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A TAXONOMY OF (MATHEMATICS) EDUCATIONAL OPPORTUNITY

UNA TAXONOMÍA DE LAS OPORTUNIDADES EDUCATIVAS (MATEMÁTICAS)

UMA TAXONOMIA DA OPORTUNIDADE EDUCACIONAL (MATEMÁTICA)

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ABSTRACT

Mathematics education research and policy makers lament differences in outcomes related to race and class, treating so called “failures” as obstacles to be eliminated, rather than the outcomes for which it is designed. That is, mathematics education serves an important economic function in society: social selection and economic stratification. Following literature that foregrounds the economic dimension of schools, this analysis offers an examination of how inequalities are created and reinforced through a taxonomy of mathematics educational opportunity. More specifically, it addresses two questions: 1) What are the opportunities that contribute to the creation and reinforcement of social inequality in rural schooling? and 2) In what ways are those opportunities hoarded or leveraged to accomplish stratification? Through an ethnography of a rural, public elementary school in the United States, five opportunities emerged: learning, credentialing, positioning, relating, and networking. The paper offers a conceptualization of each of the types grounded in mathematics education literature and describes how those opportunities were distributed. I suggest that mathematics education’s focus on learning opportunities, while important, fails to account for other dimensions of equity in schools. These other, often invisible, opportunities and the mechanisms by which they are distributed are likely a source of significant inequity.

Keywords: rural education. educational opportunity. mathematics education. economic stratification.

RESUMEN

Los responsables de la investigación y las políticas de educación matemática lamentan las diferencias en los resultados relacionados con la raza y la clase, y tratan los llamados "fracasos" como obstáculos que deben eliminarse, en lugar de los resultados para los que está diseñado. Es decir, la educación matemática cumple una importante función económica en la sociedad: la selección social y la estratificación económica. Siguiendo la literatura que destaca la dimensión económica de las escuelas, este análisis ofrece un examen de cómo se crean y refuerzan las desigualdades a través de una taxonomía de oportunidades matemáticas. Más específicamente, aborda dos interrogantes: 1) ¿Cuáles son las oportunidades que contribuyen a la creación y fortalecimiento de la desigualdad social en la escolarización rural? y 2) ¿De qué manera se acumulan o aprovechan esas oportunidades para lograr la estratificación? A través de una etnografía de una escuela primaria pública

rural en los Estados Unidos, surgieron cinco oportunidades: aprendizaje, acreditación, posicionamiento, relación y trabajo en red. El artículo ofrece una conceptualización de cada uno de los tipos basados en la literatura de educación matemática y describe cómo se distribuyeron esas oportunidades. Sugiero que el enfoque de la educación matemática en las oportunidades de aprendizaje, si bien es importante, no tiene en cuenta otras dimensiones de la equidad en las escuelas. Estas otras oportunidades, a menudo invisibles, y los mecanismos por los cuales se distribuyen son probablemente una fuente de inequidad significativa.

Palabras clave: educación rural. oportunidad educativa. educación matemática. estratificación económica.

RESUMO

A pesquisa em educação matemática e os formuladores de políticas lamentam as diferenças nos resultados relacionados a raça e classe, tratando os chamados “fracassos” como obstáculos a serem eliminados, em vez dos resultados para os quais foram projetados. Ou seja, a educação matemática serve a uma importante função econômica na sociedade: seleção social e estratificação econômica. Seguindo a literatura que destaca a dimensão econômica das escolas, esta análise oferece um exame de como as desigualdades são criadas e reforçadas por meio de uma taxonomia de oportunidade educacional matemática. Mais especificamente, aborda duas questões: 1) Quais são as oportunidades que contribuem para a criação e reforço da desigualdade social na escolarização rural? e 2) De que maneiras essas oportunidades são acumuladas ou alavancadas para realizar a estratificação? Por meio de uma etnografia de uma escola primária rural pública nos Estados Unidos, surgiram cinco oportunidades: aprendizado, credenciamento, posicionamento, relacionamento e networking. O artigo oferece uma conceituação de cada um dos tipos com base na literatura de educação matemática e descreve como essas oportunidades foram distribuídas. Sugiro que o foco da educação matemática nas oportunidades de aprendizagem, embora importante, não leva em conta outras dimensões de equidade nas escolas. Essas outras oportunidades, muitas vezes invisíveis, e os mecanismos pelos quais são distribuídas são provavelmente uma fonte significativa de desigualdade.

Palavras-chave: educação do campo. oportunidade educacional. educação matemática. estratificação econômica.

Introduction

Mathematics education is an integral part of a system of stratification (Pais, 2014; Secada, 1989) of which the alleged “failures" are the outcomes for which it is designed (Apple, 1985; Martin, 2015). Despite what current mathematics education reform efforts (e.g., NCTM, 2020) suggest, mathematics’ social value lies in its role in social selection (Cabral & Baldino, 2019; Pais, 2013). Across literature that foregrounds the economic dimension of schools, authors have suggested that school is more about learning to participate in capitalism than the disciplines by which it is formally organized. In schools, students are sorted into classes and classified through evaluative criteria. Certification—through course grades, high school graduation, college preparatory certificates, and so on—acts as the final prize. This phenomenon is what Baldino and Cabral (2013) referred to as the credit system.

This project emerges from educational sociology and critical mathematics education. The disciplines overlap in important ways to suggest that schooling (Calarco, 2018; Domina et al., 2017) and school mathematics (Pais & Valero, 2012) have reciprocal relationships with a capitalistic economy. Both school and school mathematics assign grades and bestow credentials to individuals, which have implications for how students compete for positions. These positions have different statuses, so school mathematics influences the society in which it exists.

Nevertheless, mathematics education has maintained its focus on teaching and learning, neglecting the economic functions of schools and school mathematics. As such, the field has failed to recognize much of what schools and school mathematics accomplish. Some scholars have considered issues of equity in learning (i.e., how much and which mathematics is learned by whom), but the field of mathematics education has not yet examined inequities that fall along other dimensions.

Through ethnography, I examined the economic dimension of schools (and school mathematics) directly. In an effort to document the processes by which stratification is accomplished, I offer a taxonomy of opportunities distributed within and by schools and school mathematics. My questions are two-fold:

1. What are the opportunities that contribute to the creation and reinforcement of social inequality in rural schooling? That is, a) what constitutes the "educational opportunities" in sociology? and b) in what ways should the field of mathematics education extend its examination of inequity beyond learning opportunities to include other dimensions of opportunity?
2. In what ways are those opportunities hoarded or leveraged to accomplish stratification? That is, what are the mechanisms by which inequalities are created and reinforced through each of the types of opportunities?

Stratification of Opportunities

The ethnographic project was iterative. Data collection informed my reading of the literature, and I took my theoretical understandings back to the field. In the sections that follow, I review the literature relevant to the opportunities and inequalities present in the data, organizing it into a taxonomy of opportunity. Because my reading, data collection, and analysis were iterative, my findings pointed me to relevant literature, which in subsequent rounds of analysis, helped me understand the phenomena in terms of educational opportunities. As such, the following literature review largely attends to Research Question 1.

Mathematics education research has taken learning mathematics with understanding as the primary goal for students in mathematics classrooms (Carpenter & Lehrer, 1999; Hiebert & Grouws, 2007). While this is an important topic in mathematics education research, the field has, consequentially, advanced a politically "neutral" and colorblind understanding of students' school and school mathematics experiences (Gutiérrez, 2013). A relatively small subset of the mathematics education literature has considered students' identities along multiple dimensions of race, class, and gender. Research has shown that educational disparities (e.g., "achievement gaps") are related to inequitable access to opportunities to learn (Oakes, 2005), resulting in an "education debt" (Ladson-Billings, 2006).

One approach to examining equity in mathematics education has focused on how inequities emerge in the classroom, offering (qualitative) descriptions of classroom inequity (e.g., Gholson & Martin, 2019) or (quantitative) analyses of the distribution of opportunities to engage in discourse (Reinholz and Shah, 2018), which reflect differential learning opportunities (Ing et al., 2015; Sfard, 2008). Even research that has attended to issues of equity in an explicit way has maintained focus on maximizing students' mathematics learning (Ernest, 2016). Hiebert and Grouws (2007) called this the "the core question of education" (p. 371). I refer to the opportunities "that allow students to engage in and spend time on academic tasks…" (NRC, 2001, p. 333) as *learning opportunities.* Examination of the inequities within and around learning opportunities—especially that which promotes a critical understanding of the distribution of those opportunities—is an important topic of inquiry. However, inequities in school and school mathematics extend beyond learning opportunities.

Education research has established differences in students' opportunities, which lead to disparities in students' credentials (e.g., college prep certificates, high school diploma, advanced placement coursework) (Oakes, 2005). These distinctions have implications for the credit system in which students trade school credentials for social positions in a capitalistic society (Baldino & Cabral, 2013). I refer to

the opportunities school and school mathematics create to receive institutional credit—which later act as capital in competing for social positions—as *credentialing opportunities.*

Other issues of equity have foregrounded students' mathematical identities, documenting how students are positioned as competent mathematics learners. And more broadly, some literature has considered how schools attribute different qualities to different children (e.g., Oakes, 2005; Willis, 1977). Horn (2012) distinguished between a student's mathematical competence, "their ability to complete a variety of mathematical tasks: his or her 'smartness'" (p. 19) and their status, how competent a student feels and is perceived to be by peers. Following Elizabeth Cohen's (1994) work on complex instruction, Horn (2012) defined status as "the perception of students' academic capability and social desirability" (p. 21).

Students' status manifests in participation patterns. That is, it has implications for if and how students' ideas are heard or disregarded. And because students' participation in mathematical discourse is related to their learning (Sfard, 2008), students' status-driven interactions influence their learning and existing social-status in the classroom. Just as students encounter opportunities to learn in the mathematics classroom and in school broadly, students encounter opportunities to gain (or lose) status. I refer to these opportunities as *positioning opportunities.*

Another facet of educational equity has centered students' experiences in school. Wallace and colleagues (2012), conceptualized adolescents' *perceptions of being known* as "reflect[ing] teachers' authentic recognition of adolescents' multiple emerging identities" (p. 19). And while these contextual and psychosocial constructs affect students' academic achievement, they have been linked to other important outcomes, including risky behavior and mental health. Just as students encounter opportunities to learn, earn credentials, or gain status in school, I suggest students encounter opportunities to be known. I refer to these as *relating opportunities.*

While examinations of equity have often foregrounded student learning to examine the emergence of inequity within the classroom, these issues are not limited to the classroom. Some have drawn on social capital, which Lin (1999) defined as a set of "resources embedded in a social structure, which are accessed and/or mobilized in purposive actions" (p. 35). For example, Murray et al. (2020) drew on Putnam's (2000) distinction of bonding social capital (capital built within dense, homogeneous networks) and bridging social capital (capital built across a social distance) and examined how parents deploy social capital. They found that bonding social capital without bridging social capital was associated with advantaged parents using networks to hoard opportunities. However, in schools with both bonding and bridging social capital, schools were able to create more equitable and inclusive school communities. Just as schools provide learning opportunities, they provide opportunities for students and families to leverage their social resources. I refer to such opportunities as *networking opportunities.*

Schools and school mathematics distribute many opportunities. When considering issues of equity, mathematics education often (almost exclusively) considers inequitable distribution of learning opportunities. And while the distribution of learning opportunities is an important consideration, the field's discussion of opportunity should not be limited in this way. In an effort to offer a more complete picture of the ways in which schools and school mathematics structure society, this analysis presents opportunities for credentialing, positioning, relating, and networking. Together, the dimensions described above accounted for the aspects of instruction recorded in field notes. Table 1 offers definitions grounded in mathematics education and sociology literature of the five opportunity types described.

Table 1: Definitions of Opportunity Types

Opportunity Type	Definition
Learning	Opportunities "that allow students to engage in and spend time on academic tasks…" (NRC, 2001, p. 333)

Relating	Opportunities to affect adolescents' perceptions of being known, which "reflect[s] teachers' authentic recognition of adolescents' multiple emerging identities" (Wallace, et al., 2012, p. 19)
Positioning	Opportunities to gain (or lose) status. Status is "the perception of students' academic capability and social desirability. (Horn, 2012, p. 21)
Networking	Opportunities for students and families to leverage their social capital, defined as a set of "resources embedded in a social structure, which are accessed and/or mobilized in purposive actions" (Lin, 1999, p. 35)
Credentialing	Opportunities to receive institutionally recognized credit, which imply differential participation in the economy—higher salaries for certification (Baldino, 1998; Baldino & Cabral, 2013) or exclusion from participation based on educational records (e.g., discipline record)

Methods

Research Site

RiverTown is a rural community in the middle of a midwestern U.S. state, home to approximately 8,500 people. RiverTown is situated along an interstate that stretches horizontally across the state connecting the two metropolitan centers. RiverTown was selected, in part, because it is home to people from middle-class, working-class, and poor backgrounds (Lareau, 2011) and has moderate racial diversity.

RiverTown Public Schools (RPS) is comprised of four schools, each focused on a different grade level band. The focus school, Oak Tree Elementary, serves students in grades 3-5. For the most part, the instruction is typical. Teachers give a lesson and practice new skills with students. Then students complete a homework assignment.

Research Sample

The ethnographic project focused on the fourth and fifth grade students of RiverTown, of which there are five and four teachers and classes, respectively. Among the fourth and fifth grade students, I followed the students in four classrooms—three fourth grade and one fifth grade—more closely. Consistent with ethnographic methods (LeCompte & Schensul, 2010), my analysis and data collection were iterative, with initial analysis informing subsequent rounds of data collection and analysis.

Data

I collected data using participant observations and surveys. I visited the school site approximately two times a week for about three hours per visit. Initially, I spent the majority of time in one fourth grade class—Mrs. Cooper's classroom—before dividing my time among the other three focus classrooms. I rotated the days and times I observed each class to see students and teachers in various activities, observing during regular classes, "specials," lunch, recess, and other school activities.

While in the classroom, I was primarily an observer. Aside from answering some questions for students, I did not participate in any teaching and learning tasks. During observations, I kept jottings to record the nature of and participants in classroom interactions. Informal conversations with teachers served to

clarify observations. In addition to classroom observations, I observed activities peripheral to the school day as they were relevant to category creation and distribution of opportunity.

Data Analysis

After each session, I spent time expanding these jottings into detailed field notes that described my observations (Emerson, et al., 2011). As themes emerged, I wrote memos with analysis that extended across field notes. These memos, in conversation with the literature described above, served as the foundation for the framework described here.

A Taxonomy of Opportunities

In this section, I share the excerpts of my field notes and describe each of the opportunities identified, organized by the opportunity types introduced previously. For each, I describe the opportunity, examples of its distribution, and the mechanisms of inequality related to the distribution. This serves as evidence for the first research question and attends to the second research question.

Learning Opportunities

Learning opportunities originate within and around the academic lesson itself and the instructional opportunities presented by teachers, schools, peers, and the learning environment. These opportunities (or lack thereof) are typically situated within the classroom and foreground the richness of learning opportunities (of school subjects) for children. Because the instruction at Oak Tree Elementary was typical and not particularly ambitious, there were few rich learning opportunities to hoard within the elementary school. And because in the elementary grades, curriculum had not yet been stratified into various tracks (e.g., honors, regular, and remedial), there did not seem to be significant within-school variation in instruction between teachers.

Even still, there was some evidence of hoarding learning opportunities at RiverTown, most notably through parents' requests for specific teachers. According to Mrs. Evans, she and Mrs. Simmons (both fourth grade teachers) had the most teaching experience (15 years each) and because of this, parents had requested them to be their child's classroom teacher, suggesting that those classrooms have the greatest (perceived) learning opportunities. These opportunities were not distributed equitably. Teachers, administrators, and staff were able to request a class placement for their children—an opportunity not widely available for other parents. In this case, the mechanism of inequality was the policy that RPS employees could place their students in a specific classroom. Because RPS was one of the few employers of middle-class jobs, this opportunity was distributed almost exclusively to middle-class families.

Credentialing Opportunities

Credentialing opportunities are centered around documented signifiers of status that follow students through their educational records. Examples include points, grades, certifications (e.g., college-preparatory certificate), and transcripts. Because my observations focused on the experiences of students in elementary grades, explicit examples of credentialing were limited. However, students encountered opportunities to receive marks on their educational records that would ultimately matter for their educational credentials. For example, Mrs. Cooper refrained from documenting students' "horsing around" officially, instead handling the behavior directly. This protected students from the ramifications of being marked officially, or *credentialled*, as having problematic behaviors. This served as an example of an opportunity for a non-academic credential (behavior referral) that Mrs. Carter did not distribute. The mechanism of (non)distribution was Mrs. Cooper's relationship with students and her ability to address behaviors directly.

Positioning Opportunities

Positioning opportunities foreground status (Horn, 2012), including how the student and family is positioned as competent (or incompetent) in their smartness, obedience, moral goodness (e.g., a good kid), or other attributes (e.g., a hard worker). Students and parents were consistently engaged in these opportunities (i.e., children were consistently positioned), and as such, examples are plentiful. I will highlight one example in Mrs. Thomas's summer school class with three students to demonstrate the opportunity and its presence in the data. Mrs. Thomas was the librarian at RiverTown and served as a fourth grade reading and language arts teacher for summer school:

> Mrs. Thomas followed a routine: She directed kids to the page number; read the question aloud; and then ask for volunteers. Through this process, students raised their hands—some more assertively than others—to be called on. Mrs. Thomas would take the student's answer, and if the kid got approval that their answer was correct from Mrs. Thomas, the child was invited to get a piece of candy, which sat in a grey Walmart bag on Mrs. Thomas's chair.

This constituted a positioning opportunity. Different students were positioned in different ways. In the following excerpt, two students offered a definition of the phrase "to dawn on" with the second student building on the first student's definition.

> The girl said "oh, it means that an idea just kind of popped into her head" and Ms. Thomas said "oh, that's close" and then another student—a boy—said that it meant that the idea "came to" the character in the story. Ms. Thomas said that it was right, it meant to understand, and the boy student got a piece of candy.

In this excerpt, the girl offered an initial meaning for the phrase "to dawn on" and while Mrs. Thomas positioned her as being "close," she attributed correctness to the boy that followed. The second child had the benefit of building off the first students' ideas. Mrs. Thomas attributed correctness to the boy student without attributing the same benefit to the girl. This was made explicit with the award of a piece of candy.

In the same class, Katerina, a Black girl who sat next to me, shared that she "never" gets called on. I described that in my field notes: "Katerina shared with me that she wanted to get a piece of candy and she 'always' had her hand up but never gets called on to answer a question and get a piece of candy." Again, the positioning opportunity was created in the class by the structure of call and answer described above. This structure—and the teachers' decisions about who to call on and how to interact with those students—acted as the mechanism of inequality. In enacting the lesson, Mrs. Thomas positioned students in a variety of ways. By calling on them, she positioned some students as co-constructers of the learning. In the excerpt above, she positioned the girl student as "close" and attributed correctness to the boy student. In the case of Katerina, who was not called on, she was positioned as unknowing.

Relating Opportunities

Relating opportunities foreground a sense of being known and seen within the school (Wallace, et al., 2012). When a student or teacher interacts with the school, they have the opportunity to be known. In the following excerpt, I noted Mrs. Cooper's interaction with a student (Caitlin) and Mrs. Cooper's son (Mason) at recess.

> When we got outside, Mrs. Cooper was asking questions trying to figure out the situation…She [Caitlin] says that she lives with her grandma and that currently they live in a one bedroom, one bath apartment on the second floor, but they are looking for another place to live. Mrs. Cooper kind of identifies with her by saying that it's annoying to have to carry groceries and stuff up to the second floor… Mrs. Cooper asked what type and size of house they had in mind and Caitlin says two bedrooms. Mason—still sitting nearby kind of jumping around with a ball—jumps into the conversation commenting "two bedrooms, two bathrooms." Caitlin said 'no, no we don't…' and Mrs. Cooper said 'they can share a bathroom, they don't need a second bathroom,' normalizing the size of house.

In this conversation, Mrs. Cooper engaged in a lot of relating. She asked questions to get to know the student and family and was quick to relate to the student, normalizing Caitlin's circumstances. Mrs. Cooper asked more questions, but when Caitlin seemed less open to sharing, she was quick to respect the child:

> Mrs. Cooper finally asks directly: "Do you do you know why not? Why do they [Caitlin's siblings] live with your mom and you live with your grandma?" And Caitlin says "I used to know but I don't remember" and Mrs. Cooper said "oh, okay, well, that's okay. And if you do remember and, and you just don't want to talk about it, that's also okay. You don't have to share your story with anybody that you don't want to."

Here, Mrs. Cooper extended beyond getting to know the child's situation to recognize how the child was feeling and experiencing the conversation. In this example, the opportunity was to be known or seen by Mrs. Cooper. The mechanism of distribution was two-fold: 1) Caitlin lingered nearby during recess; and 2) Mrs. Cooper took an interest in Caitlin, engaging her in conversation.

Networking Opportunities

Networking opportunities refer to the student's or family's ability to draw on their community networks. These opportunities extend within and outside the school to include the child/family relationships to others. One example of this is around students' classroom placements. At the open house, Mrs. Cooper told at least three families that she manipulated course placements for students who otherwise would not be afforded the opportunity to be placed in a classroom. In the following excerpt, Asher's father described receiving notification of his child's placement:

> The father described getting the child's class assignment, (paraphrased), "we saw that come through. We were so excited. Because to start over with a new relationship, it's just so hard to start over. We can just keep on working and keep on building. We've made so much progress…" Mrs. Cooper's voice dropped a bit, "I did that. I moved him." She continued, (paraphrased), "They put them [student names] in there and push a button, and they go all over the place, but we had a good thing going last year, he made a lot of progress. I thought it'd be good for him to stay with me."

The networking opportunity here was two-fold: 1) the ability to select the classroom teacher and 2) the insider knowledge of an appropriate placement. Asher (a student with a working-class background) did not inherently have access to either of those opportunities, but Mrs. Cooper circumvented the policy to place him in her class. In this case, the subversion of the established policy acted as a mechanism of distribution, extending the opportunity to Asher.

Converging Opportunities

In an effort to lay out the distinct opportunities that emerged in my data, I attended to each in turn. Of course, opportunities are neither presented nor hoarded in isolation. Instead, they cluster, and the leveraging of some opportunities affords greater opportunities in other places. While I could offer some suggestions as to the many clusters of opportunities, establishing those connections would require sharing many more excerpts, which space does not allow. Instead, the example of course placement, above, is one instance of convergence. The opportunity to be placed in a classroom (as opposed to randomly assigned) is primarily a networking opportunity. Leveraging this sort of networking opportunity is related to (perceived) learning opportunities, evidenced by parents selecting teachers with the most experience. In the example shared above, Mrs. Cooper used her own network to place students in her class, which would otherwise have been randomly assigned—a placement Asher's parents seemed to appreciate. And in doing so, she increased the students' (perceived) learning opportunities (i.e., the progress Asher's dad described) and relating opportunities (i.e., the relationship Asher's dad described). This example demonstrates one way in which the opportunities could come together to leverage each other. A more complete analysis would include greater descriptions of the convergence of opportunity.

Consequences of Opportunity in a Rural Elementary School

Mathematics education has long documented disparities in students' learning opportunities, and while this work is important, it has failed to recognize the full spectrum of opportunities that are distributed within and by schools. Given school and school mathematics' role in stratification and connection to capitalism, the field's conceptualization of opportunity should be expanded to include at least five types of opportunities: learning, credentialing, positioning, relating, and networking. These five opportunities do not exist in isolation; rather, they present themselves and are leveraged in clusters. Because they are often invisible–both in mathematics education research and in classrooms–they are likely a source of significant inequity.

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