

Interdisciplinary Connections: Teaching Mathematics for Social Justice and Financial Literacy

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Abstract

The authors argue for a broad mathematical literacy, and explore mathematical practices which concern personal finance and social justice issues. They base their claims on a review of literature that looks at connections among these three areas. Postulating the intersections among these areas, the authors claim that by understanding the connections among mathematics, financial literacy, and social justice, mathematics teachers may revitalize mathematics teaching and learning, such that it develops students' broad views of social issues, and it realizes their capacity for initiating social change.

Keywords: mathematical literacy; financial literacy; interdisciplinary connections; social justice issues

Introduction

The development of critically thinking democratic citizens requires education of children and adults who interpret and articulate the numeric representations of the social relationships that they experience (Paulos, 1988). Unfortunately, “most U.S. high school students leave high school with quantitative skills far below what they need to live well in today’s society”

(Quantitative Literacy Design Team, 2001, p.1). One may attribute this situation, in part, to the educational disconnect of mathematical areas, such as geometry, calculus, algebra, and trigonometry, from the life experiences that student encounter outside the school setting. This quantitative knowledge is useful on both a personal and societal level. People use this numeric information in choosing a telephone plan, a car, home appliances, in paying taxes and/or mortgages, in investing money, in analyzing nutrition labels, in considering voting patterns in a state, etc. (Orrill, 2001; Wiest, Higgins, & Hart Frost, 2007). More importantly, people need this knowledge to realize and reframe the mathematical relationships that undergird patterns of social injustices of their daily contexts. Mathematics represents an essential component for interpreting principles of economic reasoning that guide patterns of argumentation which justify existing social structures and positions.

For example, the profits reaped by corporate clothiers that provide various brands of apparel labelled as affordable to affluent consumers may accomplish such processes through the exploitation of workers through small wages and inhumane working conditions. The mathematics of this situation would be interpreted from a perspective of (1) measuring the cost savings of the consumer, (2) examining the profit maximization of the corporation, and/or (3) the contemplating the mathematics of the human suffering experienced by workers. Interpreting the first two perspectives in isolation or in tandem presents an unjust analysis that ignores the mathematical reality of the third viewpoint. Certainly, quantitative literacy represents a necessary component of these processes, yet the process requires a social orientation that considers all perspectives of the economic relationships to qualify as education for democracy. Teaching mathematics for financial literacy and social justice reframes the learning focus of the analysis such that it provides voice to the underprivileged.

In this paper, we provide a literature-based theoretical framework that associates preservice and in-service teachers' mathematical literacy with interpretations of personal finance and social justice. We argue that a complex notion of mathematics literacy extends to other disciplines, for the development of informed critically thinking citizens. Financial decisions that involve compassionate underpinnings and consider the systemic outcomes of related choices represent essential components of this participatory environment. A socially just setting that equitably benefits all members necessitates an element of community stewardship that respects individual freedom yet challenges systems of inequity rooted in self-promotion and greed.

Preparing teachers who realize and convey the interfacing among the areas of mathematics, financial literacy, and social justice may foster the creation of an environment of humane social structures, founded on compassion for individual human needs. This courage to illuminate complex numeric associations with social injustices correlates with social power, as individuals can improve the quality of their lives through informed financial decision-making (Orrill, 2001). In a socially just society, individuals “have similar preparation for participation” (Wiest et al., 2007, p.51) as citizens and consumers, possessing the necessary skills to understand and critically interpret the numeric data (Malloy, 2002).

When teachers realize the transformational power of associating mathematics with complex social relationships, they may teach their students broad notions of financial literacy (Lucey, 2012) that represent tools to empower students who have been historically “disenfranchised from key roles in society” (Wiest et al., 2007, p.50). Through these processes, teachers may both affect social change, and support their students to become agents of change. Teachers and students can accomplish this process when they examine various social problems, engage in authentic situations that involve critical thinking and reflective skills, and pursue

community engagement (Muller, 2008; Planas & Civil, 2007). Yet these conversations may be lost on students (1) who have not yet had the opportunity to learn the mathematics necessary to fully appreciate them, (2) who have simply given up on an educational system that does not seem to care (Brantlinger, 2008), or (3) who have not experienced the life experiences to realize the need for social change.

Literature

In this section, we describe the results of a literature review that considered mathematical literacy, financial literacy, and social justice issues, and postulated their intersections. We searched the following electronic databases to conduct the review: (a) the Eric database, (b) the Education database, (c) the Ebsco database, and (d) the Proquest Dissertations database. In searching these engines, the researchers included as restrictions only full-text articles published in peer journals since 1985. These databases were searched using the following terms: (a) mathematical literacy and (b) financial literacy. In addition, the researchers combined the following terms: (a) mathematics and social justice; (b) mathematical literacy and financial literacy, and (c) mathematics, social justice, and financial literacy. Texts and edited works that contained literature on these topics were also sought.

It is recognized that the terms used in the research may have shaped the patterns of works reviewed. The authors understand the limitations using the above words and combinations of words, as informing scholarship may have been unintentionally overlooked. Although these searches generated a few hundreds of articles, the following sources fit the purpose of this manuscript and were included in this review: thirty-eight articles, twenty-one books, twenty-six book chapters, 7 Dissertations, 1 Masters thesis, and four websites: The Programme of International Student Assessment (PISA), the Jump\$tart Survey Coalition, Child Finance, and

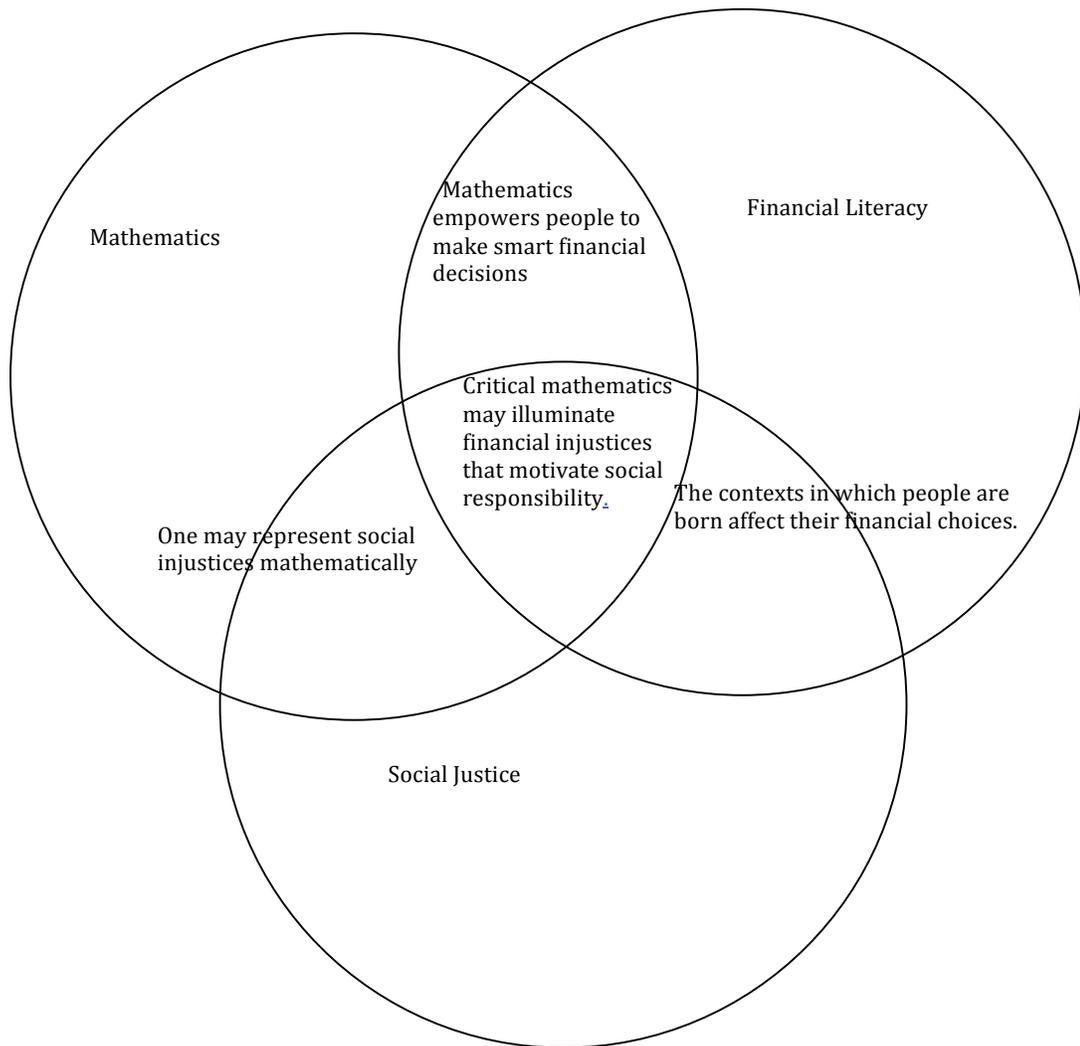
Radical Math.

Theoretical framework

In this paper, we present the argument for a broad mathematical literacy that views mathematics as a tool to reframe social perspectives of economic thinking. It explores the relationships of mathematics with understandings of personal finance and social justice issues as depicted in Figure 1. It is important to prepare mathematics teachers who (1) recognize the association of mathematics to social phenomena, (2) acknowledge the bias associated with a neutral perspective of social relationships, and (3) meet the challenge to engage students in mathematically-based dialogue that challenge capitalist notions and resultant patterns of injustice. By conceptualizing the relationships among mathematics, financial literacy, and social justice, it may be possible to revitalize mathematics teaching and learning for students of disenfranchised populations, such that it validates their views of society and offers a mathematical basis to support their arguments for initiating social change. In the following sections, the authors define mathematical literacy, financial literacy, and social justice issues, and further describe the relationships among mathematics, financial literacy, and social justice.

Figure 1

Interrelationship Among Mathematics, Financial Literacy, and Social Justice



Mathematical literacy: Narrow and broad views

Researchers (e.g., Carnevale & Desrochers, 2003; Gellert, Jablonka, & Keitel, 2001) speak to the societal divide between experts and lay people in regards to mathematics knowledge: “The wall of ignorance between those who are mathematically literate and those who are not can threaten democratic cultures...the mathematically illiterate are outsiders...” (Carnevale & Desrochers, 2003, p. 29). We posit that mathematical literacy represents a

prerequisite skill for interpreting social/cultural contexts. Decision-makers employ mathematical concepts and relationships represent physical objects, their associations, and interactions. The teaching of mathematical theory and processes in isolation from these phenomena does not provide students with authentic learning opportunities.

This knowledge gap represents part of the difference between simple and complex notions of mathematics, the manners by which they are taught, and the social messages that they infer. Simple notions of mathematics occur through rote learning processes that foster formulaic understandings of mathematics. Students learn to solve mathematical problems by practicing the mechanics of numeric calculations and solving isolated problems that demonstrate their application of learned processes. Complex notions of mathematics develop through the application of mathematical calculations to real world phenomenon. Students learn mathematical processes by examining the numeric properties of social or scientific phenomena through social or scientific inquiry and considering the mathematical patterns evident.

Kaiser and Willander's (2005) hierarchical classification of five mathematical literacy levels formalized the contrast between simple and complex notions. According to this framework, individuals occupy positions of (1) illiteracy (ignorance of basic mathematics concepts), (2) nominal literacy (minimal understanding of mathematical terms and concepts, accompanied by misunderstandings), or (3) functional literacy (procedural knowledge in solving simple problems). The fourth and fifth levels conceptual and procedural literacy (some understanding of central mathematical ideas); and multidimensional literacy (contextual understanding of mathematics incorporating philosophical, historical, and social dimensions) represent a broad mathematical literacy.

When mathematics classrooms provide learning conditions that reward students for

formula memorization and mechanical processing they prevent students from considering the application and analysis of mathematical presences in their communities. Literature raft with examples of rote learning processes in schools that serve underrepresented students attests to conditions that (1) discourage questioning and dialogue about mathematical processes, (2) dismiss culturally relevant pedagogies that are consistent with students' learning needs, and (3) ignore vehicles for interdisciplinary learning that the community offers (e.g., Kozol, 2005). In these settings, students give-up on public education because school environments teach about a system that does not value their social perspectives or higher level thinking abilities. Through The Programme for International Student Assessment (PISA), the Organization for Economic Cooperation and Development (OECD) defined mathematical literacy as:

An individual's capacity to identify and understand the role that mathematics plays in the world, to make well-founded mathematical judgments and to engage in mathematics in ways that meet the needs of the individual's current and future life as a constructive, concerned and reflective citizen (OECD, 1999, p. 41).

Mathematics literacy involves an element of cultural relevance. Meany (2007) defined mathematical literacy as "the application of mathematical understanding in the real world" (p. 681). This process enables the individuals to recognize the sophisticated mathematical relationships that undergird the structure of the social world and contribute to decision-making in their field, through the interpretation of numeric relationships in their environments, "by giving them tools to think for themselves, to ask intelligent questions of experts, and to confront authority confidently" (Steen, 2000, p. 2).

One develops different social conceptions from the mathematics of comparison shopping to purchase a gallon of milk and the long-term benefits of paying for additional transportation to

escape a food desert. A challenge for low-income children lies with the potentially limited life vision that discourages their engagement in the thinking about long-term mathematical variables. Mathematical literacy provides the ability to recognize relationships among phenomena that may not otherwise be considered. For example, straight-line correlations are commonly employed to depict the relationships between phenomena. These lines are represented by the formula $y = mx + b$, where y represents the y coordinate, x represents the x coordinate, m represents the slope of the line, and b represents the intercept of the y axis. This formula represents a conventional relationship that students may easily memorize. It is useful in regression analyses that presume correlation relationships.

Yet a straight-line relationship that exists for a short duration can also be indicative of a different type of relationship between phenomena, for example one that is curvilinear. The straight-line relation appears for an interval and may conceal a different relationship that occurs over an expanse of data. Within personal finance, one may observe this curvilinearity in the compounding of interest, which appears as a straight line over the short term, but for which curvilinear growth occurs over longer terms. Finding the formula may require use of a quadratic equation $y = ax^2 + bx + c$, exponential formula, or an element of calculus.

Being mathematically literate allows for the exploration and discovery of relationships among various numeric representations, and this constitutes an empowering state (Wiest et al., 2007). Employing social inquiry as a mathematical learning strategy invites learners to recollect and apply learning mathematical processes as they explore their social environments and develop mathematical meanings. Such exercises in social reasoning (prompt students to both apply the concepts relevant to their personal experiences and empower them to validate their understandings of their social experiences. Mathematical literacy represents a process that

involves more than recognition of mathematical relationships among physical phenomena because a process of recognition relates to patterns of conditioning that relate to examples provided in textbooks and classroom examples. A mathematics teacher who lacks a deep knowledge of mathematics as it relates to various social conditions may potentially harm the ability of a struggling student to achieve. Narrowly construed, mathematics emphasizes facts and generalizations. In their role of “sole authority of mathematics” (Koestler, 2011), teachers who lack a complex understanding of mathematics expose students to a fixed set of rules and procedures that must be memorized and later regurgitated, and they judge mathematics statements as right or wrong (Clemens, 1991; Koestler, 2011; Llyod & Frykholm, 2000; Philipp, 2008; Ward et al., 2010). This perspective interprets mathematics as a discipline of its own, consisting of algebra, geometry and calculus, having “no relation with people and their everyday lives in society” (Valero, 2009, p. 237). Teachers form these beliefs through their own K-12 mathematics learning experiences (Aguirre, 2009; Garmon, 2005). These processes prepare them for college, where as students they memorize rote procedures and skills which have little, to no real life applicability (Gutiérrez, 2002; Haberman, 1991). Because they learn to view mathematics and its teaching/learning as mechanical exercises removed from their daily experiences, absent alternative stimuli to demonstrate otherwise, they repeat patterns of knowledge and thinking that portend uncritical and thin views of social mathematical structures (Jablonka, 2003). When teachers emphasize a procedural approach to mathematics, presenting it in isolation from other subjects, with little relational processing to the outside world, they employ similar conceptual emphases in their practice, forcing their students to focus on learning mathematics terminology, rather than solving meaningful tasks (Gutiérrez, 2002).

Thus, students lose the mental agility to adapt mathematical reasoning to make sense of

the various social contexts that they occupy and the conditions that prompt them to occur. In turn, students experience difficulties recognizing the “connections between big ideas in mathematics, and, while many develop procedural fluency, they often fail to realize how these procedures might be applied in unfamiliar problem contexts” (Brantlinger, 2007, p.20). This simplistic view of mathematics ultimately reproduces inequalities in gender, class, and social economic status: “Many students do not view mathematical knowledge as something that can be created and owned by themselves. Basing a curriculum upon an alternative vision calls for changing the mathematical content as well as the societal relations that are established by traditional teaching methods” (Jablonka, 2003, p.85).

On the other hand, if teachers realize that mathematics is culturally situated and contextual (Darling-Hammond, French & Garcia Lopez, 2002; Nasir, Hand, & Taylor, 2008), being an integral element of *all* students’ daily experiences (Steen, 2000), they have the potential to build upon students’ backgrounds and experiences and center instruction around those experiences. Examples of such experiences may include, among others, unequal resource distribution and school segregation (Brantlinger, 2007; Gonzalez, 2008; Peterson, 2006). As Muller’s (2008) stressing that “Mathematics can be worth the time and attention of the students if it is relevant to the students’ lives” (p.15) points to the potential rewards that result from a deliberate process that allows students opportunity to discover the mathematical realities of their own social perspectives, rather than receiving the imposition of an abstract concept that holds little social applicability to their daily experiences.

One may examine the intersection of these three areas in critical mathematics (Gutiérrez, 2002; Gutstein, 2006), which enables students to use mathematical knowledge to view social realities in manners consistent with their perspective (Jablonka, 2003; Skovmose & Nielsen,

1996). A complex understanding of mathematics founded upon the social realities that students experience offers potential to empower students who resist mathematics learning because of its perceived social irrelevance. To help students examine their perspectives of issues of power, agency, and oppression, teachers should provide them with skills to critically interpret mathematical and financial theories by centering the curriculum around issues that involve social injustices, and use their life experiences as scaffolds (Koestler, 2011) to validate social understandings that may challenge the status-quo.

This manner of social vision may help students to develop the mathematical literacy necessary to affect critical action inside and outside of the classroom (Ellsworth, 1997; North, 2008; Parker, 2003), and become agents of change (Gutstein, 2003, 2006). For example, students may discuss economic issues through the analysis of unequal resource allocation, the estimation of what the money for one B-2 bomber would mean for the college education of Latino/Latina students (Gutstein, 2003), the calculation of the minimal hourly wage needed by a single parent with two children to live above poverty (Wiest et al., 2007), or the investigation of overcrowding at a middle school in a predominantly minority neighborhood (Turner & Strawhun, 2005).

Financial literacy: Narrow and broad views

Studies repeatedly indicate that American youth are financially illiterate (Lucey, 2002; Mandell, 2008, 2009). While advocates of financial education recognize the need to improve the financial education of youth (Beverly & Burkhalter, 2005; Greenspan, 2005; Martin & Oliva, 2001), many surveys indicate that youth lack the basic knowledge and skills to develop or maintain financial wellness. Mandell's (2008) analysis of the Jump\$tart Coalition survey data found that youth from households in which parents' income was less than \$20,000 per year consistently scored lower on the Jump\$tart 1997, 2000, 2002, 2004, and 2006 surveys than did

those who came from households that had higher incomes. One explanation for these disparities may relate to the measurement of financial literacy. Lucey's (2005) indication of social bias in the survey would suggest that it measures relevant terms and practices familiar to members of one social context but not necessarily others.

Construed as knowledge necessary for building ownership of material wealth, conventional conceptions of financial literacy differ among individuals of various economic contexts. For example, an individual of vast financial means may focus on his or her conceptual wealth as grounded in holdings of financial investments. An individual of measure resources wrestles with obligations to finance companies and personal lenders who charge exorbitant rates. This view of financial literacy assigns individuals the responsibility for their own behaviors. The financial decisions they make, wise or imprudent, represent matters of pure choice.

A broader interpretation recognizes financial literacy as a concept applied to society holistically, rather than presenting one social group as a model. This view acknowledges that social position results from the situation one experiences at the time of one's birth and is not entirely related to choice (Lucey, 2012). From this perspective, the contexts in which people are born shape environments of financial choices they experience, refuting the notion that people solely are responsible for the financial decisions they make.

In the board view, the underlying principle of financial literacy (or financial morality) lies in the sense of compassion for oneself founded on an inner sense of personal worth (Lucey, in press). Money represents a tool that complements this sense of worth; however, it does not provide its basis. Thus, as one values oneself and acknowledges his or her strengths and weaknesses, the need to control objects, such as money and people, decreases, enhancing the capability to be compassionate to others for their individual personal worth.

In a setting that emphasizes a global social awareness, financial literacy lacks a sense of compassion necessary to affect responsibility that acknowledges the environmental influences on familial origins, resource access, and power control, and discounts the relevance of authentic communication among all societal members (Diamond, 1999; 2005; Lucey, 2012; McGregor, 2010; Sandlin & McLarin, 2010). At the same time, one should critically examine the language of financial literacy and the social control that it encourages. For example, the notion of financial opportunity may be construed as financial exploitation of another. The profit maximizing/expense reducing measures of a corporation result in unemployment for a community. Taken in broad social view, existent thin financial literacy perspectives use accumulated wealth as a benchmark indicator for social success and expertise that lacks a firm social legitimacy aside from self-promotion.

A deficit model of financial literacy that blames poverty solely on poor financial skills ignores the effects of social institutions that perpetuate conditions that justify a small percentage of the population's control of great percentages resources. This "thin" view of financial literacy rationalizes poverty through an emotional screen of greed and control. The thick view opens thinking to a recognition of the unfairness associated with a merit-based approach to financial management and through care and compassion, acknowledges the social patterns of financial manipulation that occur, and realizes the need to balance accumulation with stewardship.

Social justice practices

Freire's (1970/1998) liberatory approach regarded education as the tool to serve the struggles of marginalized students and teachers, assign teachers with the responsibility to help students create their own worlds, and reflect on their lives using a political lens in order to develop agency and to fight social injustices. This may happen through problem-posing

education, which “posits as fundamental that people subjected for domination must fight for their emancipation” (p. 62). Problem-posing learning interprets the learner as a processor of information, engaging him/her in critical social thinking. Critical mathematics is an example of problem-posing learning. When teachers enable their students to look at the world through mathematics lenses, their students realize examples of social injustices in their contexts, and engage “in purposeful action to challenge those inequitable structures” (Gau Bartell, 2005, p.7). In order for students to become agents of change, they “need to understand more deeply the conditions of their own lives and the sociopolitical dynamics of their worlds” (Gutstein, 2003, p.38). Students develop this sociopolitical awareness through questioning and analyzing the society they live in, and criticizing the world “in an effort to change it” (Gau Bartell, 2005, p.9).

A similar approach to the Freirean liberatory education is the African-American education for freedom (Perry, 2003). The teacher’s role in this method is to “create conditions for students to develop sociopolitical awareness and a sense of agency” (Gutstein, 2007, p. 424). From the perspective of underrepresented cultural groups, education is also a tool that educates people to fight social injustices. Consequently, if “addressing social justice issues should be the goal of all education” (de Freitas, 2008, p. 43), teachers in all content areas should enable their students to develop *consciousness*- that is, to critically understand and analyze the content they learn.

Despite its popularity with teacher education programs that emphasize social justice education as part of their curriculum (Cochran-Smith, Shakman, Jong, Terrell, Barnatt, & McQuillan, 2009), critics have contended that the term social justice is vague (North, 2006; Zeichner, 2006). In her conceptual framework for social justice education, North (2008) discusses the tensions among various social justice perspectives, drawing attention to the fact

that a single approach to social justice may not be effective “for all the students in all contexts” (p. 1193). North distinguished between three spheres of social justice: redistribution and recognition, macro and micro, knowledge and action. At the first level, redistribution referred to the demands for an equitable share of wealth and power, while recognition related to the claims for respect and dignity of the different cultural groups (Fraser, 1997; Fraser & Honneth, 2003). However, North (2008) contended, “neither recognition nor redistribution alone can make education more socially just. Students require both respect and adequate social goods to develop, pursue and achieve their academic life goals” (p. 1185).

The second sphere distinguished between the macro level-institutionalized procedures involving decision-making for school management, curriculum, policy development- and the micro level- the relations between staff and students (Lynch & Baker, 2005). North (2008) critiqued this approach, as it failed to look at how relationships within these two levels “promote or destabilize socially just forms of education” (p. 523), and she advocated the use of a both/and approach by examining the citizens’ political participation at these two levels inside and outside the US borders (Newmann, 1981).

The third sphere discussed the debates between knowledge and action. Is teaching students how knowledge is produced going to lead them to action (Banks, 1995; King, 2004), or is by involving students in action providing them with a critical base of understanding (Anyon, 2005)? Social justice education reaches its goal- to develop political consciousness- when teachers provide students with the critical knowledge to understand social injustices and when they engage students in critical action (Ellsworth, 1997; North, 2008; Parker, 2003). Moreover, North (2008) argued for a critical examination of institutionalized beliefs and practices, as “student empowerment and unlearning oppressive beliefs and practices require more than

knowing how to think critically or act politically because fears and desires- and the performance of them- influence what we are willing to learn and do” (p. 1191). North concluded that one single approach to social justice education was not effective for all students, and further explained that teachers needed to use “multiple pathways to create politically engaged, critically aware citizens” (p.1193). This could be accomplished through engaging the students in critical mathematics, and teaching them to use mathematics in context, to understand, question, and challenge social injustices.

Underlying the argument of whether education does or does not represent a process to affect social justice lies within the emotional framework that shapes patterns of rationality for justifying teaching and learning. If education represents a process of control for producing workers for business, as advocated through essentialist curricular frameworks (such as Common Core), which emphasize standardized communication and numeracy processes with little regard to content knowledge, the answer is clearly that it does not. If education represents a compassionate process for enlightening all members of the public with knowledge to fully participate in a critically thinking democracy, the answer is that it does. Existing processes resist adoption of Banks’ (2006) transformational approach to holistically examine sources of cultural conflict and realize the injustices that brought about patterns of cultural dominance that currently exist.

Compassionate approaches to social justice reframe patterns of discourse away from the notions of the dominant culture. Rather than considering social justice as a determinant of wealth and power structures, respect for oneself takes precedence over world domination. In the following sections we consider how mathematics and financial literacy relate to this perspective.

Interdisciplinary connections

The previous sections described the narrow and broad views of mathematical literacy, financial literacy, and social justice practices. In this section, the authors analyze the interdisciplinary connections between mathematical literacy, financial literacy, and social justice issues, discussing the need for teachers to understand the mathematical underpinnings of personal finance, and to teach their students the mathematics of finance, thereby empowering marginalized students to change their status quo and to lead more successful financial lives.

Mathematics and social justice.

A social justice approach to mathematics education may occur through (1) the realization that mathematical processes may represent tools to illustrate the patterns of human marginalization and exploitation, (2) the acknowledgment of alternative theoretical groundings that give legitimacy to such formulations, and (3) the application of groundings in examining such social relationships.

One may represent social injustices mathematically. The methods by which students learn mathematics greatly shape their abilities and willingness to realize the mathematical underpinnings of social injustice and, thus, appreciate the complex numeracies associated with affecting social change. Brantlinger's (2013) work with high school youth brings into question whether the conditions of secondary education may allow for critical mathematics to affect student learning. If teachers view mathematics in a simple sense, they teach their students the procedural aspects and formulas to be memorized. This approach inadequately prepares the individuals for their personal and vocational lives because students lack the ability to apply their mathematics to real-life contexts (Wiest et al., 2007).

When students learn the complex mathematics associated with social phenomenon, they become empowered in advanced social decision-making. Mathematics has been traditionally considered the gatekeeper to future success (Esmonde, 2009; Gutstein, 2006; Martin, 2000; 2003), as it “plays a role in governmental and corporate decision making, and these decisions disproportionately affect marginalized people - the very people who are less likely to have access to quality mathematics education” (Esmonde, 2009, p.1008). When teachers understand and value the connections between mathematics and social phenomena, they can use mathematics as a tool to motivate their students to address social justice issues (Gutiérrez, 2002; Leonard, Brooks, Barnes-Johnson, & Berry, 2010; Wiest et al., 2007). With this mindset, the teachers prepare their students to participate as informed consumers and citizens (Malloy, 2002), advocating a more just society (Gonzalez, 2009).

The significance of a complex mathematical literacy based on compassion lies in its role in including financial education to expose the patterns of social injustice obscured through emphasis on education approaches that limit facts to those that glorify the principles of responsibility and reward. As critical educators, teachers may empower marginalized students to discover relevant mathematics that expose the culture of greed and exploitation, by investigating numerical information from a large variety of sources, understanding alternative viewpoints, and applying critical thinking and decision making to disseminate this information (Koestler, 2011; McLaren, 2003; Wiest et al., 2007). Students assume a more active role, as they “understand their own power as active citizens in building a democratic society” (Radical Math, 2007).

The ability to manipulate the use of numbers to explain social behaviors and conditions correlates with power. The knowledge of mathematical operations enables the acceptance of marginalized students into certain mathematically-based fields and careers considered more

prestigious, such as computer-oriented careers: “of all the disciplines, mathematics is most likely to hinder progression towards further and higher education and employment opportunities” (Noyes, 2007, p.4). When marginalized students learn the rules of the culture of power and they develop the skills to escape contexts by adapting the rules of social exploitation that once oppressed them, they become empowered to change their status quo (Delpit, 1995; Gutstein, 2006; Ladson-Billings, 1994; Leonard, Napp, & Adeleke, 2009). To understand their own role as agents of change, and instill the same vision in their students, teachers need to (1) recognize the systems of injustice that marginalize underrepresented students, (2) possess firm knowledge of the mathematical operations to apply them, and (3) experience the efficacy to initiate and pursue instructional processes that foster student inquiry of connections between mathematics and social justice issues and to use their classrooms as places to examine social injustices (Gonzalez, 2008, 2009; Gutstein, 2003, 2007; Leonard et al., 2009).

Mathematical literacy and financial literacy.

In Figure 1, the authors presented a diagram to illustrate that mathematics literacy and financial literacy empower people to make smart financial decisions Research (Brenner, 1998; Lucey & Maxwell, 2009; Maxwell, 2008) also documents the interrelationship between mathematics and financial education, viewing mathematics as a tool to empower individuals to make sound decisions regarding the ways they spend their money. Most teachers would acknowledge the interrelationship between mathematics and personal finance, and specifically that “financial literacy lies in mathematics in the real world and in the contexts of their students” (Maxwell, 2008, p.161). Without a proper financial education, children can be vulnerable in the marketplace, as they “are greatly influenced, from an early age, by the social environment in which they live” (Martin & Oliva, 2001, p. 26).

The ability to view potential long-term effects of financial decisions represents a powerful skill. Mathematical and financial literacy are intimately connected, as mathematical formulas illustrate the social relationships that motivate and extend from financial decision-making: “the foundation of financial literacy lies in mathematics in the real world and in the contexts of their students” (Maxwell, 2008, p.161). Knowledge of the mathematical complexities that define social and financial structures empowers individuals with a deep understanding of mathematics.

It may be suggested that a thick view of financial literacy *is* social justice; however, one should not ignore the affective element that shapes the patterns of cognition for interpreting the perspective. Taken in a narrow sense, financial literacy involves the knowledge and skills related to the management and hoarding of money for future private use. The practice is largely transferred generationally through familial communication. Patterns of discourse related to money differ among populations (Farnsworth, 2012). Broad views of financial literacy lower the barriers to discourse by informing about the social implications of financial choices and affect one’s social position.

Arthur (2012) argues that an overemphasis on mathematical operations in financial literacy distracts from the social/political agenda fostered through capitalist philosophies. Using mathematical emphases to foster students’ wealth building skills perpetuates the systemic patterns of classicism and exploitation that permeate society. Comparisons of two individuals who earn different income amounts and save the same percentage of earnings illustrate how basic savings principles do not breed economic parity. Further, providing two individuals with similar amounts of earnings does not provide an assurance that individuals will pursue similar financial decisions or outcomes.

By developing a repertoire of wide and deep mathematics knowledge and skills, as well as broad notions of financial practice founded on moral principles, people may conceive of the numeric relationships beyond the financial transactions that convey social injustices. Thus, the cost of mathematical relationship extends beyond the pocketbook cost of a McDonald's Big Mac. The purchase decision relates to the manners by which McDonald's raises its cattle, respects its farm suppliers, and treats its employees. By reframing classroom conversation so that children recognize the broad social consequences of their financial decisions, children may develop behaviors that foster more compassionate lifestyles.

Developing children's cognitive potential to view the social complexities that underlie the numeric representations presented in financial accounts provides an antidote for the cosmetic illusions that conceal unjust power structures. Jahoda's (1979) demonstration of children's abilities to learn about different economic systems, yet who encounter difficulties realizing the systems' interconnectedness illustrated the abilities of youth to conceptualize abstract social concepts and the importance of teachers' clarifying associated relationships. The authors of this paper argue that mathematics learning environments offer potential to respect the diverse views and abilities of all learners to analyze and evaluate information to create new social ideas. Critical mathematics values creativity, not only uncovering different social views of mathematical relationships, but generating new conceptions of mathematics.

Financial literacy and social justice.

When considering the overlap in interpretations of financial literacy and social justice, it becomes apparent that contexts in which people come into life affect their financial choices. As conventionally defined and measured, financial literacy involves a bias towards skills and knowledge of upper economic class populations (Lucey, 2005, 2007). Recent literature (Lucey,

2012a; Lucey & Cooter, 2008) argues that in its fullest meaning, financial literacy involves more than the acquisition, management, and growth of money. Because financial transactions are representations of human decisions, social intentions and consequences are necessary elements of understanding the processes. Thus, financial literacy involves a moral element that compounds patterns of decision-making.

As Carr (2008) differentiated between “thick” and “thin” views of democratic citizenship, Lucey (2012) referred to “thick” and “thin” views of financial literacy. The thin or narrow perspective represents a traditional interpretation that construes financial decision-making as a matter of choice. This perspective holds that as individuals are responsible for their own behaviors, financial problems represent the consequence of bad decision-making. Lucey (2012) argued for a broad view of financial literacy that includes an element of fate. This position claims that financial choices occur with contexts that relate to the conditions people are born into. Thus, a person born into an impoverished household with a single mother experiences different financial decisions than one born into an affluent household with two cooperative parents. This fate or chance element dispels the notion that people are solely responsible for their financial choices. Caution needs to be taken however, with the use of the word “fate,” as the extreme wealth inequalities in this country may appear as no one’s fault. This idea directly undercuts social justice efforts.

One should also guard against a conception of fate that absolves one from his or her responsibilities for social justice. Lakoff’s (2004) distinction between individualist and caring social conceptions illustrates the different manners by which one may interpret a fate-based view of financial literacy. The view presented herein assumes a nurturing perspective. Fate assigns the responsibility of caring for the less fortunate to those who are materially fortunate. It dismisses

the idea of merit as contrived, and recognizes that social status relates to contexts of one's origins, not necessarily efforts to achieve. A socially just setting acknowledges that financial decisions are not matters of pure choice, that financial wealth accumulation is purely not a matter of merit, and that society has a responsibility to create a just environment where all have equal opportunity to the resources to develop their financial wellness.

Lucey, Laney, and Agnello (in press) propose a compassionate approach to financial literacy in which personal worth, rather than financial worth, provided basis for financial reasoning. In this view, regardless of one's financial status, one experiences a sense of worth simply because of his or her experiences with his or her strengths and weaknesses. Recognizing that he or she did not chose his or her life origins; he or she acknowledges those who value him or her for who he or she is. Financial literacy becomes a process of social justice because one founds financial decisions upon the principle of treating others as ends of themselves, rather than as means for personal gain.

Mathematical literacy, financial literacy, and social justice.

Critical mathematics may illuminate financial injustices that motivate social responsibility. If a broad mathematical literacy instills the responsibility to respect human dimensions of financial practice, then social justice represents a necessary element of that association. When teachers frame mathematics as a tool for conceptualizing the fallacies of merit-based financial thinking, (i.e. maximizing income, consuming selfishly, investing socially irresponsibly), they teach the social ideas that conveyed through basic mathematics skills.

Although literature discloses the connections between mathematics and social justice issues (e.g., Gutstein, 2003, 2006, 2007; Leonard et al., 2009; Leonard et al., 2010), and mathematical and financial literacy (Greenspan, 2005; Identifying Reference & Maxwell, 2009;

Maxwell, 2008; Morton, 2005), scarce literature concerns efforts to capture the interrelationship among these three very important content areas. Critical mathematics comprises elements of social agency and financial literacy (Frankenstein, 1987; Gutstein, 2003). Yet classroom textbook dependency limits its implementation. One may attribute this limited adoption of critical mathematics and social literacy to the resistance of dominant culture committed to a myth of merit. Vithal and Skovsmose's (1997) observation that :

...When large sections of the populace are not literate, let alone technologically and mathematically literate, and those in power make decisions which intimately affect everybody-about taxes, benefits, etc.-with the use of technologies based on complex mathematical modeling, a problem of democracy becomes urgent. This is a significant and critical problem that the mathematics education in every country must attempt to deal with (Vithal & Skovsmose, 1997, p. 144).

In its role of social technology, mathematics becomes a means to describe, and more significantly, to reconstruct reality. In an increasingly technological society, people act in systems that use complex mathematics to justify and rationalize. As a result, people have to trust "a machine, a specialist or an institution" (Vithal & Skovsmose, 1997, p. 143). Such trust may be misplaced when its foundations relates to social myths designed to control and preserve structures that benefit a minority number of societal participants whose claims of merit lack universal applicability.

Trust founded upon care and compassion offers an alternative that respects the various perspectives that students offer. By providing safe environments in which students develop mutual empathy through shared vulnerability, mathematics teachers may encourage students' mathematical inquiry that offers an alternative financial perspective rooted in care, rather than

control. Such classroom processes may affect a social technology in which mathematics serves as a tool that empowers the voices threatened by extant voices of exploitation.

Niss (1983) previously discussed the democratic role of mathematics education, stressing the need to enable students “to realise, understand, judge, utilise and also perform the application of mathematics in society, in particular in situations which are of significance to their private, social and professional life” (p.248). Democratic approaches can disrupt efforts to affect socially just learning efforts if the majority harbors dispositions that reinforce or affirm biases in conventional social thinking. Contesting such tyranny of the majority may involve (1) discussion of all views and formulating solutions that integrate all perspectives and (2) utilization of random selection techniques for student involvement. If critical mathematics affects social change by reframing the goals of financial education, the educational application of critical mathematics may start with teachers engaging students in dialogues that examine their bases for personal worth and scrutinizing the injustice of a society that evaluates people on alternative bases.

Carnevale and Desrochers (2003) addressed the push for the “democratization” of mathematics when they argued that in order for mathematics to fulfill its cultural and economic role, it needs to become responsive to the needs of *all* students. This can be accomplished by integrating mathematics into other disciplines, matching the mathematics curricula to cultural, political, and economic goals. At college level, this change may take the form of interpreting graphs and solving multiplication and division problems to consider values systems of particular payment structures that transfer money from the poor to the rich (Frankenstein, 2005). In a high school class, while students examine the distribution of income in U.S. and other countries and learn about area, they develop a statistical measure of the income distribution, and engage in

dialogues about economic inequality (Brantlinger, 2008).

In a middle school class, students may explore employment statistics related to fastest-growing, highest-paying, and nontraditional occupations, by workers' age, educational attainment, and gender (Wiest et al., 2007). An elementary school activity may take the form of involving students to discuss the reasons fast food restaurants give out toys to children, analyzing who benefits from providing these toys to children, and who can/cannot collect these toys because of limited financial resources (Vasquez, 2004).

Nevertheless, “the curriculum rarely encourages students to link mathematics and history, mathematics and politics, mathematics and language- mathematics and people,” (Peterson, 2006), following “an isolated trajectory” (Carnevale & Desrochers, 2003, p. 21), and failing to prepare students to read the world with mathematics and to understand their role as agents of change. Brantlinger’s (2007) contention that “academic mathematics is a set of institutionalized, largely elitist, and mostly non-utilitarian practices that are linked to the culture of power in ways that lessen the school achievement and life chance outcomes of urban youth” (p. 349) conveys the social harm associated with existent mathematics teaching efforts..

Gutstein (2003) attributed this challenge to teach mathematics for social justice to the fact that when students and teachers are engaged in discussions that critique knowledge sources and question institutional practices, they “can threaten schools and authority” (Gutstein, 2003, p. 39). Gonzalez’s (2008) assertion that when teachers “see teaching as a political act and broaden their conceptions of what it means to teach mathematics and of their roles of teachers of mathematics and agents of change” (p. 1) conveys a teaching choice between preserving an unjust system under which they experience success and developing a system of compassion that cares for others and their social perspectives. By choosing the latter, teachers may enable their students to

mathematically articulate societal injustices, and develop agency bringing social awareness to the conditions and part of the solution to remedy these injustices (Koestler, 2011).

Complex mathematics requires an element of “Quantitative Literacy” to be associated with financial literacy and social justice. As expressed by Lucey and Giannangelo (2006), “an urban society comprised of culturally diverse populations should not ignore its multicultural financial learning patterns. Failure to do so leaves underrepresented socioeconomic groups at risk” (p. 269). When teachers engage students in authentic mathematical inquiry of social relevance, they validate their abilities to reason and solve problems, to ask questions and to critique their data, their students may become informed citizens and consumers (Malloy, 2002). As a result, students may strive to create a better life for themselves and their families, by solving problems that prompt inequitable societal situations and to challenge the practices of economic bullying that oppress the populations traditionally marginalized from society.

Conclusions and Implications

In this paper we provided a discussion of research literature that concerned perceptions of mathematics literacy, financial literacy, and social justice, along with their intersections. We believe that a culturally compassionate approach to mathematics literacy necessitates classroom processes that develop working awareness and inquiry into these relationships. Engaging in classroom dialogues and explorations the connections among mathematics, financial literacy, and social justice may prompt a vision of mathematics learning that fosters the development of justice-oriented citizens who realize that financial decision-making involves more than a confirmation of a maintained financial budget, it represents a statement about one’s basis for personal worth and the worth of other people. Because consumer decisions affect the social welfare of a global community, teachers should facilitate safe classroom environments that invite

student pursue of complex mathematics inquiry and permit mistakes that allow for empathy and acknowledge that financial status results from more than prudent choices. While mathematical relationships represent valid measures of depicting social phenomena, students should exercise care to ensure that pursue of mathematical correctness does not compromise social integrity. Facilitating learning settings that employ open dialogues, which equally respect all participants' contributions, models for students the importance of considering various perspectives to develop broad views of social issues.

We believe that this paper offers theoretical, scholarly, and practical bases of importance. Theoretically, clarifying the connections among these three areas offers an additional dimension to a critical view of mathematics as representing manner for exposing the merit-based system of financial accumulation as lacking substance. It offers a critical view of mathematical literacy that may empower underrepresented populations to legitimize their personal worth and perspectives and initiate dialogue to affect social change. The clarification of the connections between these three areas give legitimacy to efforts for critical financial and mathematical literacy as part of the curriculum. Teaching complex notions of mathematics based on practical phenomenon that occur within students' social spheres challenges economic bases for learning designed to produce workers for aims of the social elite.

The scholarly significance of this paper lies within the theoretical framework presented, and the call for research studies that explore its confirmation, modification, and/or rejection. Studies need to interpret how teachers perceive these relationships, how preparations shape these conceptions, and what may be appropriate responses to these findings. In addition, K-12 classrooms may consider the outcomes of strategies that prompt students' examination of these associations. Brantlinger's (2008) classroom discussion with urban high school students provides

an example for exploring issues related to mathematics, financial literacy and social justice issues, as students analyzed income distribution using statistics measures, and discussed economic inequalities. However, to affect these conversations, elementary schools should pursue efforts to teach complex notions of mathematics.

One strategy may occur through the examination of statistics provided by readily accessible data sources. For example, Schultz (2007) described a project wherein students investigated the social injustices associated with their dilapidated school building. Lucey and Grant's (2010) computer-based inquiry activity, which prompts students' associations of population distributions with patterns of corporate pollution, provides an opportunity for students to consider mathematical and financial relationships among data that may explain patterns of unjust living conditions. By fostering classroom explorations of student-selected real world problems and facilitating location and examination of real world data classrooms may use mathematics to challenge the social injustices that are perpetuated through an educational system that deters critical social analysis to maintain the societal status quo.

Finally, the practical significance of this work lies within the need to revitalize mathematics teaching as a vehicle for social justice. Such efforts may empower students to articulate the financial presence within mathematics, to validate the view of the world around them, and bring about social change. Teachers who engage their students in real-life projects that utilize critical thinking to answer questions "that will potentially empower their lives and their communities" (Leonard et al., 2010, p. 264) may enable their students to develop an identity as agents of change. This will prompt them to take a stand against "discriminatory practices and call into question actions that disadvantage them while privileging others" (Leonard et. al., 2010, p. 264).

Teacher education for mathematics should enable teachers' realization of connections between mathematics, financial literacy and social justice. Providing for a more compassionate and sophisticated mathematical literacy offers potential for a more cooperative societal community (teaching people), but it is also a matter of placing socially relevant numeric information in the hands of all people, allowing for more educated dialogue about mathematical representations of social phenomena. Discussions regarding how to connect in-school and out-of-school mathematics are ongoing. Research studies should continue to investigate practices that help the students understand the role of mathematics in a democratic society, where there are no victims due to the lack of mathematical knowledge, but informed participants in a political and economic system.

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