

SOCIAL JUSTICE INSTRUCTION IN MATHEMATICS AND SCIENCE

Daniel W. Eadens

Northern Arizona University

Danielle M. Eadens

Northern Arizona University

ABSTRACT

Through illuminating and linking current societal events and U.S. Department of Education goals, this chapter stimulates readers in a thought-provoking connection between fundamental background reasons why social justice instruction is crucial in secondary schools today.

Educators' interests will be piqued as they are drawn to deeply empathize with the dire need, justification, and benefits for quickly implementing real-world social justice classroom practices.

The focus is on highly effective social justice instructional strategies for novice through seasoned secondary pre-service and in-service teachers, administrators, consultants, and education preparation professionals that can be efficaciously applied into mathematics and science lessons.

The suggested instructional strategies and practices and multi-media references are easily identifiable and serialized, ensuring the efficiency that practical educators will sincerely appreciate.

KEY WORDS

social justice, education, educational leadership, methods, teaching, secondary education, secondary mathematics, secondary science, school to pipeline, culturally responsive, multicultural education

BACKGROUND

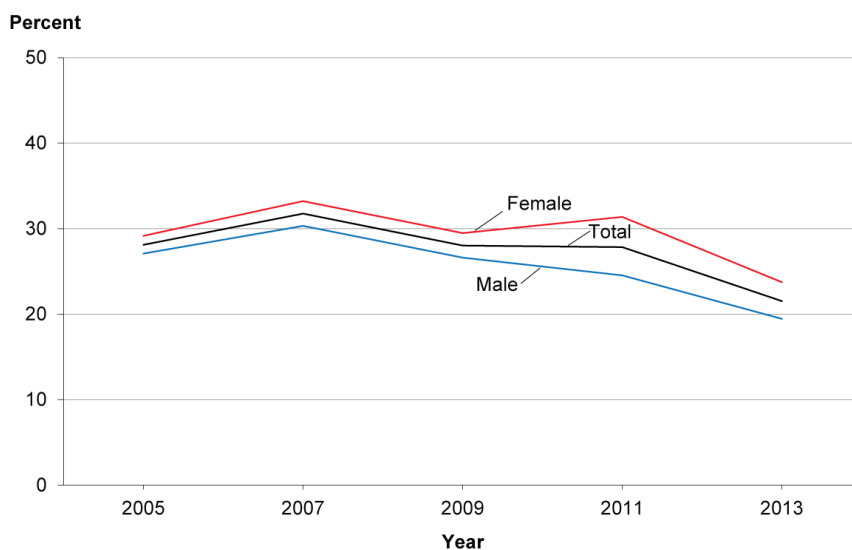
In his 2010 message, the U.S. Education Secretary, Arne Duncan, proclaimed that “excellence and equity in education are essential to achieving social justice and ensuring that our nation can compete in a global economy” (Duncan, *An Overview of the U.S. Department of Education*, p. v). Additionally, the forward of their Guiding Principals document says,

No student or adult should feel unsafe or unable to focus in school, yet this is too often a reality. Simply relying on suspensions and expulsions, however, is not the answer to creating a safe and productive school environment. Unfortunately, a significant number of students are removed from class each year — even for minor infractions of school rules — due to exclusionary discipline practices, which disproportionately impact students of color and students with disabilities...Nationwide, data collected by our Office for Civil Rights show that youths of color and youths with disabilities are

disproportionately impacted by suspensions and expulsions...data show that African-American students without disabilities are more than three times as likely as their white peers without disabilities to be expelled or suspended. Although students who receive special education services represent 12 percent of students in the country, they make up 19 percent of students suspended in school, 20 percent of students receiving out-of-school suspension once, 25 percent of students receiving multiple out-of-school suspensions, 19 percent of students expelled, 23 percent of students referred to law enforcement, and 23 percent of students receiving a school-related arrest. (US Department of Education, 2014, p. *i*)

This data that came from the Bureau of Justice Statistics and National Center for Education Statistic's (NCES) annual report on school crimes (Robers, Kemp, Truman, 2013) highlights the desperate cries of social change that must occur if our society is not to fail or violently break itself apart.

In addition to discriminatory disciplinary routines and practices, suicides, and extreme violence such as Sandy Hook and Virginia Tech, rejection, and bullying still remain a growing problem across that nation. NCES closely examines students' reports of school bullying and publishes comparative and longitudinal data using the School Crime Supplement (SCS) of the National Crime Victimization Survey. They used a national sample of 12 to 18 year olds in 2013 and found that about 22% reported being bullied in schools. Of those, a higher majority were females (24%), White (24%), Hispanic (19%), Asian (9%), Black (20%), 6th-graders (28%), 7th-graders (26%), 8th-graders (22%), 9th-graders (23%), 10th-graders (19%), 11th-graders (20%), and (14%) were 12th-graders. In all, it appears that White, female, 6th graders experienced the most bullying, as shown in Figure 1 (Musu-Gillette, Hansen, Chandler, & Snyder, 2015).



NOTE: "At school" includes the school building, on school property, on a school bus, or going to and from school.
SOURCE: U.S. Department of Justice, Bureau of Justice Statistics, School Crime Supplement (SCS) to the National Crime Victimization Survey, 2005 through 2013. Musu-Gillette, Hansen, Chandler, & Snyder (2015, p.1).

Figure 1: Percentage of students ages 12–18 who reported being bullied at school during the school year, by gender: Selected years, 2005 through 2013.

PURPOSE

With school extreme violence and bullying still prevalent today, although declining, teachers, administrators, consultants, and higher education faculty continually search to find more effective and practical social justice strategies that can be productively implemented in secondary classrooms. *Social Justice Instruction: Empowerment on the Chalkboard* emphasizes the instructional practices and strategies that pre-K-12 teachers-in-preparation, educators, and college/university instructors need to understand for all their students. This chapter presents a clear focus on key social justice instructional practices and strategies that can be utilized in secondary mathematics and science classrooms for developing all teachers.

WHY TEACH SOCIAL JUSTICE

NEEDS

Dr. Charles Robbins', Stony Brook University Vice Provost, 2014 TEDx Talk signposts when injustice is continual and lasting, it begins to create a societal negative turning point. We see this all too often in the news today. Robbins believes that everyone has a choice to fight for social justice or perpetuate the problems. He says societal well-being, or social progress index, as coined by Michael Green (2014), has three distinct categories: basic needs (water and sanitation, nutrition and basic medical health care, shelter, safety, security), foundations of well-being (basic knowledge, health, wellness, sustainability), and opportunity (personal rights and freedoms, tolerance and inclusion, advanced education access). Researchers Tay and Diener (2011) analyzed data from over sixty thousand participants from 123 countries in every major region of the world between 2005 and 2010 to test Maslow's theory. Results supported *universal human needs*, regardless of cultural differences, although each of the needs have to be met, they claim each need is independent from the others. This differs from Maslow's (1943) motivational theory that basic needs must be met sequentially beginning with the basics and moving to the next on the hierarchy pyramid with no motivation to progress until the previous needs were fully met. Many might be surprised that to learn Maslow's five hierarchies was expanded to include additional needs: cognitive, aesthetic, self-actualization, and transcendence needs. The revised needs are (McLeod, 2007):

Biological and Physiological (air, food, drink, shelter, warmth, sex, sleep, etc.), Safety (protection from elements, security, order, law, stability, etc.), Love and belongingness

(friendship, intimacy, affection and love, - from work group, family, friends, romantic relationships), Esteem (self-esteem, achievement, mastery, independence, status, dominance, prestige, managerial responsibility, etc.), Cognitive (knowledge, meaning, etc.), Aesthetic (appreciation and search for beauty, balance, form, etc.), Self-Actualization (realizing personal potential, self-fulfillment, seeking personal growth and peak experiences), and Transcendence (helping others to achieve self-actualization). (p. 4)

SOCIAL INJUSTICE RESULTS

Brand (2014) suggests that the negative effects of U.S. cultural assimilation caused economic and political power stratification that in turn, resulted in population marginalization and that culturally responsive pedagogy considers students' cultural needs. History reveals tragedies when societies fail to consistently address cultural and categorical needs, or to care for its people. The price is too high for individuals to ignore social injustices seething with years of unresolved inequity and discontentment. Dr. Camara Jules P. Harrell, studied physiological and psychological impacts of racism and discrimination as it relates to stress, its prevalence and impact on health, and association with other chronic diseases (Harrell, n.d.; Harrell, Hall, & Taliaferro, 2003). Additionally, Harrell, Burford, Cage, Nelson, Shearon, Thompson and Green (2011) found more pathways linking atmospheres that were highly racist that actually created reactions that eventually contribute to illnesses and they challenge policy makers to lead the way in creating policies and strategies to purge or reduce societal racism.

Adding personal bias, outdated facts, media sensationalism, and societal changes fuel passions and instability. The problem lies in the fact young and old people alike need to feel safe, secure, valued, and empowered (Maslow, 1943; Tay & Diener, 2011; McLeod, 2007). If individuals feel marginalized for long enough, they will enable themselves in large grassroots activist efforts, not unlike the civil rights movement of the 1950's and 60's, but sometimes in more dangerous ways today like the riots in Ferguson, and more recently, Baltimore. Black Lives Matter (ignited by events like Trevon Martin, Michael Ferguson, Michael Brown and Anthony Gray, some of which have resulted in local reforms), marriage equality and lesbian-gay-bisexual-transgender-queer-intersex-ally activism leading to States and U.S. Supreme Court hearings), and A Minimum Living Wage (resulting in companies such as McDonalds, Walmart, and Aetna raising minimum wages and places such as Arkansas and Seattle raising minimum wages) are all current movements fighting for empowerment and attaining publicity and many victories (Reifowitz, 2015). In schools, when students are chronically marginalized and ignored, it gives birth to a host of antisocial behaviors and aggression, vandalism, gang activity, rapes, and extreme violence. The nation grieves when we see news broadcasts of horrific tragedies such as fatal shooting and extreme violence in schools like Sandy Hook Elementary School in Newtown, Arapahoe High School in Colorado, Virginia Tech., and to name a few. Abroad, global unrest reacting from the world's economic crisis and prolonged social injustices resulted in major movements such as Arab Spring, Occupy Wallstreet, Occupy Montreal, Tahir Square Egypt, etc...

The bottom line is social injustice eventually yields societal issues. However, implementing positive behavior support (PBS) systems (Wheeler, & De Richey, 2013), bullying and cyber bullying prevention (Olweus & Limber, 2010; Hinduja & Patchin, 2014), restorative

justice (Van Ness, & Strong, 2013) and other similar constructive programs and strategies can greatly reduce violence, disciplinary infractions, vandalism, suspensions, and expulsions while empowering and motivating students by meeting their needs and creating constructive and communicative mechanisms that educate, inform, and resolve issues while overall, increasing social justice. The next sections detail goals and practical strategies.

STRATEGIES FOR TEACHERS

STRATEGIC PLANNING

Empowering programs such as positive behavioral supports (PBS), bullying prevention, and restorative justice should be integrated throughout the students' experience in school. Additionally, because every student is unique, has varying interests and needs, and learns differently, teachers should universally design and differentiate instruction (Pnevmatikos & Trikkaliotis, 2012) to meet each student's needs. Even though secondary schools' departments strategically develop curricula in concordance with standards and graduation requirements, incorporating school-wide programs such as PBS, bullying prevention, and restorative justice, teachers however, still maintain a healthy degree of flexibility in designing their goals, plans, time lines, and lessons plans. Lesson plans should be developmentally appropriate and instruction should remain flexible, allowing room for necessary adjustments that help meet special and general education students' needs and accommodations. Instructors should strongly consider and draw upon the varied learning styles of the students' in the classroom and assessments should remain authentic. The students' cultural contexts should be highlighted; this enhances classroom environment and community. Lastly, teachers should vary their

instructional roles and approaches to best facilitate student learning (Tomlinson & Imbeau, 2010).

GOALS

Combining experienced departments' and teachers' best practice strategies coupled with current research findings creates paramount methods that can revolutionize the paradigm of the way educators incorporate social justice in science classrooms. The ultimate goal is to increase learning and participation of all students in science and math classrooms to feel comfortable enough to achieve or exceed their full potential. Overcoming issues with social justice, equity, and bias in secondary classrooms requires these informed, intentional, and persistent actions.

Interdepartmental and interdisciplinary approaches for course goals and objectives for student outcomes in all subjects should enable students to examine the psychological, sociological and personal benefits of social justice in schools; analyze the economic impact of social justice in schools; interpret the ethical and legal ramifications of school social injustices and inequity practices; recommend strategies for correcting social injustices and inequitable practices in schools; demonstrate effective strategies to promote fairness through collaborative writing, group experiences, labs, and class interactions; and reflect upon individual personal experiences, stereotypes, and biases regarding social justice and equity issues. By identifying and unpacking factors that contribute to stereotyping, biases and prejudices, and issues of hate and violence in all subjects and examining one's personal bias, specific strategies can then be developed to resolve issues related to social justice in schools including at a minimum: gender, race, culture, ethnicity, ability, age, sexual orientation, and economic status. When classes are universally designed, they are set for the individual success for *all* students. Sample outlines of

possible social justice goals and topics that could be used to focus instruction would vary and could incorporate any of these, to name only a few:

- Personal stereotypes and biases and psychological, sociological bases. Assess students' and educators' personal and professional beliefs, attitudes, perceptions, and preconceptions (Brown, 2004).
- Forms of injustice including gender, age, ability, culture/religion, race/ethnicity, sexual orientation, physical characteristics/handicaps, socio-economic status. Dimensionalizing diversity (Point & Singh, 2003).
- Major arenas such as K-12 education, workplace, sports/recreation, military, higher education, leadership/government, society/popular culture, personal and family relationships.
- Trans/Gender Roles, biological differences, phobias and myths.
- Sex-fair hiring practices/Non-traditional occupations for men and women.
- Socialization processes.
- Cultural Influences on social justice issues.
- Sexual Harassment in education and beyond.
- Media Influences on stereotypes, roles, biases, and expectations.
- Legal issues pertaining to social justice.

A recommended resource comes from the Teaching Tolerance organization, specifically on Perspectives for a Diverse America's website has a webinar or stand-alone series called December Dilemma that is an example of an integrated plan. This contains student activities and teacher lesson plans that address Common Core State Standards and integrate anti-bias social justice for religious inclusion. Some of the student activities require interpretation and analysis skills, research and presentations, and to speak, listen, and think critically. Teachers benefit from the web resources as well within the provided lesson (Build Literacy-based, Anti-bias Learning Plans).

APPROACHES IN MATH

Teachers can create math problems about how much it would cost for Sally to buy a car; or about how much it would cost for Sally to replace her stolen car; or how much to repair

Sally's vandalized car; or for Sally to ride the bus because she is a single parent and cannot afford a car. Student engagement and higher order thinking are critical skills that cannot be achieved without real world cultural relevance. Some teachers believe that teaching math is neutral; however, not incorporating social justice is a conscious political choice that contributes to disempowering students, according to Gutstein and Peterson (2005). They furthered by highlighted through a variety of holiday and/or themes, mathematics can be incorporated across the disciplines and can easily integrate most mathematical operations with data surrounding issues of equality found in literature readings (poverty and world hunger rates around thanksgiving and winter holidays), eliminating stereotyping (exponential numbers of patterns found in trending stories gone viral in media via newspapers, magazines, movies, and children books), and social movements in history (algebraic racial profiling charting, women equality/voter rights and election factorial outcomes, gender salary difference means and modes graphing, setting minimum horizontal and vertical and equitable proportional wages, and statistics of corporate profits exploiting child labor).

APPROACHES IN SCIENCE

This section offers science educators, pre-service through seasoned veterans' in-service, effective classroom strategies that work for all student populations that creates and celebrates a more positive climate and culture, genuine equality, and mindful social justice environment in the science classroom. Choosing the most appropriate resources and lessons for teaching social justice in science classrooms are key. For successful implementation, the topics and lessons need to be as culturally relevant, authentic, pragmatic, and as meaningful as possible for students

to have a fulfilling secondary school experience. Lessons that address issues of social justice equity and the barriers created by gender, race, culture, ethnicity, ability, age, sexual orientation, and economic status can effectively be woven into secondary science classes in culturally responsive and motivating creative ways. This should lead to more Science, Engineering, and Mathematics (STEM) opportunities for students.

Similarly to mathematics, science is also not a social justice-free or neutral subject regarding whether or not to integrate social justice strategies into the curriculum. For example, a science class can calculate how many solar panels need to be installed to provide usable electricity to a house; or the class can calculate how many houses do not have electricity; or how many families cannot afford a house; or how many solar panels would be needed on an apartment complex? Environmental racism is another social justice perspective that science classroom students could engage and widen their perspectives regarding the data surrounding unbalanced numbers of diseases such as aids and genetic dispositions, organ donors and limited medical care, and disproportionate amounts of economically challenged homes adjacent to sewers, hazardous waste landfills, water treatment and waste plants, airports, factories, and railways lines. The biology of sex roles and behavioral genetics is another area to be studied in a science classroom. Social justice aspects should be consistently considered and thoughtfully integrated into almost every science lesson. Students notice and respond to the authentic realities and maintain closer engagement.

New and seasoned science teachers must continually update their framework for providing a safe and equitable learning environment both physically and socially by embracing and engaging diversity and multiculturalism and bolstering marginalized groups while ensuring classroom policies and procedures are equitable. Assessments must also be appropriate and fit

the needs of all students, universally designed, culturally relevant, and offered in variety of modalities. Equitable does not mean all equal, it means fairness to all. Sometimes unequal distribution is necessary to achieve equal results due to diverse intellectual and physical abilities, dissimilar cultural beliefs, and countless other characteristic differences.

CONCLUSION

Clearly there are fundamental reasons why social justice instruction is crucial in secondary schools. School and societal social justice issues today might be outward signs of a buildup of past inward unresolved social injustices. However, the benefits for implementing social justice instruction in classrooms are vast. Many social justice instructional strategies and professional development opportunities for mathematics and science learning environments should be implemented by teachers, administrators, consultants, and education preparation professionals. This is efficaciously facilitated with practical instructional strategies and practices and useful multi-media reference resources visibly accessible. The focus and significance of this chapter is to not just provide tools for middle and high school math and science educators to enhance their integrated instructional design skills, which proliferate social justice education, but that the results lead to lasting school policy changes, better school climate where discrimination is quashed and diversity is celebrated with inclusion as the norm, and ultimately a more peaceful, just, and equitable society. Because one of our greatest civil rights leaders once said, *injustice anywhere is a threat to justice everywhere*. --MARTIN LUTHER KING, JR., let our generation accomplish eliminating social injustice, and liberating social justice for all!

KEY INSTRUCTIONAL PRACTICES AND STRATEGIES

1. Teach the importance of why we teach social justice.
2. Highlight resulting issues from failing to teach social justice.
3. Discover your own needs and biases then practice quashing discrimination.
4. Model and require social justice and celebrate diversity and inclusion.
5. Strategically plan and integrate PBS, bullying prevention, and restorative justice.
6. Plan Lessons around *all* students' learning styles, abilities, and culture.
7. Universally design instruction to meet *all* student's needs and accommodations.
8. Ensure assessments are authentic and culturally relevant.
9. Nurture classroom environments and maintain cultural contexts and sensitivity.
10. Strongly advocate for social justice 360⁰ and for matching lasting policy changes.

MULTI-MEDIA REFERENCES

1. Publications. <http://www.tolerance.org/publications>
2. Central Texts. <http://perspectives.tolerance.org/?q=central-text-anthology>
3. Perspectives for a Diverse America. <http://perspectives.tolerance.org/>
4. Anti-bias Framework. <http://perspectives.tolerance.org/?q=node/419>
5. Advisory Activities.
<http://www.tolerance.org/sites/default/files/PDA%20Advisory%20Activities%20VF.pdf>
6. Build Your Learning Plan. <http://perspectives.tolerance.org/?q=node/588>

7. Integrated Learning Plan. <http://perspectives.tolerance.org/?q=node/588>
8. Critical Practices.
http://www.tolerance.org/sites/default/files/Critical%20Practicesv4_final.pdf
9. Professional Development Modules. <http://www.tolerance.org/seminar/webinar-teach-perspectives-diverse-america>
10. Teaching Tolerance Classroom Resources. <http://www.tolerance.org/classroom-resources>
11. Religious Tolerance Inclusion and Respect Webinar -
<http://www.tolerance.org/seminar/webinar-teach-perspectives-diverse-america>
12. Environmental Racism. <http://www.tolerance.org/lesson/reporting-environmental-racism>
13. Film Kits. <http://www.tolerance.org/teaching-kits>
14. Mix It Up Crossing Social Boundaries. <http://www.tolerance.org/mix-it-up/what-is-mix>
15. Biology Social Justice Issues. <http://www.tolerance.org/magazine/number-44-summer-2013/just-science>
16. Harvard Medical School and Science and Social Justice.
<http://www.kzoo.edu/praxis/category/science/>
17. Brooklyn, Countering Views of Nigerian Muslims.
<http://www.voicesofny.org/2015/02/brooklyn-countering-views-nigerian-muslims/>

REFERENCES

Atwater, M., Russell, M., & Butler, M. (eds.) (2014). *Multicultural Science Education: Preparing Teachers for Equity and Social Justice*. Springer.

Brand, B. (2014). Sociocultural Consciousness and Science Teacher Education. In *Multicultural Science Education* (pp. 61-78). Springer Netherlands.

Brown, K. M. (2004). Assessing preservice leaders' beliefs, attitudes, and values regarding issues of diversity, social justice, and equity: A review of existing measures. *Equity & Excellence in Education*, 37(4), 332-342.

Build Literacy-based, Anti-bias Learning Plans. (n.d.). A project of the southern poverty law center. Retrieved April 21, 2015, from <http://perspectives.tolerance.org/>

Duncan, A. (2010, September 1). An Overview of the U.S. Department of Education. Retrieved April 10, 2015, from <http://www2.ed.gov/about/overview/focus/what.html>

Green, M. (2014, October). What the Social Progress Index can reveal about your country. Retrieved April 22, 2015, from http://www.ted.com/talks/michael_green_what_the_social_progress_index_can_reveal_about_your_country?language=en#t-328139

Gutstein, E., & Peterson, B. (Eds.). (2005). *Rethinking mathematics: Teaching social justice by the numbers*. Rethinking Schools.

Harrell, J. P. (n.d.). Psychophysiology in african-american samples: Howard university studies. Retrieved from <http://www.apa.org/pi/oema/resources/ethnicity-health/psychophysiology.aspx>

Harrell, J. P., Hall, S., Taliaferro, J. (2003). Physiological responses to racism and discrimination: An assessment of the evidence. *American Journal of Public Health* 93, 243-248.

Harrell, C. J., Burford, T. I., Cage, B. N., Nelson, T. M., Shearon, S., Thompson, A., & Green, S. (2011, April 15). *Du Bois Rev.* 8(1):143-157.

Hinduja, S., & Patchin, J. W. (2014). *Bullying beyond the schoolyard: Preventing and responding to cyberbullying*. Corwin Press.

Larkin, D. B. (2013). *Deep Knowledge: Learning to Teach Science for Understanding and Equity. Teaching for Social Justice*. New York: Teachers College Press.

Maslow, A. H. (1943). A theory of human motivation. *Psychological Review*, 50(4), 370-96.

- McLeod, S. A. (2007, 2014). Maslow's hierarchy of needs. Retrieved from <http://www.simplypsychology.org/maslow.html>
- Musu-Gillette, L., Hansen, R., Chandler, K., & Snyder, T. (2015, May 1). Measuring student safety: Bullying rates at school. Retrieved May 1, 2015, from <http://nces.ed.gov/blogs/nces/post/measuring-student-safety-bullying-rates-at-school>
- Olweus, D., & Limber, S. P. (2010). Bullying in school: Evaluation and dissemination of the Olweus Bullying Prevention Program. *American Journal of Orthopsychiatry*, 80(1), 124-134.
- Pnevmatikos, D., & Trikkaliotis, I. (2012). Procedural justice in a classroom where teacher implements differentiated instruction. In *Changes in Teachers' Moral Role* (pp. 155-163). Sense Publishers.
- Point, S., & Singh, V. (2003). Defining and Dimensionalising Diversity:: Evidence from Corporate Websites across Europe. *European Management Journal*, 21(6), 750-761.
- Robers, S., Kemp, J., & Truman, J. (2013). *Indicators of School Crime and Safety: 2012*. National Center for Education Statistics, U.S. Department of Education, and Bureau of Justice Statistics, Office of Justice Programs, U.S. Department of Justice. Washington, DC. Available at <http://nces.ed.gov/pubsearch/pubsinfo.asp?pubid=2013036>.

Robbins, C. (2014, December 17). Social justice is it still relevant in the 21st century?

TEDxSBU. Retrieved from <https://www.youtube.com/watch?v=Wtroop739uU>

Tomlinson, C. A., & Imbeau, M. B. (2010). *Leading and managing a differentiated classroom*.

ASCD.

U.S. Department of Education. (2014) *Guiding Principles: A Resource Guide for Improving*

School Climate and Discipline, Washington, D.C.

Van Ness, D. W., & Strong, K. H. (2013). *Restoring justice: An introduction to restorative*

justice. Routledge.

Wheeler, J. J., & De Richey, D. D. (2013). *Behavior management: Principles and practices of*

positive behavior supports. Pearson Higher Ed.