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Social Justice and Writing in a Math Classroom

Jesica Chaya
Merrimack College
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“When will I ever use this?” It is the question that math teachers are trained to anticipate. Day in and day out, students who fear mathematics or dislike the challenge it poses will question its purpose and necessity in an effort to shrink its importance in their overall academic careers. Other students may find that they can easily glide through their math classes by memorizing procedures and facts and regurgitating them back to their teachers. Both scenarios pose a problem that educators have been challenged to tackle. Math teachers, then, can do one of two things. They can either simply tell the students that they will need the material for the next test, their future jobs, to balance a checkbook, etc., or they can *show* them how it can be used *right now* to better understand the world around them. This is what math teachers who are incorporating social justice, as well as writing, into their lesson plans are aiming to do. By intertwining new math concepts with important and relevant social issues, teachers can empower students to recognize the applicable nature of math to problems that their generation will be dealing with for years to come. In doing this, they can also change students’ perceptions of what succeeding in a math class looks like and address a rising necessity for writing across the curriculum by connecting these social justice based plans with writing assignments that encourage and reinforce vocabulary and a deep understanding of the material.

In the past few years, there has been a great shift in mathematical pedagogy, both in theory and in practice. Focusing first on why this shift came about will bring to light an issue that mathematics students had been facing for a long time. The success that a student experienced in a math class had grown to represent her/his ability to memorize facts and procedures. The curriculum encouraged little connection between topics or understanding of the source of ideas and techniques. In *The Mathematical Education of Teachers II*, this surface approach to math is

discussed in reference to the challenges that experienced and emerging teachers are facing. “For many prospective teachers, learning mathematics has meant only learning its procedures and, they may, in fact, have been rewarded with high grades in mathematics for their fluency in using procedures” (CBMS 11). There has been a history of emphasis on rote memorization as the way to success in a math classroom, from colonial times to the early 1800s, again in the early 1900s, and yet again in the late 1900s (CBMS 9). This idea has permeated the education system and staked a claim in mathematics classrooms that refuses to give, even in modern-day learning environments. Some studies have shown that an environment exists in U.S. classrooms in which “doing mathematics means following the rules laid down by the teacher,” “knowing mathematics means remembering and applying the correct rule when the teacher asks a question,” and “mathematical truth is determined when the answer is ratified by the teacher” (CBMS 10). When teachers teach students the way that they were taught in school, it is very easy to continue applying techniques that are no longer sufficient or effective. The Common Core State Standards, or CCSS, initiative has attempted to break this cycle (*Common Core*).

The CCSS are a state-led initiative that has developed “a set of clear college- and career-ready standards for kindergarten through twelfth grade in English language arts/literacy and mathematics” (*Common Core*). States can voluntarily choose to adopt these standards for their own education systems, as 42 states have already done (*Common Core*). This movement, which is only about five years old, has raised the expectations on and responsibilities of teachers, in some cases drastically. Teachers are required to equip their students with the skills needed to continue progressing through the educational system and the different standards. The CCSS have revamped K-12 mathematics education by reorganizing traditional topics and adding new

concepts. The progression and evolution of topics are designed to be connected and students are given many more opportunities to make meaningful connections with the material and its applications. The CCSS website emphasizes three characteristics of the shift they are hoping to promote: “a greater focus on fewer topics,” a stronger sense of “coherence” by “linking topics and thinking across grades,” and a strengthened “rigor” for “pursue[ing] conceptual understanding, procedural skills and fluency, and application with equal intensity” (*Common Core*). One of the eight Standards for Mathematical Practice focuses on modeling with mathematics: “[m]athematically proficient students can apply the mathematics they know to solve problems arising in everyday life, society, and the workplace” (*Common Core*). What this movement encourages, in addition to a national standard for expectations, is a more meaningful and effective approach to teaching mathematics in the classroom. What have some teachers done to address this new need? They have begun to incorporate social justice issues into their classrooms.

How do we get students engaged in the material at hand? How do we connect math with “students’ cultural and community histories”? How do we make students aware of “their power as active citizens” to understand and change the world through math? (Gutstein and Peterson 1-4). These are just a few questions that select teachers asked themselves when trying to address this new and necessary layer of teaching mathematics in a way that strengthens critical thinking skills and applies math realistically. These teachers, such as Eric Gutstein and Bob Peterson, editors and writers of *Rethinking Mathematics*, found the answer to their search in the field of Social Justice. Gutstein and Peterson introduce their book by saying “math is often taught in ways divorced from the real world... This [social justice] approach seeks to deepen students’

understanding of society and to prepare them to be critical, active participants in a democracy” (Gutstein and Peterson 1). The scope of social justice is so vast that it offers countless issues that are just waiting to be discussed and analyzed in a math class. For example, “without mathematics, it is impossible to fully understand a government budget, the impact of a war, the meaning of a national debt,... the influence of advertising on children, the level of pollutants in the water, air, and soil, and the dangers of the chemicals in the food we eat...” (Gutstein and Peterson 2). Social profiling, unemployment rates and patterns, and sweatshops are a few more examples of social justice issues that would allow students to learn more about inequality in their communities and in other parts of the world, while also applying and strengthening their ability to use the mathematical concepts needed to meet their state standards (Gutstein and Peterson 2-3).

Because this is a relatively new movement that is still growing, there is not a lot of research that has been done on the effectiveness of social justice in the math classroom on a large scale. However, there does exist literature on individual teachers’ experiences with implementing lesson plans that incorporate social justice issues and students’ reactions (Reagan 19). Gutstein and Peterson are two examples of such teachers, as are the educators they have featured in *Rethinking Mathematics*. Although the lack of a large-scale study makes it difficult to draw a conclusion about the effectiveness of this technique, individual experiences have shown that students are very engaged in the material when they can make a personal connection with it and/or understand its importance in the context of their communities. For example, Benjamin S. Gower, a British teacher, assessed his students’ feelings by asking “How do you feel about Maths in general?” and “What do you think about the Maths we did today?” after incorporating

social justice in his mathematics lessons. He highlights that while two students reported that math made them feel “angry and sad” and made them “literally dread going into maths,” the same students then commented on the social justice focused lesson plan with “I like this lesson. It was informative and fun” and “It was... better than working from sheets... quite interesting” (Gower 8). In addition to positively affecting students’ overall attitude towards math, students were able to appreciate the material in a new way. “It was fun because... we talked and related to other subjects: geography, citizenship, etc.” and “the math we did... was interesting as it was not a theoretical thing, it tackled a real life issue that plagues the world” were some responses from students after an assignment that focused on “different countries’ claims for water aid, based on the scarcity of fresh water” (Gower 8). Using social justice issues in lesson planning is a great way to bring math to life in any grade-level, kindergarten through twelfth grade. It engages the students by addressing concepts of “fair” and encourages the use of their imaginations as they become active citizens hoping to change the world for the better.

Teachers all over the country have been contributing to this new trend with their own original ideas, experiences and suggestions based on their communities. What is so great about this technique is that it allows for great flexibility when teachers are gearing the material towards their particular body of students. An experienced and innovative math and social justice teacher can examine the community around her/him and identify the issues that are relevant to the students’ lives as well as important to their education and development as members of a democratic society. For example, Katie Hendrickson recognized that fracking was an emerging ecological problem that was influencing her students’ particular community because of high levels of shale that had been found. She saw this as an opportunity to require her students to

analyze the situation through a mathematical lens to better understand the debate surrounding fracking and to be able to form an educated opinion on the topic. The activity had students focus on one aspect of fracking and engage in guided research in order to find data that was fit for use. The students were then asked to create a presentation that revealed their particular research question, the conclusion that they came to, and a description of the math used to calculate the result. Students were converting data from percentages to amounts of fluid or numbers of people affected so that they could support their answers (Hendrickson 367-369). One of the reflections from the students read, “You can use numbers to better understand situations that can’t be expressed in words” (Hendrickson 371). Giving the students an opportunity to explore an ecological problem through the use of their newly acquired math skills proved to be an effective way to highlight the relevance of mathematics in understanding and solving social issues. A sixth grade teacher named Jacqueline Leonard, author of *Using U.S. Census Data to Teach Mathematics for Social Justice*, describes a lesson plan that incorporates the importance of census data with its usability in calculating best fit lines to predict population growths. She shares that digital resources offer the capability “to determine the number of parks, libraries, and recreation centers in specific neighborhoods,” in an effort to identify vacancies of such resources with the potential of advocating for them to local government officials (Leonard 42). Various examples of this kind exist and are continuing to grow in numbers.

Although this fresh and inventive manner of teaching math is still young in growth, support and resources are available and ever-growing. *Rethinking Mathematics*, its website www.rethinkingschools.org, and the website www.radicalmath.org were all written and created in order to support this innovative approach to teaching mathematics. These sources lead

to even more material, such as lesson plan ideas, activity suggestions, support circles, etc. that are accessible to motivated teachers all over the country. Arguments and worries about this approach have arisen, such as that it “occasionally weaken[s] the mathematics content and opportunities for mathematical learning,” breaks with the traditional outlook that teaching math should be neutral, “is ideological and unconcerned with pupil outcomes,” or requires specialized training to be effectively implemented. However, this social justice approach coincides with evolving expectations for deeper mathematical exploration and understanding for students across all grades, supports the development of educated and able citizens, and increases student levels of interest and engagement by connecting the content to their lives (Reagan 17; Gutstein and Peterson 6; Bartell and Carpenter 97). It can be projected that the data will continue to grow in support for this movement and its benefits and impact on students’ critical thinking skills, engagement in the material, and mastery of concepts in mathematical modeling situations.

In addition to the evolving emphasis placed on math modeling and applied learning by the CCSS, is the growing movement and need for stronger literacy skills in our students. The definition of literacy has been undergoing a transformation as the twenty first century comes into full play. Traditionally, literacy was a concept understood in the realm of an English classroom through mostly reading, writing, discussion, and listening. It focused on linear reading and, in respect to education, it was seen as the sole responsibility of an English teacher to teach, practice, and assess students’ literacy skills. However, as the education system, technology, and the job world have evolved, so has the definition of literacy and expectations for students in respect to their literacy skills.

With this changing world has come a modified and wider definition of literacy. In order to succeed in the classroom, and more importantly, beyond the classroom as a citizen and job holder, students must have a strong hold on the varying literacy skills of the age. In addition to the traditional fields of reading, writing, discussion, and listening, being able to communicate with a team, problem solve, converse, actively listen, use technology appropriately and efficiently, work as a leader, and examine real life problems have become important aspects of literacy. Being able to target all of these different areas requires a movement of responsibility from the shoulders of english teachers to the shoulders of *all* teachers. This has prompted the movement for writing across the curriculum and writing within disciplines. If students can strengthen their literacy skills continuously through the school day, they are able to become better communicators and better learners.

Why is this shift on the emphasis on literacy so important? Why should students be writing in disciplines that traditionally focused very little on literacy? Why should this happen in a mathematics classroom? Researchers have taken a dab at answering all of the questions above. British researcher James Britton and his research team group made up the phrase “writing across the curriculum” in the late 1960s to the early 1970s (Stock 97). They placed an emphasis on the importance of language as a segway to learning material, regardless of the content type. Paul Hanstedt, although focusing on an undergraduate level, identifies three clear, concise, and important reasons for following in Britton’s steps: “Writing is a complex skill,” “Different fields define ‘good writing’ differently,” and “Writing is critical thinking.” (48-50). Each of these supports the need for writing in the classroom in an important way.

The first acknowledges a need for varied and numerous opportunities for students to practice writing, regardless of the subject, level, or grade. Writing is a skill that starts to form at or before kindergarten, and can then continue to develop and grow stronger for the rest of a learner's life. Thus, it is so important for students to have the chance to strengthen this skill as elementary, middle, and high school students in various disciplines, before they move on as undergrads and then as job seekers where they will be expected to have developed this skill enough to succeed and compete in the job field.

The second reason is a vital concept for students and teachers to understand the importance of writing in all disciplines. "Various fields value different things" (Hanstedt 50). This is a simple statement that acknowledges the different sets of expectations for writing and communicating between different content areas. Students who are required to compose material in each of their classes are more likely to understand that "what does and doesn't qualify as appropriate evidence changes from discipline to discipline, field to field, and even course to course" (Hanstedt 50). This is extremely important especially as high school students begin to move into specific fields as undergraduates, and then as job holders. Stock describes this sense of urgency:

Students must bring what they know and the language they use to express it to each new social community, to each new discourse community they would join. To join a community means to be active in it. Those who sit in on the discussion, occupying space, listening- even if receptively- have not joined; they are merely spectators. (101)

The goal of incorporating writing and other forms of literacy, such as discourse, is to create communicators in our students, and to give them the tools necessary to adapt to and interact in the fields they choose to pursue.

The third, and most important reason, given by Hanstedt, is that “writing is critical thinking.” This reason encompasses the motivation for, and benefits of, a stronger emphasis being placed on writing and communicating in all classrooms. Stock describes a common classroom practice referred to as “classroom talk or classroom interaction,” that labels the conversation that teachers tend to hold with their students when they think they are encouraging learning and discourse. In reality, the conversations described by Stock are more “like asking children to fill in the blanks in the teacher’s mind” (Stock 97-98). Students are not given opportunities to interact with, experiment with, reflect about, or analyze the material they are learning. Hanstedt discusses the pros of allowing students to put their thoughts onto paper. He acknowledges that thinking is most often an unobservable action, so having students verbalize and write down what is going on in their heads is the only way for a teacher, and for the students themselves, to be able to see how the new material is being processed and understood. “Written words become words reconsidered, ideas put to new tests. Gaps in information appear, revealing the need for further learning” (Hanstedt 50). Writing leads to critical thinking which leads to substantial benefits for both students and teachers with respect to the learning experience.

As the need for stronger writing skills became acknowledged and supported, the education system realized that a change in expectations for both teachers and students was necessary. The updated Common Core State Standards address this need in two categories. One is under the general standards for writing and the other is that of standards for specific subject

areas. One of those subject areas is Science and Technical Subjects, under which mathematics falls. For our purposes, the focus lies on those Language Arts Standards that apply to a math classroom and coursework. Categories are organized into sub-standards for grades 9-10 and 11-12. For example, under grades 11-12 in the Science & Technical Subjects, students are expected to “write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes” (*Common Core*). Under the same category but for grades 9-10, students should be able to “translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words” (*Common Core*). The standards also emphasize the use of domain-specific vocabulary words, writing “routinely over extended time frames,” forming and writing arguments, utilizing varying modes of resources to solve a problem, and research projects in respective disciplines (*Common Core*). Thus, all teachers, regardless of the discipline they work with, must begin to hold their students to these new writing standards.

How can and are these standards being met in a mathematics classroom? Researchers and educators have been suggesting and employing various methods of including writing in a math classroom, with reflections and end results showing positive effects on student learning, as well as on effectiveness of teacher instruction. Some teachers chose to employ writing in varying degrees of difficulty so as to gently build up students’ confidence in their own writing (Baxter, Woodward, Olson 121). A common example of a non-intensive writing assignment in a math classroom is the use of journals and short prompts. David K. Pugalee discusses the pros of using journals by analyzing their effect from two angles: that of the student and that of the teacher

(308). As a student, having the opportunity to translate thoughts, both conscious and unconscious, into words on paper is an invaluable method of self-assessment. Pugalee describes this process as a strengthening and aid to the “development of metacognitive skills... [which] involves students’ awareness and self-regulation of their cognitive processes” (308). They may find that in trying to explain the mathematical reasoning behind a procedure, or to define and identify the relationship between domain-specific vocabulary words, they are able to see if they are truly understanding the new material (Bicer, Capraro, and Capraro 363). Instead of simply sitting in their desks, copying down notes, and following rote procedures, students are forced to “collect, internalize, and evaluate knowledge” (Puagalee 308). On the other side of these journals and prompts are the teachers, who gain invaluable information about their students’ progress from incorporating such writing activities. Three teachers who incorporated writing prompts into their high school Algebra classes experienced this first hand. They noticed that while students were able to correctly repeat the steps and procedures taught to them in order to solve a problem, their writing revealed a lack of true understanding of the material. There was a “mismatch between what students’ perceived they were supposed to understand and what the teacher wanted them to understand” (Miller, “Teacher Benefits” 334). Thus, teachers are able to use journals and prompt responses to reflect, evaluate, and modify instruction. The teachers in the study described by Miller identified specific and important influences that they had experienced. These included reteaching material and pushing off assessments when students’ written work reflected misunderstanding. The teachers also used writing prompts as a way to formatively assess students within a lecture and to hold one-on-one meetings with students based off their individual responses (Miller “Teacher Benefits” 335). Writing prompts and journaling work well

because students who may not advocate well for themselves when they are struggling get their voices heard in a different way, and thus their needs met (Miller “Writing to Learn” 518-519). Pugalee points out that, “Journals can become a means of dialogue between the student and teacher and can serve to create a comfortable environment for discourse and individualized instruction” (308). This is one instructional method for introducing writing into the math classroom.

Other writing assignments that are being encouraged and used are those that require students to problem-solve and build an argument in order to support an idea, suggestion, or opinion. “Students must show what they know and how they know it, using evidence in the texts provided” (Daddona 34). Latasha Cunningham Moss addresses this type of assignment in her dissertation through a discussion encompassing argumentation through policy-analysis. She argues that mathematics classrooms are chalk full of problems that are “well-structured,” in the sense that they are designed to be easily solved when, in reality, problems are not as black-and-white as they appear, and solving for x is not the end of a solution (1). Thus, challenging students to use their newly acquired mathematics skills to analyze a situation and formulate an argument allows them to do more than just repeat memorized procedures. They are applying their knowledge and articulating their thoughts in order to address a real-life problem and express their conclusion using mathematical evidence and understanding, all of which has them strengthening different kinds of literacy skills. This approach gives a teacher a much more accurate reading of whether students have truly grasped the new material enough to apply it in a different context. It also gives educators the opportunity to address writing as it is seen in the mathematics discipline specifically. According to Faulconer:

Writing mathematics often requires a solid understanding of numeric, symbolic, graphical, and verbal representations, their uses, and their interconnections. Since the language of mathematics is extremely precise and terse, writing mathematics requires specific instruction, an in-depth understanding of the vocabulary, and a great deal of practice. (9)

This quotation aligns with the Common Core State Standards that are striving for an emphasis on problem-solving, math-modeling, and real-life applications and the ability to communicate an understanding of such processes.

Now, two things have been argued, the first being that students benefit as learners and as citizens from incorporating social justice issues into the mathematics classroom, and the second being that writing is an invaluable asset to a math classroom to push students to grow and deepen their understanding of the material. Separately, each of these instructional methods requires students to put ideas and thoughts about mathematical concepts into words. The third argument? Combining both would be an ideal and effective way to meet both of these standards. Since writing is a growing necessity across the curriculum, and the new CCSS encourage a more meaningful and applicable pedagogy, using social justice issues to create writing assignments in a math classroom is an inventive method to addressing both needs.

In the various numbers of example lessons and activities implemented by social justice and mathematics advocates, the use of writing to expand on and utilize mathematical vocabulary and understanding can be found. Whether it be through the use of journals and prompts, projects, worksheets, research assignments, etc., teachers have been meeting literacy needs through the use of social justice topics and issues. Discussion and conversation about a topic from any

discipline in itself encourages students to start thinking more deeply about the meaning behind the numbers. They are motivated to analyze and interpret data in order to participate in the classroom dialogue and form an educated opinion, with evidence to support their argument. Students are also forced to put their mathematical work into words, to verbalize it and utilize appropriate vocabulary to describe their solutions. Shiuli Mukhopadhyay addresses the benefits of giving students an opportunity to engage in dialogue about the mathematics that they are learning, sharing that it results with “an overall shift away from practices that inform and a move towards practices that involve” (47). Gower describes this kind of classroom environment in his article *Teaching Mathematics for Social Justice* by choosing social issues to bring into the classroom through a mathematical lens. Using numbers, students are encouraged to ask questions, interpret data, make decisions and arguments, and support their opinions with facts when possible (Gower). This creates a learning environment conducive to safe, effective, and dynamic learning. It also targets the literacy movement’s desire to create stronger communicators within our students.

What follows these dialogues and discussions is the recording of students’ ideas and conclusions. They must put their thoughts into words, into informative or convincing writing to share with others. That is what Katie Hendrickson had her students do with the fracking activity previously described. Students had to turn their research, numbers, and ideas into writing that could be presented and communicated to others. Journal entries or prompts could also be used to encourage students to record their reflections after being exposed to the mathematics of a social justice issue. For example, Kat Rands proposes a lesson plan in her article *Supporting Transgender and Gender-Nonconforming Youth Through Teaching Mathematics for Social*

Justice that offers a strong mathematical basis, a focus on an important social justice issue, and a great opportunity for students to enhance their literacy skills. Students are given the necessary background knowledge, and the chance to discuss what prior knowledge and experiences they are bringing to the topic. They are then exposed to data provided by the National School Climate Survey that they must interpret through a mathematical lens, discuss, analyze, and draw conclusions about. Having students complete a writing assignment about the data that they are analyzing would be an effective way to get them to use appropriate statistical vocabulary terms to discuss representative samples and sample sizes. All the while, they are getting exposed to the reality of life as a transgender student. Rands suggests ending the lesson with a push for action, such as the sharing of the information analyzed or collected from the student's particular school, a social media campaign, events that bring transgender issues to light such as speakers, workshops, etc. and more (115-119). Her proposal is a perfect example of how possible it is to challenge students with developing mathematical and literacy skills through the incorporation of social justice issues.

What Rands' article also reveals is that as technology has come to and continues to develop and grow in accessibility, literacy has also grown with the age to encompass digital literacy. There is an abundance of resources available to students with important and revealing data and information. Students are expected to leave school and enter the job field with a firm understanding of technology and the skill set needed to utilize it efficiently and effectively. The retrieval of information that is a common theme in Social Justice focused mathematics lesson plans encourages the use of a variety of resource types. Articles describing social justice issues and presenting data associated with the topic can be utilized. Visuals such as videos, images,

graphs, tables, etc. can also be great resources to retrieve data from or to learn more about a social issue. Gower reported that he asked students to interpret data from graphs and tables to draw conclusions about certain social justice topics, such as the one previously noted about “water scarcity” in other countries (8). Hendrickson also addressed digital literacy by using such sources to provide her students with the necessary background information about fracking to actively engage in the forthcoming activity (367-369). In addition, there are numerous digital resources available at students’ fingertips with information, data, statistics, etc. that highlight and reveal important facts about certain social justice issues, such as the survey data used by Rands in her proposal. Having students search for these sources strengthens their research skills and gives teachers opportunities to discuss reliable sources.

These lesson plans, ideas, and suggestions for the intertwining of mathematics, writing, and social justice issues show that it is feasible to target the various skills our students need to develop, within the same activities, assignments, and assessments. However, as would be expected with any new and upcoming movement, especially in the education field, there are always challenges that threaten to destroy the progress such innovative and creative social justice and mathematics advocates are working towards. For instance, various resources have identified one common problem: the need for substantial, effective, and integrated training for teachers to be able to effectively employ such instruction (Reagan; Garii & Appova). Targeting math and writing skills while also incorporating controversial issues into the classroom discussion is not an easy task. It requires extensive planning and mathematics teachers must be careful in making sure that the material is challenging enough in its technical applications. In other words, the math has to be there. Students must be strengthening their mathematics skills and reaching the

benchmarks and standards set by their respective states, or the CCSS when applicable. Although this is a challenge, it is obvious from the nature of the lesson plan examples that have been published, shared, and utilized that it is not only possible, but creates a rich and effective learning experience for students.

Another challenge that has been proposed is that having to do with writing assignments in mathematics classrooms. Mathematics teachers are struggling to balance the grading between the mathematical work and the written explanations. Not having been trained to identify grammar, spelling, and structural errors, they often feel inept at correcting students' written work. However, seeing as the Common Core State Standards are requiring that writing be encouraged and assigned in all disciplines, this is a challenge that needs to be faced and overcome. Writing brings depth to the traditionally meaningless numbers students are used to working with in math classrooms. Miller summarizes it perfectly by saying, "The objective of writing in a content area is to focus students' thinking on a better understanding of the subject matter. Students who write in a content area often produce better written products with practice, but this result is an added benefit, not the primary objective" ("Writing to Learn" 519-520). Using math and writing to bring a social justice issue to light is an even more meaningful way to meet this growing need for increased writing opportunities in the math classroom.

Other challenges teachers may face are parents or guardians, supervisors, superintendents, co-workers, etc. who disapprove of the political climate that may ensue from the introduction of social issues into the classroom. They may claim that the classroom should remain a neutral place of learning and growing. However, the classroom could never be a neutral place. Each student comes with her/his own background, challenges, stories, etc. that have

contributed to their growth, and continues to affect their social, emotional, and economic status. Pretending that these differences do not exist will only lead to higher rates of intolerance, discrimination, prejudice, and ignorance. One of the overarching goals of educating our children through the U.S. school system is that they come out ready to engage in their communities as an educated and active member of society, willing to fight inequalities and support and fight for the things they believe in. Having this education happen in a mathematics classroom is an important way to show students that there are problems that must be discussed, acknowledged, and changed. Problems exist not only in “foreign lands,” but within the walls of their schools, homes, communities and country. It is never too early to start forming opinions and fighting for what is right or important to the students.

As the age of literacy and social expectations and issues transform and develop, the dynamics of a mathematics classroom are also changing in response. The new Common Core State Standards expect mathematics educators to make the material more meaningful and more applicable and relevant to students’ lives through math modeling, problem solving, and applications. They are also requiring that writing be made a more consistent part of math classrooms in a variety of manners in order to strengthen students’ understanding of the material, as well as their ability to use vocabulary appropriately and effectively communicate ideas and conclusions. Social Justice based lesson plans and activities offer an innovative and effective way to reach both of these new expectations. Through interlacing social justice issues, writing, and mathematics, teachers can target multiple necessities: a need for students to be socially aware of issues existing in their communities and outside of them, a demand for stronger communication skills from students throughout all disciplines, and a call for a stronger and

deeper understanding of mathematics and its implications within the discipline and outside of it. As research continues to grow in the fields of Social Justice and math, and writing and math, the connection between the two will become more evident. Teachers will take advantage of the opportunities that combining math, writing, and social justice issues bring to their classrooms. Furthermore, and most importantly, students will benefit from such a model by fostering an appreciation for the depth and applicability of mathematics to important issues while also strengthening their literacy skills to meet twenty first century expectations and needs.

Social Justice & Writing Math Lesson Suggestion: The Bystander Effect Model

Introduction:

The purpose of this assignment is to present and define the concept of the bystander effect and discuss it and its implications in the lives of students. Students will then use their graphing calculators to create exponential and linear models representing data from a Bystander Effect experiment. They will be required to use appropriate vocabulary terms to analyze, explain, and compare the models, with the goal of choosing the more appropriate and applicable model.

Lesson Delivery:

- **What do they know?** Teacher may choose to start the lesson with a gauging of what students know about the bystander effect. This can be done through a discussion or through a quick questionnaire or survey.
- **Introduce the Bystander Effect:** Teacher should introduce the concept of the bystander effect. This can be done by first describing a scenario where the bystander effect is taking place and asking students if they have experienced a situation like that, where they were either the bystander or a person seeking help. This can then lead into the defining of the bystander effect and a short discussion on possible reasons why it occurs (such as the diffusion of responsibility).
- **Brainstorm Opportunity:** Students should then be given an opportunity to brainstorm other scenarios where the bystander effect may take place. This includes experiences they have had or witnessed, as well as other situations they may come up with. They should

also be asked to brainstorm reasons why bystanders do not act in certain situations. They can either brainstorm individually and take notes on their worksheets, brainstorm in pairs, or work in groups and put up ideas on the board/smartboard as best fits the situation. I prefer groups for an activity like this because it gives them a chance to bounce ideas off each other and get comfortable with sharing them. A couple questions that can be projected are:

- What are some examples of situations where the bystander effect might exist?
- Why might the bystander not act? How about specifically in a school setting?

➤ **Latane & Darley's Bystander Experiment:** Latane and Darley's experiment on the Bystander Effect, called "An Epileptic Seizure" should then be presented (93). Describe the experiment's goals, the participants involved, the situation created, and the results of the study. In this experiment, college students were invited to discuss their learning habits and struggles through the use of headphones. Thus, the students could only hear, not see, the other "participants," the number of which was controlled by the experimenters. A pre-recording of a student having a seizure is played and the participant's reaction is observed, including whether or not they went to seek help and how long it took them to do so (Latane and Darley 94-97).

➤ **Use the data to create an exponential model:** Using the data from the experiment, students will input the x and y -values into their calculator as lists (2ND -> STAT). X -values represent the number of people present in the situation, not including the participant and the student experiencing a seizure, and Y -values represent the percentage of people from each specific scenario that responded within a certain amount of time. The

data points used from the experiment were the following: (0, 85), (1, 65), and (4, 31). (Latane & Darley 97). So, for example, when the participant thought that there was one additional student listening to the seizure taking place, 65% of the participants sought help before the fit ended (about a 2-3 minute block of time). Students will then use their graphing calculators to create an exponential regression model using the inputted data points (STAT -> CALC -> ExpReg). They should write the created equation down, graph it on their calculators, and sketch the model on their worksheets, making sure to label each axis.

- **Analyze exponential model:** Students should be asked to interpret this exponential function that they have created.
 - What does it mean in terms of the bystander effect and the experiment? What kind of exponential function is it?
 - What is the growth/decay factor?
 - They must write their thoughts and answers on their worksheet.

Remind them that they should be writing in full sentences and using appropriate vocabulary terms, such as exponential decay, exponential growth, factors, x -values, y -values, function values, etc.

- **Use the data to create a linear model:** Using the already inputted data points, students will use their graphing calculators to create a linear regression model (STAT -> CALC -> LinReg(ax+b)). They should write the created equation down, graph it on their calculators, and sketch the model on their worksheets, making sure to label each axis.

- **Compare models:** Students should now compare both models. Which model is more appropriate in the context of the situation? (Students should use terms like domain, range, restrictions, etc. to compare and describe the models through complete sentences.)
- **Conclusion/ Reflection:** Students should be given a chance to reflect on the activity and the implications of math through the use of a social justice issue. The teacher may choose to give them some time to think about it and talk about it with classmates, but students should ultimately respond individually in writing to questions such as the following:
 - Had you heard of the bystander effect before today's class? If yes, what did you know about it? If no, what did you learn about the bystander effect today?
 - What is the significance of the math models we created today in terms of the bystander effect? What did they reveal?
 - Do you feel that this activity helped you better understand the material from the chapter that we have been studying? If yes, how?
 - Is there anything that could have been done differently or should be added to the activity? What did you like or dislike about it?

These questions will give students the opportunity to reflect on the day's lesson and what may or may not have made more sense through the activity. They can share their thoughts and opinions on the structure of the activity in itself, as well as any insights that it may have led them to in terms of exponential and linear models, calculator use, and the bystander effect. Teachers can then use the data collected to modify and enhance the activity as deemed appropriate from student responses.

Possible Challenges:

There are some aspects of this activity that may pose a challenge to the educators executing it.

The following are just a few:

- What must be taken into account are students' past interactions and experiences with a graphing calculator. It is possible that they have never used one, or that they have never used one to input data and create models. It would be beneficial to the teacher to evaluate her/his students' level of comfort with the technology needed to complete the activity, before it takes places.
- Each class creates a unique dynamic that affects the way that students function and learn in the environment. Depending on this unique dynamic, students may not feel comfortable enough to discuss this topic with other students, especially if the bystander effect is something that they have had negative experiences with. Some students may be unwilling to participate in the brainstorming part of the activity. The lesson can be adjusted for this by having students focus on working through the activity individually and having the teacher suggest ideas instead.
- Some students may not be ready to discuss this social issue maturely and respectfully. They may take it very lightly and see it as an opportunity to make jokes and laugh about others' struggles. The teacher must be careful about and conscious of this kind of behavior and be sure to halt it immediately if it occurs in order to ensure that the learning environment remains safe and effective.

Conclusion:

This lesson plan infuses three important aspects: a social issue of the bystander effect, mathematical work with a graphing calculator, a data set, exponential models, and linear models, and written requirements that lead students to appropriate use of vocabulary to analyze and explain various pieces of the activity. Students are exposed to a social phenomenon that too often occurs in school settings, helping them to become more aware of their roles in different situations. In addition, their ability to create and analyze exponential models through the use of a graphing calculator strengthen their mathematical skills. Finally, their understanding of the math concepts is deepened and their ability to communicate their conclusions is enhanced by having to turn their thoughts into written explanations using appropriate and vital vocabulary terms.

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