline or gatekeeper.

This view of mathematics as a gatekeeper has persisted through time and manifested itself in early research in the field of mathematics education in the United States. In Stanic's (1986) review of mathematics education of the late 19th and early 20th centuries, he identified the 1890s as establishing "mathematics education as a separate and distinct professional area" (p. 190), and the 1930s as developing the "crisis" (p. 191) in mathematics education. This crisis—a crisis for mathematics educators—was the projected extinction of mathematics as a required subject in the secondary school curriculum. Drawing on the work of Kliebard (c.f., Kliebard, 1995), Stanic provided a summary of curriculum interest groups that influenced the position of mathematics in the school curriculum: (a) the humanists, who emphasized the traditional disciplines of study found in Western philosophy; (b) the developmentalists, who emphasized the "natural" development of the child; (c) the social efficiency educators, who emphasized a "scientific" approach that led to the natural development of social stratification; and (d) the social meliorists, who emphasized education as a means of working toward social justice.

Stanic (1986) noted that mathematics educators, in general, sided with the humanists, claiming: "mathematics should be an important part of the school curriculum" (p. 193). He also argued that the development of the National Council of Teachers of Mathematics (NCTM) in 1920 was partly in response to the debate that surrounded the position of mathematics within the school curriculum.

The founders of the Council wrote:

> Mathematics courses have been assailed on every hand. So-called educational reformers have tinkered with the courses, and they, not knowing the subject and its values, in many cases have thrown out mathematics altogether or made it entirely elective. …To help remedy the existing situation the National Council of Teachers of Mathematics was organized. (C. M. Austin as quoted in Stanic, 1986, p. 198)

The backdrop to the mathematics education crisis was the tremendous growth in school population that occurred between 1890 and 1940—a growth of nearly 20 times (Stanic, 1986). This dramatic increase in the student population yielded the belief that the overall intellectual capabilities of students had decreased; consequently, students became characterized as the "army of incapables" (G. S. Hall as quoted in Stanic, 1986, p. 194). Stanic presented the results of this prevailing belief by citing the 1933 *National Survey of Secondary Education*, which concluded that less than half of the secondary schools required algebra and plane geometry. And, he illustrated mathematics teachers' perspectives by providing George Counts' 1926 survey of 416 secondary school teachers. Eighteen of the 48 mathematics teachers thought that fewer pupils should take mathematics, providing a contrast to teachers of other academic disciplines who believed that "their own subjects should be more largely patronized" (G. S. Counts as quoted in Stanic, p. 196). Even so, the issues of how mathematics should be positioned in the school curriculum and who should take advanced mathematics courses was not a major national concern until the 1950s.

During the 1950s, mathematics education in U.S. schools began to be attacked from many segments of society: the business sector and military for graduating students who lacked computational skills, colleges for failing to prepare entering students with mathematics knowledge adequate for college work, and the public for having "watered down" the mathematics curriculum as a response to progressivism (Kilpatrick, 1992). The launching of Sputnik in 1957 further exacerbated these attacks leading to a national demand for rigorous mathematics in secondary schools. This demand spurred a variety of attempts to reform mathematics education: "the 'new' math of the 1960s, the 'back-to-basic' programs of the 1970s, and the 'problem-solving' focus of the 1980s" (Johnston, 1997). Within these programs of reform, the questions were not only what mathematics should be taught and how, but more importantly, who should be taught mathematics.

The question of who should be taught mathematics initially appeared in the debates of the 1920s and centered on "ascertaining who was prepared for the study of algebra" (Kilpatrick, 1992, p. 21). These debates led to an increase in grouping students according to their presumed mathematics ability. This "ability" grouping often resulted in excluding female students, poor students, and students of color from the opportunity to enroll in advanced mathematics courses (Oakes, 1985; Oakes, Ormseth, Bell, & Camp, 1990). Sixty years after the beginning of the debates, the recognition of this unjust exclusion from advanced mathematics courses spurred the NCTM to publish the *Curriculum and Evaluation Standards for School Mathematics* (Standards, 1989) that included statements similar to the following:

> The social injustices of past schooling practices can no longer be tolerated. Current statistics indicate that those who study advanced mathematics are most often white males. …Creating a just society in which women and various ethnic groups enjoy equal opportunities and equitable treatment is no longer an issue. Mathematics has become a critical filter for employment and full participation in our society. We cannot afford to have the majority of our population mathematically illiterate: Equity has become an economic necessity. (p. 4)

In the Standards the NCTM contrasted societal needs of the industrial age with those of the information age, concluding that the educational goals of the industrial age no longer met the needs of the information age. They characterized the information age as a dramatic shift in the use of technology which had "changed the nature of the physical, life, and social sciences; business; industry; and government" (p. 3). The Council contended, "The impact of this technological shift is no longer an intellectual abstraction. It has become an economic reality" (p. 3).

The NCTM (1989) believed this shift demanded new societal goals for mathematics education: (a) mathematically literate workers, (b) lifelong learning, (c) opportunity for all, and (d) an informed electorate. They argued, "Implicit in these goals is a school system organized to serve as an important resource for all citizens throughout their lives" (p. 3). These goals required those responsible for mathematics education to strip mathematics from its traditional notions of exclusion and basic computation and develop it into a dynamic form of an inclusive literacy, particularly given that mathematics had become a critical filter for

full employment and participation within a democratic society. Countless other education scholars (Frankenstein, 1995; Moses & Cobb, 2001; Secada, 1995; Skovsmose, 1994; Tate, 1995) have made similar arguments as they recognize the need for all students to be provided the opportunity to enroll in advanced mathematics courses, arguing that a dynamic mathematics literacy is a gatekeeper for economic access, full citizenship, and higher education. In the paragraphs that follow, I highlight quantitative and qualitative studies that substantiate mathematics as a gatekeeper.

The claims that mathematics is a "critical filter" or gatekeeper to economic access, full citizenship, and higher education are quantitatively substantiated by two reports by the U. S. government: the 1997 White Paper entitled *Mathematics Equals Opportunity* and the 1999 follow-up summary of the 1988 National Education Longitudinal Study (NELS: 88) entitled *Do Gatekeeper Courses Expand Education Options?* The U. S. Department of Education prepared both reports based on data from the NELS: 88 samples of 24,599 eighth graders from 1,052 schools, and the 1992 follow-up study of 12,053 students.

In *Mathematics Equals Opportunity*, the following statements were made:

> In the United States today, mastering mathematics has become more important than ever. Students with a strong grasp of mathematics have an advantage in academics and in the job market. The 8th grade is a critical point in mathematics education. Achievement at that stage clears the way for students to take rigorous high school mathematics and science courses—keys to college entrance and success in the labor force.
>
> Students who take rigorous mathematics and science courses are much more likely to go to college than those who do not.
>
> Algebra is the "gateway" to advanced mathematics and science in high school, yet most students do not take it in middle school.
>
> Taking rigorous mathematics and science courses in high school appears to be especially important for low-income students.
>
> Despite the importance of low-income students taking rigorous mathematics and science courses, these students are less likely to take them. (U. S. Department of Education, 1997, pp. 5–6)

This report, based on statistical analyses, explicitly stated that algebra was the "gateway" or gatekeeper to advanced (i.e., rigorous) mathematics courses and that advanced mathematics provided an advantage in academics and in the job market—the same argument provided by the NCTM and education scholars.

The statistical analyses in the report entitled, *Do Gatekeeper Courses Expand Educational Options?* (U. S. Department of Education, 1999) presented the following findings:

> Students who enrolled in algebra as eighth-graders were more likely to reach advanced math courses (e.g., algebra 3, trigonometry, or calculus, etc.) in high school than students who did not enroll in algebra as eighth-graders.
>
> Students who enrolled in algebra as eighth-graders, and completed an advanced math course during high school, were more likely to apply to a four-year college than those eighth-grade students who did not enroll in algebra as eighth-graders, but who also completed an advanced math course during high school. (pp. 1–2)

The summary concluded that not all students who took advanced mathematics courses in high school enrolled in a four-year postsecondary school, although they were more likely to do so—again confirming mathematics as a gatekeeper.

Nicholas Lemann's (1999) book *The Big Test: The Secret History of the American Meritocracy* provides a qualitative substantiation that mathematics is a gatekeeper to economic access, full citizenship, and higher education. In Parts I and II of his book, Lemann presented a detailed historical narrative of the merger between the Educational Testing Service with the College Board. Leman argued this merger established how mathematics would directly and indirectly categorize Americans—becoming a gatekeeper—for the remainder of the 20th and beginning of the 21st centuries. During World War I, the United States War Department (currently known as the Department of Defense) categorized people using an adapted version of Binet's Intelligence Quotient test to determine the entering rank and duties of servicemen. This categorization evolved into ranking people by "aptitude" through administering standardized tests in contemporary U. S. education.

In Part III of his book, Lemann presented a case-study characterization of contemporary Platonic guardians, individuals who unjustly (or not) benefited from the concept of aptitude testing and the ideal of American meritocracy. Lemann argued that because of their ability to demonstrate mathematics proficiency (among other disciplines) on standardized tests, these individuals found themselves passing through the gates

to economic access, full citizenship, and higher education.

The concept of mathematics as providing the key for passing through the gates to economic access, full citizenship, and higher education is located in the core of Western philosophy. In the United States, school mathematics evolved from a discipline in "crisis" into one that would provide the means of "sorting" students. As student enrollment in public schools increased, the opportunity to enroll in advanced mathematics courses (the key) was limited because some students were characterized as "incapable." Female students, poor students, and students of color were offered a limited access to quality advanced mathematics education. This limited access was a motivating factor behind the Standards, and the subsequent NCTM documents.[3]

NCTM and education scholars' argument that mathematics had and continues to have a gatekeeping status has been confirmed both quantitatively and qualitatively. Given this status, I pose two questions: (a) Why does U.S. education not provide all students access to a quality, advanced (mathematics) education that would empower them with economic access and full citizenship? and (b) How can we as mathematics educators transform the status quo in the mathematics classroom?

To fully engage in the first question demands a deconstruction of the concepts of democratic public schooling and American meritocracy and an analysis of the morals and ethics of capitalism. To provide such a deconstruction and analysis is beyond the scope of this article. Nonetheless, I believe that Bowles's (1971/1977) argument provides a comprehensive, yet condensed response to the question of why U. S. education remains unequal without oversimplifying the complexities of the question. Through a historical analysis of schooling he revealed four components of U. S. education: (a) schools evolved not in pursuit of equality, but in response to the developing needs of capitalism (e.g., a skilled and educated work force); (b) as the importance of a skilled and educated work force grew within capitalism so did the importance of maintaining educational inequality in order to reproduce the class structure; (c) from the 1920s to 1970s the class structure in schools showed no signs of diminishment (the same argument can be made for the 1970s to 2000s); and (d) the inequality in education had "its root in the very class structures which it serves to legitimize and reproduce" (p. 137). He concluded by writing: "Inequalities in education are thus seen as part of the web of capitalist society, and likely to persist as long as capitalism survives" (p. 137).

Although Bowles's statements imply that only the overthrow of capitalism will emancipate education from its inequalities, I believe that developing mathematics classrooms that are empowering to all students might contribute to educational experiences that are more equitable and just. This development may also assist in the deconstruction of capitalism so that it might be reconstructed to be more equitable and just. The following discussion presents three theoretical perspectives that I have identified as *empowering* students. These perspectives aim to assist in more equitable and just educative experiences for all students: the situated perspective, the culturally relevant perspective, and the critical perspective. I believe these perspectives provide a plausible answer to the second question asked above: How do we as mathematics educators transform the status quo in the mathematics classroom?

An Inclusive Empowering Mathematics Education

To frame the discussion that follows, I provide a definition of *empowerment* and *empowering mathematics*. Freire (1970/2000) framed the notion of empowerment within the concept of *conscientização*, defined as "learning to perceive social, political and economic contradictions, and to take action against the oppressive elements of reality" (p. 35). He argued that *conscientização* leads people not to "destructive fanaticism" but makes it possible "for people to enter the historical process as responsible Subjects[4]" (p. 36), enrolling them in a search for self-affirmation. Similarly, Lather (1991) defined empowerment as the ability to perform a critical analysis regarding the causes of powerlessness, the ability to identify the structures of oppression, and the ability to act as a single subject, group, or both to effect change toward social justice. She claimed that empowerment is a learning process one undertakes for oneself; "it is not something done 'to' or 'for' someone" (Lather, 1991, p. 4). In effect, empowerment provides the subject with the skills and knowledge to make sociopolitical critiques about her or his surroundings and to take action (or not) against the oppressive elements of those surroundings. The emphasis in both definitions is *self*-empowerment with an aim toward sociopolitical critique. With this emphasis in mind, I next define *empowering mathematics*.

Ernest (2002) provided three domains of empowering mathematics—mathematical, social, and epistemological—that assist in organizing how I define

empowering mathematics. Mathematical empowerment relates to "gaining the power over the language, skills and practices of using mathematics" (section 1, ¶ 3) (e.g., school mathematics). Social empowerment involves using mathematics as a tool for sociopolitical critique, gaining power over the social domains—"the worlds of work, life and social affairs" (section 1, ¶ 4). And, epistemological empowerment concerns the "individual's growth of confidence in not only using mathematics, but also a personal sense of power over the creation and validation of knowledge"(section 1, ¶ 5). Ernest argued, and I agree, that all students gain confidence in their mathematics skills and abilities through the use of mathematics in routine and nonroutine ways and that this confidence will logically lead to higher levels of mathematics attainment. All students achieving higher levels of attainment will assist in leveling the racial, gender, and class imbalances that currently persist in advanced mathematics courses. Effectively, Ernest's definition of empowering mathematics echoes the definition of empowerment stated earlier.

Using Ernest's three domains of empowering mathematics as a starting point, I selected three empowering mathematics perspectives. In doing so, I kept in mind Stanic's (1989) challenge to mathematics educators: "If mathematics educators take seriously the goal of equity, they must question not just the common view of school mathematics but also their own taken-for-granted assumptions about its nature and worth" (p. 58). I believe that the situated perspective, culturally relevant perspective, and critical perspective, in varying degrees, motivate such questioning and resonate with the definition I have given of empowering mathematics. These configurations are complex theoretical perspectives derived from multiple scholars who sometimes have conflicting working definitions. These perspectives, located in the "social turn" (Lerman, 2000, p. 23) of mathematics education research, originate outside the realm of "traditional" mathematics education theory, in that they are rooted in anthropology, cultural psychology, sociology, and sociopolitical critique. In the discussion that follows, I provide sketches of each theoretical perspective by briefly summarizing the viewpoints of key scholars working within the perspective. I then explain how each perspective holds possibilities in transforming gatekeeping mathematics from an exclusive instrument for stratification into an inclusive instrument for empowerment.

The Situated Perspective

The situated perspective is the coupling of scholarship from cultural anthropology and cultural psychology. In the situated perspective, learning becomes a process of changing participation in changing communities of practice in which an individual's resulting knowledge becomes a function of the environment in which she or he operates. Consequently, in the situated perspective, the dualisms of mind and world are viewed as artificial constructs (Boaler, 2000b). Moreover, the situated perspective, in contrast to constructivist perspectives, emphasizes interactive systems that are larger in scope than the behavioral and cognitive processes of the individual student.

Mathematics knowledge in the situated perspective is understood as being co-constituted in a community within a context. It is the community and context in which the student learns the mathematics that significantly impacts how the student uses and understands the mathematics (Boaler, 2000b). Boaler (1993) suggested that learning mathematics in contexts assists in providing student motivation and interest and enhances transference of skills by linking classroom mathematics with real-world mathematics. She argued, however, that learning mathematics in contexts does not mean learning mathematics ideas and procedures by inserting them into "real-world" textbook problems or by extending mathematics to larger real-world class projects. Rather, she suggested that the classroom itself becomes the context in which mathematics is learned and understood: "If the students' social and cultural values are encouraged and supported in the mathematics classroom, through the use of contexts or through an acknowledgement of personal routes and direction, then their learning will have more meaning" (p. 17).

The situated perspective offers different notions of what it means to have mathematics ability, changing the concept from "either one has mathematics ability or not" to an analysis of how the environment co-constitutes the mathematics knowledge that is learned (Boaler, 2000a). Boaler argued that this change in how mathematics ability is assessed in the situated perspective could "move mathematics education away from the discriminatory practices that produce more failures than successes toward something considerably more equitable and supportive of social justice" (p. 118).

The Culturally Relevant Perspective

Working toward social justice is also a component of the culturally relevant perspective. Ladson-Billings (1994) developed the "culturally relevant" (p. 17) perspective as she studied teachers who were successful with African-American children. This perspective is derived from the work of cultural anthropologists who studied the cultural disconnects between (White) teachers and students of color and made suggestions about how teachers could "match their teaching styles to the culture and home backgrounds of their students" (Ladson-Billings, 2001, p. 75). Ladson-Billings defined the culturally relevant perspective as promoting student achievement and success through cultural competence (teachers assist students in developing a positive identification with their home culture) and through sociopolitical consciousness (teachers help students develop a civic and social awareness in order to work toward equity and social justice).

Teachers working from a culturally relevant perspective (a) demonstrate a belief that children can be competent regardless of race or social class, (b) provide students with scaffolding between what they know and what they do not know, (c) focus on instruction during class rather than busy-work or behavior management, (d) extend students' thinking beyond what they already know, and (e) exhibit in-depth knowledge of students as well as subject matter (Ladson-Billings, 1995). Ladson-Billings argued that all children "can be successful in mathematics when their understanding of it is linked to meaningful cultural referents, and when the instruction assumes that all students are capable of mastering the subject matter" (p. 141).

Mathematics knowledge in the culturally relevant perspective is viewed as a version of *ethnomathematics*—*ethno* defined as all culturally identifiable groups with their jargons, codes, symbols, myths, and even specific ways of reasoning and inferring; *mathema* defined as categories of analysis; and *tics* defined as methods or techniques (D' Ambrosio, 1985/1997, 1997). In the culturally relevant mathematics classroom, the teacher builds from the students' ethno or informal mathematics and orients the lesson toward their culture and experiences, while developing the students' critical thinking skills (Gutstein, Lipman, Hernandez, & de los Reyes, 1997). The positive results of teaching from a culturally relevant perspective are realized when students develop mathematics empowerment: deducing mathematical generalizations and constructing creative solution methods to nonroutine problems, and perceiving mathematics as a tool for sociopolitical critique (Gutstein, 2003).

The Critical Perspective

Perceiving mathematics as a tool for sociopolitical critique is also a feature of the critical perspective. This perspective is rooted in the social and political critique of the Frankfurt School (circa 1920) whose membership included but was not limited to Max Horkheimer, Theodor Adorno, Leo Lowenthal, and Franz Neumann. The critical perspective is characterized as (a) providing an investigation into the sources of knowledge, (b) identifying social problems and plausible solutions, and (c) reacting to social injustices. In providing these most general and unifying characteristics of a critical education, Skovsmose (1994) noted, "A critical education cannot be a simple prolongation of existing social relationships. It cannot be an apparatus for prevailing inequalities in society. To be critical, education must react to social contradictions" (p. 38).

Skovsmose (1994), drawing from Freire's (1970/2000) popularization of the concept *conscientização* and his work in literacy empowerment, derived the term "mathemacy" (p. 48). Skovsmose claimed that since modern society is highly technological and the core of all modern-day technology is mathematics that mathemacy is a means of empowerment. He stated, "If mathemacy has a role to play in education, similar to but not identical to the role of literacy, then mathemacy must be seen as composed of different competences: a mathematical, a technological, and a reflective" (p. 48).

In the critical perspective, mathematics knowledge is seen as demonstrating these three competencies (Skovsmose, 1994). Mathematical competence is demonstrating proficiency in the normally understood skills of school mathematics, reproducing and mastering various theorems, proofs, and algorithms. Technological competence demonstrates proficiency in applying mathematics in model building, using mathematics in pursuit of different technological aims. And, reflective competence achieves mathematics' critical dimension, reflecting upon and evaluating the just and unjust uses of mathematics. Skovsmose contended that mathemacy is a necessary condition for a politically informed citizenry and efficient labor force, claiming that mathemacy provides a means for empowerment in organizing and reorganizing social and political institutions and their accompanying traditions.

Transforming Gatekeeping Mathematics

The preceding sketches demonstrate that these three theoretical perspectives approach mathematics and mathematics teaching and learning differently than traditional perspectives. All three perspectives, in varying degrees, question the taken-for-granted assumptions about mathematics and its nature and worth, locate the formation of mathematics knowledge within the social community, and argue that mathematics is an indispensable instrument used in sociopolitical critique. In the following paragraphs I explicate the degrees to which the three perspectives address these issues.

The situated perspective negates the assumption that mathematics is a contextually free discipline, contending that it is the context in which mathematics is learned that determines how it will be used and understood. The culturally relevant perspective negates the assumption that mathematics is a culturally free discipline, recognizing mathematics is not separate from culture but is a product of culture. The critical perspective redefines the worth of mathematics through an acknowledgment and critical examination of the just and, often overlooked, unjust uses of mathematics.

The situated perspective locates mathematics knowledge in the social community. In this perspective, mathematics is not learned from a mathematics textbook and then applied to real-world contexts, but is negotiated in communities that exist in real-world contexts. The culturally relevant perspective also locates mathematics knowledge in the social community. This perspective argues teachers should begin to build on the collective mathematics knowledge present in the classroom communities, moving toward mathematics found in textbooks. The critical perspective does not locate mathematics knowledge in the social community but is oriented towards using mathematics to critique and transform the social and political communities in which mathematics exists and has its origins.

The situated perspective posits that students will begin to understand mathematics as a discipline that is learned in the context of communities. It is in this way that students may learn how mathematics can be applied in uncovering the inequities and injustices present in communities or can be used for sociopolitical critique. Similarly, one of the two tenets of the culturally relevant perspective is for the teacher to assist students in developing a sociopolitical consciousness. Finally, using mathematics as a means for sociopolitical critique is essential to the critical perspective, as mathematics is understood as a tool that can be used for critique.

How do the three aspects of mathematics and mathematics teaching and learning relate to each other in these perspectives and how does this relationship address the three domains of empowering mathematics? First, mathematics empowerment is achieved because each perspective questions the assumptions that are often taken-for-granted about the nature and worth of mathematics. Although all three perspectives see value in the study of mathematics, including "academic"[5] mathematics, they differ from traditional perspectives in that academic mathematics itself is troubled[6] with regards to its contextual existence, its cultural connectedness, and its critical utility. Second, students achieve social empowerment because all three perspectives argue that students should engage in mathematics contextually and culturally; and, therefore students have the opportunity to gain confidence in using mathematics in routine and nonroutine problems. The advocates for these three perspectives argue that as students expand the use of mathematics into nonroutine problems, they become cognizant of how mathematics can be used as a tool for sociopolitical critique. Finally students achieve epistemological empowerment because all three perspectives trouble academic mathematics that in turn may lead students to understand that the concept of a "true" or "politically-free" mathematics is a fiction. Students will hopefully understand that mathematics knowledge is (and always has been) a contextually and culturally (and politically) constructed human endeavor. If students achieve this perspective of mathematics, they will better understand their role as producers of mathematics knowledge, not just consumers. Hence, the three domains of empowering mathematics—mathematical, social, and epistemological—are achieved in each perspective or through various combinations of the three perspectives.

The chief aim of an empowering mathematics is to transform gatekeeping mathematics from a discipline of oppressive exclusion into a discipline of empowering inclusion. (This aim is inclusive of mathematics educators and education researchers.) Empowering inclusion is achieved when students (and teachers of mathematics) are presented with the opportunity to learn that the foundations of mathematics can be troubled. This troubling of mathematics' foundations transforms the discourse in the mathematics classroom from a discourse of transmitting mathematics to a "chosen" few students, into a discourse of exploring mathematics with all

students. Empowering inclusion is achieved when students (and teachers of mathematics) are presented with the opportunity to learn that, similar to literacy, mathemacy is a tool that can be used to reword worlds. This rewording of worlds (Freire, 1970/2000) with mathematics transforms mathematics from a tool used by a few students in "mathematical" pursuits, into a tool used by all students in sociopolitical pursuits. Finally, empowering inclusion is achieved when students (and teachers of mathematics) are presented with the opportunity to learn that mathematics knowledge is constructed human knowledge. This returning to the origins of mathematics knowledge transforms mathematics from an Ideal of the gods reproduced by a few students, into a human endeavor produced by all students.

Concluding Thoughts

The concept of mathematics as gatekeeper has a very long and disturbing history. There have been educators satisfied with the gatekeeping status of mathematics and those that have questioned not only its gatekeeping status but also its nature and worth. In my thinking about mathematics as a gatekeeper and the possibility of transforming mathematics education, I often reflect on Foucault's challenge. He challenged us to think the un-thought, to think: "how is it that one particular statement appeared rather than another?" (Foucault, 1969/1972, p. 27). With Foucault's challenge in mind, I often think what if Plato had said,

> We shall persuade those who are to perform high functions in the city to undertake _____, but not as amateurs. They should persist in their studies until they reach the level of pure thought, where they will be able to contemplate the very nature of _____…. it should serve the purposes of war and lead the soul away from the world of appearances toward essence and reality. (trans. 1996, p. 219)

In the preceding blanks, I insert different human pursuits, such as writing, speaking, painting, sculpting, dancing, and so on, asking: does mathematics really lead the soul away from the world of appearances toward essence and reality?[7] Or could dancing, for example, achieve the same result? While rethinking Plato's centuries old comment, I rethink the privileged status of mathematics as a gatekeeper (and as an instrument of stratification). But rather than asking what is school mathematics as gatekeeper or what does it mean, I ask different questions: How does school mathematics as gatekeeper function? Where is school mathematics as gatekeeper to be found? How does school mathematics as gatekeeper get produced and regulated? How does school mathematics as gatekeeper exist? (Bové, 1995). These questions transform the discussions around gatekeeper mathematics from discussions that attempt to find meaning in gatekeeper mathematics to discussions that examine the ethics of gatekeeper mathematics. Implicit in this examination is an analysis of how the structure of schools and those responsible for that structure are implicated (or not) in reproducing the unethical effects of gatekeeping mathematics.

Will asking the questions noted above transform gatekeeping mathematics from an exclusive instrument for stratification into an inclusive instrument for empowerment? Will asking these questions stop the "ability" sorting of eight-year-old children? Will asking these questions encourage mathematics teachers (and educators) to adopt the situated, culturally relevant, or critical perspectives, perspectives that aim toward empowering all children with a key? Although I believe that there are no definitive answers to these questions, I do believe that critically examining (and implementing) the different possibilities for mathematics teaching and learning found in the theoretical perspectives explained in this article provides a sensible beginning to transforming mathematics education. In closing, I fervently proclaim the way we use mathematics today in our nation's schools must stop! Mathematics should not be used as an instrument for stratification but rather an instrument for empowerment!

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[1] The student racial/ethnic data were based on the 2001-2002 Georgia Public Education Report Card; the racial/ethnic classifications were the State of Georgia's not this author's. For details of racial/ethnic data on all schools in the State of Georgia see: http://techservices.doe.k12.ga.us/reportcard/

[2] Plato (trans. 1996) in establishing his utopian Republic imagined that the philosopher guardians of the city, identified as the

aristocracy, would be children taken from their parents at an early age and educated at the academy until of age when they would dutifully rule as public servants and not for personal gain. Plato believed that these children would be from all classes: "it may sometimes happen that a silver child will be born of a golden parent, a golden child from a silver parent and so on" (p. 113); and from both sexes: "we must conclude that sex cannot be the criterion in appointments to government positions…there should be no differentiation" (pp. 146-147). However, Plato's concept of aristocracy has been greatly misinterpreted within Western ideology. The concept has historically and consistently favored the social positionality of the White heterosexual Christian male of bourgeois privilege.

[3] Throughout the remainder of this article the term NCTM documents designates the *Professional Standards for Teaching Mathematics* (1991), *Assessment Standards for School Mathematics* (1995), *Principles and Standards for School Mathematics* (2000), and the *Curriculum and Evaluation Standards for School Mathematics* (1989).

[4] Freire (1970/2000) defined the term Subjects, with a capital *S*, as "those who know and act, in contrast to objects, which are known and acted upon" (p. 36).

[5] I define the term "academic" mathematics as D`Ambrosio (1997) defined the term: mathematics that is taught and learned in schools, differentiated from ethnomathematics.

[6] In this context, I use the term trouble to place academic mathematics under erasure. Spivak (1974/1997) explained Derrida's (1974/1997) *sous rature*, that is, under erasure, as learning "to use and erase our language at the same time" (p. xviii). She claimed that Derrida is "acutely aware… [of] the strategy of using the only available language while not subscribing to its premises, or 'operat[ing] according to the vocabulary of the very thing that one delimits' (MP 18, SP 147)" (p. xviii). In other words, I argue that these three perspectives, while purporting the teaching of the procedures and concepts of academic mathematics (i.e., the language of mathematics), also place it *sous rature* so as not to limit the mathematics creativity and engagement of all students.

[7] Even though I trouble Plato's remark regarding "essence and reality," the purpose of this article is not to engage in that argument, an argument that I believe will be my life's work.