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Integrating social justice with mathematics and science: An analysis of student teacher lessons

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ABSTRACT

Student teachers have difficulty planning lessons that fully integrate social justice with mathematics/science content. This study was a content analysis of 26 poster presentations of mathematics or science lessons incorporating social justice issues made by student teachers (20F, 6M) at a mid-sized college in central New York State. The presented lessons applied four pedagogical approaches to integration (data collection followed by graphing analysis; discussion of text/video; modeling; library/internet investigation) and addressed three major social justice themes (diversity, system disparities in human communities, and in stewardship of earth). Deeper content knowledge, faculty lesson modeling/reflection and practice delivering lessons are recommended.

Changing demographic patterns in the United States suggest that new teachers are increasingly likely to teach students whose backgrounds are vastly different from that of the teachers themselves (Garmon, 2005). Social justice, which offers both students and teachers opportunities to recognize and begin to redress societal oppression and marginalization, is a powerful tool that, when used effectively, gives all stakeholders in schools opportunities to more fully participate and succeed in educational opportunities (McDonald, 2005). Yet many new teachers find that working in diverse classrooms is challenging (McDonald, 2008): effective functioning in these classrooms requires preparation, dedication, and a willingness to develop cultural competencies, make connections across communities, and engage in civic understanding (Garmon, 2005; Romo & Chavez, 2006).

Professional education programs do address these concerns directly, but most coursework focuses on creating classroom communities to ensure learning in diverse and multicultural settings (Garmon, 2005; Romo & Chavez, 2006). University coursework emphasizes the role of social justice within a pedagogical stance and student teachers – those students in the last year of their teacher preparation programs – embrace this perspective (Kennedy, 2006; McDonald, 2005; Tyson & Sung Choon, 2006). Yet social justice pedagogy, which gives weight to recognizing oppression and taking steps to foment change, is less valued in primary and secondary schools and many classroom teachers are not comfortable with or knowledgeable of social justice strategies (Westheimer & Kahne, 2002). Teaching for social justice raises questions in the classroom about the role of the school in society: are we preparing students to reproduce existing knowledge or to create new questions and new understandings? Teachers who incorporate social justice into their teaching create a classroom environment that, ideally, supports student inquiry into and understanding of inequitable power relationships in society while helping students become effective voices for change (Gutstein, 2007; Mayberry, 1998; Roth, 2007). These transformative educational goals are often at odds with traditional classroom practices that support and reproduce exiting societal values and expectations without deeply questioning the reasons underlying society's decisions (Barton, Tan, & Rivert, 2008; Gutstein, 2006, 2007; Mayberry, 1998; Roth, 2005).

Many new teachers, especially at the elementary school level, are not confident in their ability to teach the mathematics and science curricula mandated in their classrooms (Empson, 2002; Gerofsky, 2006; Hind, Leach, & Ryder, 2001) and they enter their professional practice with a limited and unsophisticated knowledge of the science or mathematics they will be teaching (Eaton, Bell, Greenwood, & McCullagh, 2006; Schoenfeld, 2007). Evidence suggests that these teachers express an overall discomfort, bordering on a fear of, the

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content and pedagogy of primary school mathematics (Goldman, 2007; Greshner, 2007). While science is "expected" to have room for some discussion (Mukhopadhuyay & Greer, 2007), both science and mathematics are understood to be a set of routinized, algorithmic practices that lead to a single, correct answer and neither science nor mathematics are assumed to be closely connected to real-world issues and concerns (Gerofsky, 2006; Mukhopadhuyay & Greer, 2007; Schoenfeld, 2007; Zevenbergen, 2000). For many student teachers, the mathematics and science curricula they are required to learn, understand, and ultimately teach, is overwhelming. Many will rely solely on the classroom textbook to guide their classroom practice (Herbel-Eisenmann, 2007; Schoenfeld, 2007), although the teachers' comfort with the mathematics and science will determine students' opportunities to experience and learn the content (Remillard, 2000, 2005).

While specific definitions of social justice vary, all include an underlying assumption of identifying and valuing diversity, recognizing oppression caused by differences, and taking action to alleviate injustice (Bigelow, Christensen, Karp, Miner, & Peterson, 1994; McDonald, 2008; Stables, 2005; Wise, 2006). Social justice also includes tying the academic content to students' own lives, recognizing that this will empower them within the contexts of their lives and communities (Bigelow et al., 1994; Gutstein, 2006; McDonald, 2005). Preservice and student teachers are expected to incorporate social justice practices into their lesson planning and are challenged to create content-specific units across all academic areas (Citadel School of Education, n.d.; David O. McKay School of Education, 2005; Pace University, 2004; SUNY-Oswego School of Education, 2004) to ensure that newly graduated teachers are able to incorporate diversity and fairness into their lessons and units (NCATE, 2002; Teacher Education Accreditation Council (TEAC), 2004). At the primary and secondary levels, the incorporation of social justice concerns is accepted as appropriate and (relatively) straightforward (Wise, 2006). Ultimately, it is hoped that these new teachers will bring a social justice conscience into the classroom to help primary and secondary school students identify ways they can take action to make positive change in society. Evidence suggests, however, that the ability of student teachers to integrate social justice into classroom content is often disconnected from the sociopolitical realties of their placement classrooms. These student teachers focus instead on recognizing individuals in the classroom as objects of social justice pedagogy, rather than exploring the larger communities that the classrooms represent (McDonald, 2008).

While teaching for social justice is acknowledged to be difficult for nearly all teachers (Barton et al., 2008; Jaeger, 2006), many teachers have embraced the teaching of social justice in the humanities (Pierce, 2006; Stables, 2005; Tyson & Sung Choon, 2006), recognizing that literature, history, social studies, and philosophy lend themselves to discussions of social justice concerns at all academic levels. However, the incorporation of social justice into science and mathematics teaching is understood to be more challenging and is often limited to the recognition of contributions of women and peoples from non-dominant cultures and observations of disparities and oppression in society (Bloom, 2005; Gutstein & Peterson, 2005; Romo & Chavez, 2006). Student teachers are less likely to explore issues of marginalization and oppression through mathematical and scientific lenses, perhaps because they do not conceptualize, or are less confident or comfortable with, these ideas (Gutstein, 2006; McDonald, 2008; Norman, 1998).

Both mathematics and science content are ripe for the inclusion of social justice content into curricular design. Gutstein (2007) and Roth (2005) acknowledge that, when teaching mathematics and/or science, teachers address more than the identified content. Traditionally taught, mathematics and science reflect the institutionalization of what is deemed as necessary and valued knowledge: answers are known before the questions are asked and there is limited contextualization between the classroom experience and the world outside of school. Social justice pedagogy adds tension to mathematics and science classrooms because by contextualizing the mathematics and science into the lives and communities inhabited by students themselves, the classroom pedagogy raises questions about values, ethics, and the implications of decision-making practices that utilize the tools of mathematics and science (Barton et al., 2008; Donnelly, 2006; Gutstein, 2007; Hind et al., 2001; Norman, 1998). Traditional science education stresses the socialization of students into accepted scientific practices while often ignoring the creative and questioning role of science that leads to innovative practices and, ultimately, knowledge (Roth, 2005, 2007). Thus, incorporation of non-traditional teaching practices acknowledges and attempts to expand the limited school practices of classroom mathematics and science. This, then, creates a classroom discourse that bridges science and mathematics with a social justice context to create, for the students, a new understanding of the meanings and uses of science and mathematics to identify and rectify societal inequities (Barton et al., 2008; Gutstein, 2006; Hind et al., 2001; Mukhopadhuyay & Greer, 2007; Roth, 2005, 2007).

Yet classroom teachers rarely recognize school mathematics and science as explicit tools for societal change. The mathematical and scientific implications of social justice considerations introduce gray areas and uneasy possibilities not usually associated with the clear-cut answers expected from mathematics and science content in primary and secondary classrooms (Bishop, Clarke, Corrigan, & Gunston, 2006; Mukhopadhuyay & Greer, 2007). There is ample evidence, however, that tying this knowledge to students' understanding of social justice, while helping them develop the tools of critical thinking, scientific contextualization, and mathematical rigor, empowers them in all areas of their lives, inside and outside the classroom (Barton, 1998; Barton et al., 2008; Gutstein, 2003, 2007; Remillard, 2005). While there are some readily accessible mathematics and science social justice curricular resources (Bigelow et al., 1994; Gutstein, 2003; Lesser & Nordenhaug, 2004), social justice is most often introduced into the science and mathematics curriculum haphazardly and informally (Mukhopadhuyay & Greer, 2007).

Student teachers recognize the importance of social justice in the classroom, both for themselves as teachers and for their students (Bishop et al., 2006; Jaeger, 2006; Kennedy, 2006). Yet student teachers often find themselves doubly challenged: 1). they are struggling to incorporate a new pedagogy, one that is not understood and not often supported by experienced classroom teachers, and 2). they are unsure how to incorporate mathematically and scientifically correct content into a social justice framework (Frazier & Sterling, 2005; Hind et al., 2001; Moscovici, 2003; Williams, Connell, & White, 2003). Additionally, when student teachers face the realities of the classroom – including challenging curriculum they are required to teach, classroom management concerns, issues of school administration and management, and standardized testing mandates – social justice pedagogy is one of the first casualties of new teacher overload (Romo & Chavez, 2006). Thus, the evidence suggests that while teaching for social justice is supported within education programs and may be adopted by teachers and student teachers, inclusion of social justice within primary and secondary mathematics and science curriculum is in its infancy.

In this study, we conduct a qualitative analysis of the mathematics and science lessons that primary and secondary student teachers presented during a "Social Justice Conference." This conference was a twice-yearly event during which student teachers shared a poster describing a lesson that integrated social justice with a content area. Specifically, we: 1) discuss the pedagogical techniques student teachers use to integrate social justice with scientific and mathematical learning; 2) examine the types of social justice themes student teachers address through these lessons; and 3) explore how to help students design and implement successful social justice understanding in K-12 science and mathematics