

## Education for Whom? Word Problems as Carriers of Cultural Values

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### Abstract

Is the mathematics presented in textbooks, trade books and standardized tests neutral? Drawing from critical theory and feminist epistemologies, the purpose of this research is to examine mathematics curricular materials through the lens of two questions: “What is valued?” and “Knowledge for whom?” Findings indicate that mathematics texts contain multiple examples of problems that reify hegemony, the exploitation of people, and a marked disregard for the environment. This article includes ways mathematics educators can reconceptualize mathematics texts as inextricably linked to cultural reproduction and furthermore, to use these insights to build ways that mathematics educators can disrupt the current narratives of inequity, waste, exploitation and the privileging of particularly narrow perspectives in mathematics education and replace them with more equitable, inclusive, sustainable and critical perspectives.

### Education for Whom? Word Problems as Carriers of Cultural Values

School is widely regarded as one of the primary means of cultural reproduction, and within this context, our mathematics texts play a large, albeit frequently invisible and unchallenged role in this reproduction. In this article, I cast light onto issues taken for granted, and intend to help move the conversation from the dominant discourse to the outer edges of comfort, and perhaps even beyond. To this end, I engaged several groups of my graduate students, both pre-service and in-service teachers, in examining how mathematics texts might be part of this cultural reproduction.

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In the arena of public education in the United States, much emphasis, of late, has been focused on the establishment, implementation and measurement of progress towards meeting local, state, and national standards for educational success, typically as measured on standardized assessments. Nudged ahead by the Elementary and Secondary Education Act (United States Department of Education, 2010), these standards are embodied in the benchmarks and indicators used to construct curricula and guide instruction. These benchmarks and indicators make up what is known as the curriculum in our schools. Typically a public document, the curriculum contains all of the essential information deemed necessary for “success” as defined by some body designated as experts. The curriculum is the canon of public school education, and myriad educational decisions, ranging from textbook purchases, course scheduling, teaching certification and more hinge upon what is contained in the curriculum.

In efforts to teach the entire mandated curriculum, most school districts elect to purchase textbooks that mostly (or fully) address the standards, benchmarks and indicators outlined by the school division. Although there are many factors that influence the textbook-adoption process and decision (including price, history, and the relationship with the textbook salesperson), the primary deciding factor is usually one of tight alignment to tested standards, quietly emphasizing a kind of “Taylorism” (Au, 2011) in the pursuit of the most efficient use of time (as measured by test scores).

However, what many textbook adoption committees or individuals frequently overlook or fail to consider is what’s commonly known as the “hidden curriculum” embedded within the curricular materials themselves. Coined by Jackson in 1968, the term *hidden curriculum* has come to be understood as the unwritten and unscripted transmission and reproduction of norms, values, and beliefs—that is, culture—conveyed in both the formal educational content and the social interactions in schools (Giroux & Penna, 1983). Typically unrecognized and unchallenged, the hidden curriculum is one of the primary means of cultural reproduction, effectively and efficiently shaping what is believed to be worthy, valued, and important.

Within the field of mathematics education, there exists a particularly pervasive belief that “mathematics is universal” and as such, is “neutral,” carrying no artifacts of language, identity, nor culture. “It’s just numbers” is a common refrain, which may, in fact, speak to a deeper belief about mathematics education, in that it has long been framed as a black box of sorts, with a mostly unchallengeable, perhaps unknowable, evolutionary history and place within the canon.

As such, when textbook adoption committees select books and supplemental materials for their students, what degree of sensitivity to the hidden curriculum is demonstrated? What about the textbook authors and publishing companies themselves? To be sure, textbook publishers have, over the last decades, worked to represent more of the diversity that is present in the United States—but typically only in the most superficial ways. No longer are textbooks brimming with white children in gender-specific roles. Rather, modern textbooks include students from

many ethnicities and sometimes many nations, sometimes even moving into the territory of essentialism by featuring images of people in country-specific ceremonial or historical garb. Current mathematics textbooks clearly include a range of names that more accurately represent the students in the U.S., typically with a heavy skew towards Latino names. Additionally, it's increasingly common for mathematics texts to include images of persons with disabilities, and men and women in roles different from those traditionally assigned. Female mechanics and male nurses may even be disproportionately represented in some mathematics books.

Because of these quite visible changes in the ways mathematics texts include individuals in ways that mildly challenge the status quo, many educators (mostly white and female, with incomes placing them squarely in the middle class) (National Center for Education Statistics, 2013) appear content with the current situation, as there is no audible, generalized outcry. However, I posit that this superficial treatment of "multiculturalism" that focuses on the addition of people of color may in fact be working against some of the primary goals of a socially just society by tokenizing individuals and groups without any direct movements towards challenging the shifting other aspects of the status quo.

To this end, a large part of what I (and my participants) contend to be the insidiousness of cultural reproduction hinges on the way "normal" is portrayed and presented. Particular ideas and concepts are framed as typical, and remain unchallenged and un-problematized. There is a pervasive favoritism of what I call, "inner circle" elements, which include preference for white perspectives, male perspectives, English-speaking perspectives, middle or upper class perspectives, heterosexual perspectives, Christian (or sometimes Jewish) perspectives, and patriarchal perspectives, some of which will be discussed in this paper.

So... isn't mathematics neutral? For many K-12 educators, the answer seems obvious: Of course; it's just numbers, and mathematics texts (textbooks, curricular materials and standardized assessments) are totally objective. However, what this hasty response may fail to include is the rich complexity and contextualization that mathematics texts carry (Bright & Wong, 2009; Gutstein, 2006; Boaler, 2009; Moses & Cobb, 2001). Although it's entirely possible that the contexts presented in mathematics texts are purposefully selected to convey a particular frame, perhaps the field of mathematics educational materials is simply part of a more pervasive, unproblematized facet of institutionalized hegemonic educational practices. Speaking to this possibility (if not probability), Greer and Mukhopadhyay (2012) state, "mathematics and mathematics education are implicated in various forms of interpersonal dominance and in ideological struggles" (p. 229).

With the exception of vanguard educators like Greer & Mukhopadhyay (2012), Gutstein (2006), Moses & Cobb (2001), Boaler (2009), and Ball, Gofney & Bass (2005), very few researchers have focused on mathematics as a carrier or transmitter of hegemony. Framed around the questions, "What is valued?" and "Knowledge for whom?" the purpose of this research is to highlight the ways mathematics

educators can conceptualize mathematics texts as inextricably linked to cultural reproduction (Bourdieu, 1986), and use these insights to build ways to disrupt the current narratives of inequity and the privileging of particularly narrow perspectives in mathematics education and replace them with more equitable, inclusive and critical perspectives (Freire, 1982).

The mathematics educators (and future educators) described in this research drew from the work of Kubota (2004) and critically analyzed mathematics items—word problems—purposefully selected from their classroom mathematics materials. They practiced uncovering the ways in which mathematics education is decidedly not neutral, but is instead politically, socially and historically situated within a particular agenda. Using these new perspectives to examine this corpus, the educators in this research were surprised to unearth hundreds of examples they experienced as hegemonic. They used (and continue to use) their new insights to actively disrupt the hegemonic narratives and, with their students, co-create counternarratives intended to empower the learners. Details about how the participants selected problems and crafted analyses are provided in the methods section.

In framing the stances of the contributors to this work (the graduate students), it is useful to highlight the post-structural stance adopted by both myself and by the students as well. As Foote and Bartell (2011) state,

This research acknowledges that researchers producing knowledge are located within a particular social, economic, and political context of society. This positionality (Tetreault, 1993) of a researcher is shaped by his/her unique mix of race, class, gender, sexuality, and other identifiers, including positions of power into which society has placed the person, as well as his/her personal life experiences within and around these identifiers. (p. 46)

Thus, the items selected for inclusion in this research represent the stances adopted by the participants (including myself), and as such provide intentionally subjective testimony to our lived experiences as students, as teachers, and as mathematicians.

### Theoretical Framework

Informed by critical theory, this work is an effort which, “recognizes power—that seeks in its analyses to plumb the archaeology of taken-for-granted perspectives to understand how unjust and oppressive social conditions came to be reified as historical “givens” (Cannella & Lincoln, 2012, p. 105). This term, “givens,” serves well in the context of this research, as the use of this term in mathematics traditionally means “known.” By employing critical theory, the intent of this work is to scratch away at these givens—particularly the most omnipresent examples in the canon of mathematics education—and cast light into what may have been not only the unconsidered messages or intentions of the original authors in invoking these givens, but also to reframe these assumptions in ways that may be more

emancipatory for all K-12 mathematics students in the U.S.—not just those already enjoying various forms of privilege.

Building upon these ideas, this work also draws from feminist epistemology, in that the situated-ness of the knowledge of mathematics signals a masculinity that is often unnamed and unchallenged (Haraway, 1988). Invoking Anzaldúa's (2002) concept of the *nepantlera*, which she describes as those who “facilitate passage between worlds” and who engage in thinking that seeks to “question old ideas and beliefs, acquire new perspectives, change worldviews, and shift from one world to another” (p. 1), this work frames the activities of participants as active and agentic, questioning and challenging.

Finally, this work is heavily informed by post-structuralism, digging into the ways the self is constructed through language, riffing from the conviction that “there is no unified reality, but rather multiple and individual realities” (p. 62, Savin-Baden & Major, 2013). As such, this work is founded upon the interpretations of the participants, whose authority, rooted in their individual and unique lived experiences, is taken as independent versions of truth. In my role as researcher with a post-structuralist stance, I seek not to challenge or discount the interpretations of my participants, but rather to provide a forum for their testimonies in the form of reactions to and analyses of mathematics problems. As such, with each example included herein, “the speaker does not speak for or represent a community, but rather performs an act of identity-formation which is simultaneously personal and collective” (p. 15, Yúdice, 1991). In other words, each participant articulates a perspective that although particular to a single lived experience, may also be resonant for others who may have walked similar paths. Further, in the assertion of these thoughts and reactions, the individual voices form a sort of chorus that defines the collective response of the community, which may perhaps provide insight for textbook authors and publishers.

## Methods

This research is centered in the collaborative work of 58 graduate students (teachers and future teachers) who agreed to participate in this exploration. The participants were enrolled in one of 3 sections of a graduate mathematics methods course for educators, which focused heavily on a critical implementation of pedagogical content knowledge in mathematics, and each participant engaged in a two-part exploration. The first part, a collaborative analysis of a text, took place during a regular class meeting. The second part, which consisted of individual identification of “troubling” mathematics problems, took place as an out-of-class assignment. Both parts will be described in turn.

### *Part 1*

To begin, the participants engaged in an in-class, collaborative analysis of a

mathematics text, a picture book titled *The Dot and the Line: A Romance in Lower Mathematics* (Juster, 1963). The text, featuring 3 non-human characters (dot, line and squiggle), is described as, “a supremely witty love story with a twist that reveals profound truths about relationships—both human and mathematical—sure to tickle lovers of all ages” (Amazon.com, 2012). Because the text itself is a physically small book (measuring only about 7” x 7”) and as such is not conducive to a whole-group read-aloud session, the book was briefly shown to the whole group before being passed around for individual inspection. However, thanks to the popularity of the text when it was initially published, it was subsequently made into an animated short film (with the same title) (Jones & Noble, 1965) and went on to win an Academy Award in the “Best Short Subject: Cartoons” category. The narration of this award-winning film follows the text from the book almost verbatim. After a short introduction, the participants were divided into three groups. Each group was assigned one of the three characters from the book (and movie): the dot, the line, or the squiggle. Each group was asked to watch the movie with an eye towards their assigned character, and to notice for how that character was portrayed. Participants were also asked to note what was framed as “normal” and what kinds of things seemed to be valued or privileged for each character.

After the 10-minute viewing of the film, the participants were provided with a transcript of the text, and asked to discuss within their assigned groups (the dot, line or squiggle) how their character was portrayed. What was framed as “normal?” What seemed to be valued? Where/ with whom did power seem to be located? Working together, the “character groups” discussed and debated their interpretations, and then shared insights with the group at large, and discussed their varying perspectives, acknowledging that each person’s perspective is rooted in her or his own historical and cultural context.

Using Burbles’ (1986) work, “Tootle: A Parable of School and Destiny” as a model for deconstructing this superficially innocuous children’s book (and subsequent film, which is readily available for viewing on the internet), the participants were asked to consider the following in relation to *The Dot and the Line*:

Where the text implicitly assumes certain social circumstances that can be raised to question; where it colors certain conditions with an evaluative shade, or makes outright judgments about them; and where it distorts, misrepresents, or offers a partial, incomplete version of social events, it can be subject to criticism. (Burbles, 1986, p. 240)

In other words, the participants engaged in a collaborative form of critical discourse analysis, “noticing and naming structures, conditions and manifestations of domination (however small or large)” (p. 5, Rogers, 2011). Working from this definition, participants readily identified examples from the Juster (1963) text and the parallel Jones and Noble (1965) film of sexism, (as only male characters who actually engage in mathematics, and the female character is physically objectified),

heterosexism and heteronormativity (as “couplehood” is presented as the only possible norm, and in a heterosexual fashion), racism (as the squiggle is interpreted to be a male of color, interpreted by participants to be Black), violence against women (as the female character is depicted as fleeing arrows and is physically manipulated and even thrown around by male characters), linguicism (as the squiggle character is maligned for pronunciation the letter L), white privilege (as the protagonist is interpreted by participants as white and as such, has access to “white” styles of discourse), tokenization and even Western-faith-normativity (as some participants interpreted the story as an Adam-and-Eve trope).

### *Part 2*

Building from this experience, participants were then asked to use some of the same frames to look at their own mathematics curricular materials, either in their teaching or student-teaching settings, and select 3 examples (of word problems) to scrutinize using some of the same critical stances. Participants were directed to select any 3 examples that stood out to them in some way as being carriers of a particular cultural or social stance, drawing from their own, personal reactions to and interpretations of the problems. Using the phrase “impact over intent” as a refrain, participants were encouraged to focus less on what the author’s intentions might have been, and rather, to focus more closely on how the impact of word problems might privilege a particular worldview, stance or perspective while marginalizing another.

Drawing from what Burbles terms “ideology analysis” or “ideology critique,” students were asked to engage in, “an attempt to hold a portrayal accountable to social reality” (p. 240). The participants were asked to consider the following questions as they selected examples (word problems) and considered their interpretations, focusing on challenging what Gay (2011) terms, “the unquestionably correct knowledge” (30).

- What is valued in this problem?
- Who or what has power?
- What is not mentioned/ missing/ assumed in the problem?
- What prior knowledge (aside from mathematics) is assumed for this problem?
- Does this problem contain or promote “aspirational” cultural values?

After all participants had identified at least 3 examples of word problems that privileged or frame as “normal” a particular worldview, and after all participants had responded to the preceding prompts for each of their 3 or more problems, they then engaged in focus group discussions to both provide commentary on the process and also to discuss insights gained during their analyses of their chosen problems. Information from these focus groups, along with the written analyses of textbook items, were included in this research. Finally, participants shared these examples with their students and collaboratively generated more relevant, socially just scenarios that resonated in the lived experiences of the students.

In an effort to synthesize the all-over-the-map findings of the students, we used grounded theory (Glaser & Strauss, 1967) to generate codes and themes, grouping “like” findings together under headings that seemed to capture the big ideas. These categories echoed many of those the students identified in their examinations of the Juster (1963) text in Part 1, but also included a focus on middle-class values, capitalism, acquisitiveness, and disregard for environmental and human impacts.

### Findings

The 58 participants in this effort identified 180 unique mathematics word problems (items) from a range of sources, including materials drawn from the elementary level, Algebra 1, Algebra 2, Geometry, Trigonometry, Statistics, Pre-Calculus and Calculus courses. Although there were conceptual similarities in many items, there were no verbatim overlaps drawn from the same sources.

The majority of examples (just over half) identified by the participants fell under the general umbrella of promoting or accentuating middle-class ideals, which participants identified as valuing competitive consumerism, conspicuous leisure time and activities, engaging in white-collar work, and, as one participant explained, “keeping up with the Joneses.” These concepts neatly fit what Bourdieu (1977) would describe as part of the cultural capital middle and upper-middle class students bring to their school experiences. Sub-categories within this area included problems that focused on travel, problems that focused on home improvement, problems that focused on shopping or acquiring things, problems that focused on earning money, and most commonly, problems that focused on leisure time.

One of the most common themes that emerged in the examples participants identified in their mathematics texts was that of consumerism and acquisitiveness. Dozens of problems were identified that focused on purchasing items, with the stated goal often being to acquire the maximum quantity for minimum cost. The problems were mostly rooted in the perspective of the consumer, serving to normalize and routinize the act of shopping, reinforcing the ideals of capitalism and framing the students as buyers. Some of the items featured in problems included laptops, televisions, jackets, cars, a scooter, and a mildly baffling, no-picture-included problem about a “snowskate.” “A boy asked me what it was, and I had to go Google it,” explained a participant.

Related to this focus on acquiring possessions, participants also identified dozens of examples promoting middle- and upper-middle-class values as highlighted in consumative acts related to living spaces. These examples (typically with a stated focus on calculating area and/ or perimeter) centered on re-carpeting, re-tiling, or re-painting rooms, walls, or other surfaces. What participants found troubling about this was the ways in which “re-anything” (except reduce, reuse or recycle) implies a disdain for not only an environmentalist orientation, but also the idea that there exists fashion trends in home decor, and the problems frame as normal the need to



keep up with current fashion in our surroundings. Participants also took issue with what they interpreted as classist ideals, in that those who elect to re-work parts of their homes are typically homeowners and not renters, and have the disposable income to support decorative projects. One participant explained her thinking on this, stating, “These problems tell me that it’s “normal” to be a homeowner, and... I am expected to be constantly striving to “improve” my space in ways that cost money, usually with a focus on some standard of beauty and not functionality.”

The leisure time examples covered a range of activities, but by and large focused on those with more structured adult supervision, organization, and input—all characteristics more closely associated with middle-class families than with working class families (Lareau, 1987). Examples included problems that focused on bowling, golf, scuba, carriage rides, pilot lessons, music lessons, dance lessons, snowboard lessons, martial arts lessons, and the like. Most of the examples identified were for leisure activities required a financial obligation and enrollment in advance, with the implication that highly structured events are more common and more desirable—again, suggesting middle class families. Lareau (1987) explains that “working class parents [have]... limited time and disposable income” (p. 81) to engage their children in these kinds of activities.

Travel-related examples identified by the participants ranged from the broad and generic (“vacation”) to the more detailed and specific (skiing in Switzerland, hiking in Ireland, staying at an underwater hotel). Each travel scenario requires leisure time and disposable income from some usually unidentified source, which again foregrounds the middle-class experience and frames it as normal. This problem, found in a Harcourt text (Maletsky, E., 2002, p. 77b), is a typical example:

Two art students are touring Paris. They each buy a one-day museum pass for \$14. Each student also buys a ticket to the Eiffel Tower for \$11 and a boat ticket for \$3. How much do the two students spend altogether? Explain.

What may superficially seem like an affordable day in Paris is in fact part of an outing in one of the most expensive cities in the world for tourists (TripAdvisor, 2012). There is no mention of the numerous additional expenses involved in this problem (such as airfare, lodging, and meals), but rather, the problem is presented as if art students touring Paris is a matter-of-course experience. In spite of this missing contextual information, the problem still requires students to think about spending money, including for things that, if another paradigm were in operation, might be viewed for free—like art. Further, there is no mention of the environmental impact related to travel (air travel and the “boat ride” mentioned in the problem). Additionally, although this textbook is still in use with students, it is so dated that at the time of this writing, admission prices to the Eiffel Tower have increased 3-fold, to \$33 (<http://www.francetourism.com.au>).

Some examples skewed into territory unfamiliar for many children and adolescents, and focused on topics many would find obscure or irrelevant to their lived

experiences and interests. One such example asked Algebra 2 students to calculate the cost of a particular mixture of potpourri (Burger, et al., 2007) that included pine needles and lavender, resulting in a product that would cost exactly \$200. The very idea of potpourri—a mixture of aromatic plant matter intended to imbue a particular smell—is decidedly intended for people with disposable income and the belief that these smells improve the overall ambiance of a space. Additionally, with the target price of \$200, the wording of this mixture problem implies that it is normal to spend this amount of money to make one’s home smell a particular way.

Additionally, participants identified multiple examples that alluded to an upper-class lifestyle and set of lived experiences. About a dozen examples focused on ways to invest money to reap the greatest profit, but none of these problems explored where the profit actually comes from or from whose pockets it is drawn. Five examples identified by the participants focused on inheriting large sums of money or precious gemstones. Other examples alluded to the lifestyle of the wealthy-- owning a vacation home, having multiple horses in one’s corral, arranging parking for one’s yacht, and so on, each framed as normal experience. Perhaps most telling were the examples that emphasized getting “cheap labor” and calculating ways to pay “the help” as little as possible. One example in particular was found on a school-district-recommended website, mathhelpforum.com. The problem, described by the participant as “clearly exploitative,” reads:

An orange grower in California hires migrant workers to pick oranges during the season. He has 12 employees, and each can pick 400 oranges per hour. He has discovered that if he adds more workers, the production per worker decreases due to lack of supervision. When  $x$  new workers (above the 12) are hired, each worker picks  $400 - 2x^2$  oranges per hour (mathhelpforum.com, 2009).

The layered status-orientations in this problem were described as “insulting and painful” by the student who identified the problem, and when discussed in the focus group, were described as racist and serving to reinforce damaging stereotypes. Additionally, the students pointed out the probable misnomer in the first sentence, as the person hiring the migrant workers isn’t the one growing the oranges—it’s most likely the migrant workers tasked with this job as well.

Several other participants also identified problems that, without naming it, seemed to hint at race or racialized ways of knowing and being. One common example is illustrated in problems that focus on meals, like one that was featured in *Algebra 1* (Larson, 2010), with these instructions and given information:

You want to plan a nutritious breakfast. It should supply at least 500 calories or more. Be sure your choices would provide a reasonable breakfast. (p. 371).

<i>Breakfast food</i>	<i>Calories</i>
Plain bagel	195
Cereal, 1 cup	102
Apple juice, 1 glass	123

Tomato juice, 1 glass	41
Egg	75
Milk, 1 cup	150

First, the phrasing of the problem states that breakfast consists of options, and that the reader has a choice in what to select for the meal. While this may be the case for some students, there are also many students who received free or reduced price meals at school, and as such, have no choice in what they are served. Also, this breakfast is typical of what is eaten in U.S. households, although as the participant asked, “Do people really drink tomato juice for breakfast?” It was noted that few of the options seem to be whole foods (except perhaps the egg or maybe the cereal), with the emphasis being instead on processed foods. Additionally, what’s emphasized in this problem is not the nutritional content, but rather, the calories associated with each food. The instructions, using the words “nutritious” and “reasonable” assume some collective, baseline agreements of what these terms might actually mean in practice. Finally, the inclusion of milk (assumed to be cow’s milk) on this list of options for a “nutritious” breakfast fails to recognize the fact that the majority of people on the planet (~60%) are lactose intolerant (Itan, Jones, Ingram, Swallow, & Thomas, 2010), and it is primarily white people (people of European descent) who are able to digest milk. Thus, in considering who the authors had in mind when writing this item, it would seem that white, middle class children were the target audience.

Heteronormativity was another theme identified by participants on several occasions. One commonly known example is *As I was going to St. Ives* (Wikipedia, 2013), a traditional nursery rhyme found in multiple books (including Boswell & Larson, 2010) and on countless math-oriented websites. The poem’s second line mentions a man with wives and in doing so, normalizes-by-naming heterosexuality (and in fact, polygamy) in an unquestioned and unchallenged frame; in contrast, rare (if ever) do mathematics texts include problems that focus on same-sex marital or romantic life-partnerships. Additionally, the poem is stated as “I met a man with seven wives,” foregrounding the male figure (although only one person) and backgrounding seven others, the wives, described by their marital status and not their sex. Participants also noted that the wives were framed as perhaps a type of accessory—not “a man and his seven wives” but as a man *with* seven wives, further depersonalizing the women. In considering this problem through a feminist lens, participants agreed that the use of language, perhaps intended to sound playful, carried a subtle but clear message of male privilege, like, as one participant explained, “unseen smoke that you can smell.” The problem was deemed to be even more disturbing once participants began to deconstruct the un-remarked-upon animal cruelty by describing cats and kittens being carried in sacks by the women.

A curious and confusing example was identified in the *Saxon Math: Course 2, Teacher’s Edition* (Hake, 2007), on p. 78. The problem for students, which included no illustration or photograph, read:

Dawn cranked for a number of turns. Then, Tim gave the crank 216 turns. If the total number of turns was 400, how many turns did Dawn give the crank?

What makes this problem most vexing is the way the author freely interchanges the verb “to turn” with the verb, “to crank,” and then also uses both crank and turn as nouns. Clearly privileging those students with stronger grasps of English and an understanding of the ways nouns can be used as verbs (and vice versa), the author anticipated challenges for English learners reading this problem, and included this suggestion:

Teacher’s Edition Note for English Learners: Demonstrate the word crank by using a rotary motion with your hands. Be sure to repeat the word crank while making the motion. Have the students repeat the word and make the motion for confirmation of their understanding.

This minimal note, with a superficial-at-best attempt to provide differentiation for new speakers of English, speaks to what may be interpreted as a lack of investment in ensuring English learners have full access to the content being presented.

Even the most classic, playful, and beloved examples, when scrutinized carefully, showed evidence of carrying specific cultural norms that may privilege some realities while denying or even insulting others. One participant examined the 1974 Shel Silverstein poem, “Smart” (p. 35), and found multiple examples she described as “disappointing.” In the poem, which focuses on money, the protagonist engages in a series of money exchanges, trading a dollar bill for two quarters, then trading the two quarters for 3 dimes, and so on, each time believing he has made a gain (having exchanged fewer coins for more coins). The mathematics are simple and appropriate for those learning about U.S. currency, but the entire arc of the poem is the story of the protagonist being taken advantage of, repeatedly, by those he trusts. The very title of the poem (“Smart”) is sarcastic, and the emphasis on acquisitiveness (both the overall number of coins and the total value) is powerful. The protagonist expresses opportunistic thinking, implying the wish to take advantage of others, in his exchange with “old blind Bates” (p. 35) and his description of another trader as “the fool” (p. 35). At no point in the poem did anyone attempt to educate or support the protagonist in ensuring his money was equitably accounted for; in fact, the poem ends with the protagonist’s father turning “red in the cheeks” (p. 35) and refusing to speak.

### Counterpoint

Although most participants described experiencing a series of epiphanies around issues of social justice education and the subtle ways hegemonic thinking can creep into mathematics problems, as the result of their participation in this project, a handful of participants (3 or 4) instead had a different reaction that ranged from indifference to strenuous defense of the entire canon of mathematics problems discussed. One wrote, “I am inherently skeptical of reading values, ‘‘cul-

tural aspirations,” and power dynamics into everything. In particular, I think most math textbook problems are made with little or no thought, and with the attempt to make it ‘relevant to students’.” Drawing heavily from the work of Lockhart’s (2009) generalized critique of “word problems” in mathematics, this participant went on to state, “I think to have borderline paranoia about how we as teachers are somehow perpetuating an oppressive system by assigning word problems that may involve a male carpenter instead of a female one is fairly ridiculous.” So although the majority of participants in the research gained new insights into how mathematics educational materials may perpetuate worldviews and norms that may be damaging, insulting or otherwise excluding to some students, a few participants found that engaging in this research reinforced further solidified their complicity with or perhaps indifference to hegemonic thinking and the dismissal or silencing of those with other perspectives.

This is not to say, however, that the skeptics were wrong. Perhaps the presence of these examples is in fact unproblematic and unnoticed by the students reading them; perhaps the images and scenarios and contexts are enlightening, or inspirational, or educational—or as often described, “aspirational,” that is, included to provide less-privileged students with suggestions for things or goals they may aspire towards. Perhaps the values espoused in the problems—either directly or indirectly—have no impact at all. But perhaps they do. Perhaps the problems point out what is considered to be the “right” way of being, the “right” kind of home, the “right” kind of vacation, the “right” kind of leisure activity. What, then, happens to the spirits of students who perhaps do not aspire to these ideas and ideals, or who recognize that their own lives are currently devoid of these opportunities and structures? What becomes of their passions for mathematics, their engagement with the curricula, their vision of how school is intended for them?

To be fair, the problems highlighted here (and in truth, those selected by the students to begin with) represent but a fraction of the total set of problems posed to students in the United States. These are not randomly sampled or selected, but rather, purposefully chosen because, through the eyes of the participants, these problems carry markers of social, cultural, and/ or linguistic privilege. This is not to say that the entire body of mathematics problems presented to students is flawed or faulty, but rather, simply to highlight that these threads of inequity and the assertions of specific cultural values are woven throughout mathematics curricula at all levels. The next steps in this project will involve the participants taking their selected mathematics problems back to their K-12 students for the purpose of re-working, re-framing, or re-conceptualizing their chosen problems into examples that will more accurately suit the beliefs and ideals that will best serve the students themselves. Gutstein (2007) advocates for this form of co-construction of new meanings with students, stating, “While we cannot always directly or immediately affect macro political and economic structures, although that is an essential part of creating a more just society, we do have agency ourselves” (p. 438).

### Discussion

As the literature on the ways current mathematics discourses may serve hegemonic ideals is only newly emerging, this work is significant in that it identifies an engaging and accessible means for educators to deepen their critical perspectives and undertake agentic activities that work against hegemonic patterns of discourse in schools. By locating social justice work in the critical analysis and purposeful re-shaping of mathematics contexts, this work broadens the field of opportunity for creating a more democratic and critical liberatory pedagogy (Freire, 1982; Frankenstein, 2009). The initial findings from this research suggest that given a supportive and collaborative forum, educators may be equipped to challenge the oft-replayed examples used in mathematics education and craft new and more socially just substitutes.

In exploring how engaging in this activity changed the thinking and professional practices of participants, several themes emerged. Initially, many participants expressed a sense of disappointment or shame at never noticing the preponderance of “troubling” math problems before. Once beyond this initial wave of guilt, some participants expressed outrage aimed in two directions: first, outrage directed at their own teachers for never identifying or challenging the hegemonic examples in textbooks and problems, and second, outrage directed at the authors, editors and publishers of the materials. However, most participants recognized that understanding of hegemony and the insidiousness of cultural reproduction is not part of the common conversation in mathematics education— if anything, it’s avoided. Pennycook (2006) explains, “Any model of relation between language and society will only be as good as one’s understanding of society” (p. 117). For authors, editors and publishers who have never been asked to consider their work through the lenses offered in this paper, the problems identified as classist, sexist, heterosexist, racist, xenophobic or consumerism-oriented seem only natural. So where do we go from here, if anywhere?

First, and perhaps most obviously, I believe that as educators, we should strongly consider broadening our lenses to consider how different kinds of frames (math contexts) may be interpreted and experienced by our students. What seems normal or neutral to me may be foreign, uncomfortable or even offensive to my students. But of course, this raises the concern with meeting the needs of all learners—how might I possibly account for and incorporate the range of conflicting and possibly confusing perspectives shared by my students? At root, I posit that the solution to this is to know one’s students, and to create a classroom climate wherein challenging the status quo is accepted, normalized and encouraged. Educators can create classroom climates wherein it’s normal for students to make note of what sits uneasily, to call out what may be seen as classist or sexist or racist, to identify and respond to what feels oppressive or colonizing in some way—even if these thoughts and ideas aren’t at the point they can be fully articulated and outlined. Perhaps we can

craft classroom communities where it's all right and normal to say "I feel uneasy about this, and although I can't exactly say why, there's something about it that feels wrong or off." Setting this space, where the students are authentically agentic, may provide educators with insights into how they might re-shape the mathematics contexts we ask students to engage with. In other words, this iterative process may better equip teachers to select more appropriate problems in the first place.

I posit that from this centering of the student's lived experiences, this centering of student voices, careful listening may provide educators with rich educational opportunities to expand their understandings of the kinds of things students notice, the kinds of things students bristle at, and the kinds of things students identify as problematic. Thus, this situation may set up a scenario in which teaching is symbiotic, and in the purest Freirian (1973) sense, the students inform the teacher and the teacher responds in kind, making better selections for the students the following year. Also, by asking students to intentionally re-shape their own curricular materials, their level of engagement with the actual content (as the need for fidelity to actual mathematics objectives will remain) may in fact deepen student understandings—for example, when recrafting a problem about calculating the perimeter of an irregularly shaped room, it will be important for the student to present another context that focuses on the same mathematical objective. This may serve to benefit the students even more deeply than by simply completing the assigned problems.

Additionally, with this kind of grass-roots focus on the contexts presented in mathematics, it's entirely possible that a class of students (or even individual students) may wish to reach out to textbook authors and curricular material publishers with specific feedback on the ways their examples and wordings may be unwelcome or unsettling for students. This may, in turn, help to reshape the overall quality of examples textbooks choose to include.

But what about those who argue that students need to see many examples from different walks of life, that students need to experience "aspirational" values through the modeling showing in mathematics contexts? Although these ideas may seem, at first pass, to be noble, they may in fact embody "white savior" (Titone, 1998) thinking, wherein caring about students is conflated with encouraging and fostering assimilation into the teacher's (typically middle-class, mainstream) ideals.

As the literature on the ways current mathematics discourses may serve hegemonic ideals is only newly emerging, my hope is that this work may serve as a model for others to build and improve upon in that it identifies an engaging and accessible means for educators to deepen their critical perspectives and undertake agentic activities that work against hegemonic patterns of discourse in schools. By locating social justice work in the critical analysis and purposeful re-shaping of mathematics contexts, this work broadens the field of opportunity for creating a more democratic and critical liberatory pedagogy (Freire, 1982). The initial findings from this research suggest that given a supportive and collaborative forum, educa-

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