

Superheroes in Math Class: Using Comics to Teach Diversity Awareness.

Edel M. Reilly

They are mutants, genetically gifted human beings—the world's newest and most persecuted minority group....In a world increasingly filled with hatred and prejudice, they are scientific oddities...freaks of nature...outcasts who are feared and loathed by those who cannot accept their differences....Under the tutelage of Professor Charles Xavier...these 'gifted' students have learned to control and direct their respective powers for the greater good of mankind. They fight to protect a world that fears them. (*X-Men the Movie*, 2000)

The X-Men are one of the world's most famous superhero teams. One of the things that makes them so fascinating is their diversity. Each X-Man has unique powers arising from a genetic mutation. Though the X-Men fight to save the world again and again, unfortunately they are often feared, shunned, and even threatened because of their differences.

In the real world, difference and diversity are less dramatic, but still represent great challenges. This article explores efforts to teach students to value, celebrate, and better understand diversity through a comic book writing activity. The examples in this article are drawn from a mathematics course, but because enhanced diversity education is a widespread educational goal, it is hoped that the teaching methods described here can be applied to a wide range of disciplines.

This article will focus on an activity used to teach mathematics in a way that allowed students to think about diversity while at the same time focusing on important mathematical concepts. The students were asked to create their own comic books to promote an appreciation of differences while also exploring a mathematics topic. After reading up on comic book heroes with superpowers, the students selected a mathematics concept that was to be a "superpower" and a social issue that their hero had to solve. The article begins with a discussion of teaching about diversity both in general and more specifically in the mathematics classroom. It then examines the use of comic books for teaching math and explores how comic books can be used as a tool to teach about diversity. Finally, a specific class-

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room example is examined. This example involves a math assignment in which students were required to create math comic books about diverse characters. The comic book activity is described along with an assessment procedure and student reflections on their learning from the activity.

Teaching about Diversity

Demographic changes across the nation have led to new kinds of classrooms, classrooms with students of many different backgrounds, experiences, and attitudes towards learning. A recent report from the US National Centre for Education Statistics (NCES) shows that student populations in US public schools have become more diverse since 1990 (Snyder & Dillow, 2012). By the mid-2000s most districts were experiencing rapid growth in the number of students of color, culturally and linguistically diverse students, and students from low-income families (Howard, 2007). At the same time as this growth was occurring, so too were new calls for increased accountability in U.S. schools particularly in courses like mathematics. At the local, state, and national level teachers are being asked to meet the needs of all students. However, despite these calls for increased accountability and the need for standardized curricula, Angus and de Oliveira (2012) point out the need for a culturally responsive curriculum that takes into account the various facets of knowledge and skills that are present in a diverse classroom. Indeed there have been numerous calls for the need for teachers to deal with diversity in their classrooms in a variety of ways (Fehr & Agnello, 2012; Henkin & Steinmetz, 2008; Jayakumar, 2008; and O'Hara & Pritchard, 2008).

At the same time, population changes means classrooms are being filled with students from diverse cultures with diverse language abilities and diverse learning styles. Can this diversity be used to educators' advantage? According to Davidson and Kramer (1997), "the gift of diversity is one of a classroom's most powerful assets no matter what the age level" (p. 131). Diverse students bring a wealth of different knowledge and experience to the classroom. A more diverse student body means classrooms starting to reflect more and more the cultural make-up of the society in which they are situated. As a result, teachers should find a way to use the differences among their students to help all of them understand and appreciate the differences in society. Student diversity should be viewed as an important educational opportunity.

Mathematics Education and Diversity

Yet as student populations grow more diverse, the mathematics abilities within a particular classroom will broaden potentially creating even larger achievement gaps which need to be overcome. Mathematics teachers have to work more than ever to incorporate reform efforts to provide meaningful mathematics education to all students that deal with real-world issues. According to Herzig (2005), "students' reactions to mathematics are affected both by their interests, abilities, and goals and by the particular way mathematics is

conceived and taught within the mathematics classroom" (p. 253). In other words, students bring a variety of issues to the mathematics classroom that sometimes conflict with how mathematics concepts are being taught. It is important that students be taught the purpose of what they are learning, and that they feel they have something to contribute to the discussion regardless of their race, ethnicity, socioeconomic status or gender. National Council of Teachers of Mathematics (2001) states "all students should have access to an excellent and equitable mathematics program...that is responsive to their prior knowledge, intellectual strengths and personal interests" (p. 13).

Mathematics has been considered the gatekeeper for many fields of study. Without success in mathematics, many students are prevented from entering into fields of study that would provide them with a wide variety of options for possible careers. To overcome this problem, teachers of mathematics should work to enhance their teaching strategies in order to present mathematics in an exciting and inclusive way so that all students can make sense of what they are learning and do so in their own unique way.

Learning happens through participation in social practices and learning is inseparable from that participation (Herzig, 2005). In order to be successful and productive citizens in today's workforce, students need to learn to work together and to experience the values and skills that other classmates bring to a task. According to Hodgkinson (2005), "both the mathematics curriculum and the processes of learning mathematics are social, cultural and value-laden activities" (p. 113). Therefore, being part of a group while at the same time recognizing the different contributions each member brings to the group can lead to a sense of belonging and a worthwhile learning experience. Each student needs to feel like they are an important member of the class and have something worthwhile to contribute.

What is also important is engaging students in problems that are relevant to their lives. When looking at students' learning interests, consideration must be given to the variety of cultures from which the students come. "If diverse learners are to fully benefit from the schooling experience, the teaching of mathematics needs to be linked to their lives and circumstances and, in some respect, share their cultural norms" (Ernst-Slavit and Slavit, 2007, p. 22). In other words, in addition to using the social setting students come from, teachers also need to devote time to making mathematics concepts meaningful and relevant. According to Chazam, (as cited in Lesser, 1996), "diversity helps students make connections by giving opportunities to connect school mathematics to real human lives and cultures, as well as to the algorithms used in the hobbies and jobs in students' cultural environments."

When looking at diversity one also needs to consider the role of language and in particular the language of math. Learning the math register can be a complex and challenging task for diverse learners as some mathematics words may not translate well into their native language. In many cases, new words and meanings are required for academic language that may be different from social language. For example, "difference," "product," "factor," or "prime" all have a different meaning in social language that is not the same as their math-

ematical academic meaning. Teachers need to provide opportunities for students to practice on this newly acquired language in non-threatening ways. According to Bay-Williams and Livers (2009) providing appropriate language instruction is important for all students. Bay-Williams and Livers also stress that timing is everything. These researchers argue that the context in which mathematics language is presented must be culturally relevant. One method for working with complex mathematical language is to have students write pieces which allow them to incorporate the new math ideas into more familiar contexts.

Using Comics to Teach Mathematics

In recent years, the use of comic books has become more common in classrooms. While there are some educators who are against the use of this popular cultural medium in schools, there is also growing support for the use of comic books as a teaching tool. In this section, I will examine the benefits of using comic books for teaching. In particular I will examine how comic books can be beneficial for the diverse classrooms of today.

Gone are the days when students got into trouble for having a comic book tucked away between the pages of a thick textbook. Popular culture is a key component to students' lives today. As a result, teachers should be willing to consider comic books and graphic novels as a tool that can be used to motivate students to be actively engaged in the learning process. Hall (2011) states that "comic books and graphic novels are one of the newest fully fledged art forms, a vibrant hybrid medium birthed in America and brimming with all the wildly experimental vigor of youth" (p. 39). The use of comic books can capture a student's imagination and allow teachers to combine content with context while at the same time getting students to think about some of the issues occurring in the context.

Yang (2003) describes five benefits to using comic books as a teaching tool. Comics can be used as a motivational tool. It is often difficult to get students excited about something they are not interested in. However, because comics are so different from a typical classroom textbook, even students who are not comic book fans may be interested in the colorful pictures and dialogue among the characters. Comic books are *visual* using a combination of pictures and words to tell a story. This use of art and narrative often fits students' different learning styles. Comic books as *permanent artifacts* is one of the reasons why they are often used in ESL classrooms. Students can control the speed with which communication progresses. It is the same as reading a novel but with the visuals bring creativity and communication into the classroom (Gomez, 2014). Comic books can be *intermediary*. They can form a bridge to help students move from simple to more difficult concepts. Comics also allow for the addressing of emotionally charged topics (Schwarz, 2009) and allow students to use critical thinking skills by analyzing the story and the art. And probably the greatest benefit of comic books is that they are *popular*. The average comic book reader is 24 years old (Yang, 2003) showing that they are geared towards the younger readers. Unlike

many other tools used in mathematics classes, comics do not take a lot of time to teach or demonstrate how to use.

Creating Math Comic Books

When one looks at context when teaching math, consideration needs to be given as to how math can be placed in meaningful and appropriate settings. Comic books provide an excellent opportunity for teaching diversity. According to Gerde and Foster (2007) “comic books reflect the culture, but they also inform as many comic books provide information and expect their readers to stay current in world events and social issues” (p. 245). Comic books can be used to present diverse social issues and to show that “conflicts and ethics are universal” (Schwartz, 2009, p. 248). Comic books can also be used to bridge the generational gap as students and teachers can share common thoughts and ideas on what is being represented in a comic book story.

Cooper, Nesmith, and Schwartz (2011) asked educators from the elementary to university level to examine comics as a teaching tool. These researchers found that comics could “promote higher order thinking, offer realistic connections and examples, and some real world activities” (p. 6). This can be particularly beneficial in mathematics classes when working with students from different language backgrounds and cultural experiences. By allowing students to use and create comic books in math class, the students can bring their own language and cultural experiences into the mathematics lesson, thereby using their personal backgrounds and experiences to aid in the development of mathematics understanding.

Having students create their own comic books allows for the students to become more involved in challenging mathematical tasks. Toh (2009) reports that teachers found that underachieving students were more willing to participate in math lessons when creating their own cartoons which included the algebraic language. By having students create their own comic books, teachers can get students who may be more visual learners actively involved in their own math learning. These days most students are visually orientated (Crilley, 2009). According to Boerman-Cornell (2013), “graphic novels can be an effective way to engage students who don’t yet know they love the subject you are teaching” (p. 75). By having students work together on this very different activity from the typical group activity in math class, students can bring many talents to the table.

The X-Men’s Mathematical Adventures

The mutant heroes of the X-Men each have a unique skill or ability. This math lesson, is built on this idea by asking students to focus on skills and abilities that might be different from their own and thereby helping the students to have more meaningful interactions with a variety of diverse perspectives. Students were asked to examine the ways individuals cope with their own and other peoples’ differences. In the X-Men comic book, ordinary people become angry and afraid when they learn that some teenagers have super powers that make

them “different.” Of course, in real life, similar problems exist. If people look different, have different skin colors, dress differently, or speak differently from everyone else, they may be called names or shunned or even abused. And it isn’t just appearances which can cause prejudice. Being good at school, especially being good at mathematics, can also make a person “different,” perhaps leading to that person being teased or mistreated.

This article reports on efforts to explore the notions of difference and diversity in a mathematics course in order to enhance students’ learning of both mathematics and diversity. An assignment was designed which asked students to tell a story of how people cope with being “different.” These stories were to be written in comic book format including illustrations and dialogue balloons. Students were assigned to collaborative groups and each student was given an X-Man character card. Each X-Man card showed a picture of a character as well as describing that character’s mutant abilities. In the X-Men comic books published by Marvel Entertainment Group Inc., the X-Men are mutant humans who have super powers like the ability to fly, the ability to control the weather, and the ability to freeze objects. These fantastic abilities from the original superhero stories were maintained, but each character was also given a special mathematical super power, such as the ability to solve fraction problems at super speed.

Then each student group was asked to write a comic book story about the characters in their group. The students were required to include four parts in each comic book: the set-up; the plot; the story; and the lessons learned. Each story had to be written in a way that made use of all the team members’ math super powers. Students were asked to write stories which focused on the overall theme of fully developing one’s talents in the face of societal pressures to conform. With regards to the section on Lessons Learned, the students needed to write at least one more page of their story, as a group, explaining the things they learned from working on the entire unit. The activity was designed to make students think about some of the diverse issues they will face in their future careers and lives and how math can help them with these issues. The comic books the students wrote also needed to include an illustrated cover with a title and the names of the book’s authors, a dedication page, page numbers, and an author’s page where each student author wrote some personal information about themselves.

Writing Diverse Adventures

The comic book writing assignment was given in an eighth grade advanced mathematics class. There were 11 students in the class. These students had been together since sixth grade and so they had a very good working relationship. The idea of working collaboratively was not new to them. In fact, because of their advanced mathematical skills, they were excited to try something different. By writing comic books about mathematical concepts, the students were challenged to find a way to frame their understandings of the concepts. That is, they would have to tell and illustrate a story which

showed they understood a specific mathematical idea. The students would also have to link that idea to the story's plot, thereby demonstrating how mathematical knowledge can be related to life situations.

The class, divided into three groups, created three comic books with various themes. All of the comic book adventure themes that involved heroes working together to prevent some disaster from occurring. In *Math Men*, the superheroes had to rescue a child from a dungeon by helping the child understand multiplication. In *The Subtractors*, the superheroes had to disarm a bomb by breaking a code. And in *The Adventures of Supercow and Frost*, the heroes had to find the area of an irregular polygon to protect their city from a powerful sunbeam.

Math Men

The authors of this comic book were three male students. When describing the superheroes' characteristics, some underlying traits of middle school age boys were apparent. In all three cases, the superheroes parents' were dead and they had been taken in by a kindly stranger who helped them develop their ability to use their powers. When asked about why the parents were deceased in the story, the boys talked about minor battles they had been having with their parents. These were battles like not wanting a curfew and being able to participate in a sport their parents thought would be dangerous. The descriptions of the characters' lives before they met the stranger were that of being alone and not really fitting in. This was also true of the authors' real lives. Because these students were talented in math and had been in accelerated math classes since elementary school, they were often seen as part of the nerdy group and so did not hang around with the popular students. While they brushed this issue off in real life, the comic book story gave them an opportunity to elaborate on this bias, to find others in the same situation, and to create a group of friends that got along because they were different rather than being shunned for being different.

The adventure in *Math Men* was to have the superheroes rescue the 9-year-old niece of the stranger who had helped them with their powers. They selected a math topic that would be familiar to a 9-year-old, since she was the one looking for help. The students selected multiplication as their math concept. While multiplication was obviously not as challenging as the math these students did in their regular math class, they did put a twist on it by looking at different strategies for doing multiplication (partial products and lattice) rather than just using the traditional multiplication method. Because these students had been accelerated throughout their elementary years, they would have been taught multiplication using the traditional method. However, the students all had younger brothers or sisters who had recently been introduced to these new methods for doing multiplication, and so these boys decided they would like to tie that into their story by having to help a third grader understand multiplication (Fig. 1). Once the girl was able to solve the multiplication problems, she would be free to go.

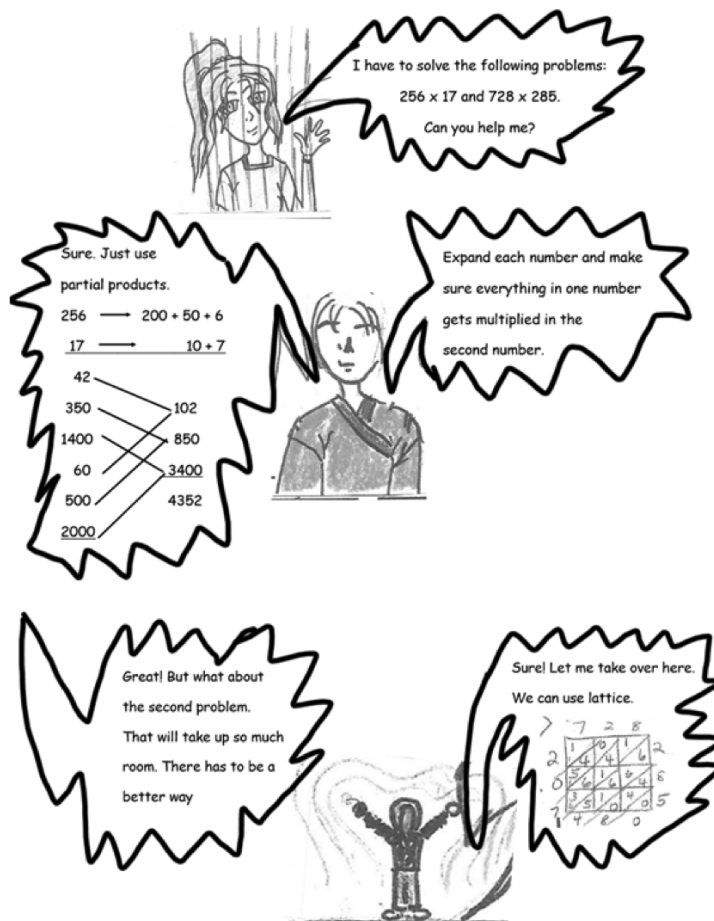


Fig. 1: Page from Math Men

The Subtractors

The authors of *The Subtractors* were two male students and two female students. When describing their backgrounds before becoming a team, these superheroes still talked about not being part of a group, but they also included what they could do. For example, one superhero had amazing tennis and dance ability, another had been part of a great soccer team, and another had the ability to work with animals. These characters were not separated from their families but rather were called upon from different activities after their amazing talents were spotted. Because this group was more diverse than the previous group and had one more student, there was more activity throughout the story as can be seen in the math piece selected.

The superheroes in *The Subtractors* had to find and disarm a bomb by breaking a code (Fig. 2). While these students may have done math activities in previous years on finding codes, it was not part of their then current math class. Therefore, these students had to re-search what kind of a code they wanted to use in their story. After much discussion during work time, they decided to go with a Vigenere Cipher which is more challenging than a Caesar Cipher (Fig. 3). The students said they thought the Caesar Cipher seemed a little too straight forward. Unlike *Math Men*, this story did not involve a third party without a superpower, and so the students used the opportunity to enhance their own mathematical skills by researching different types of ciphers and deciding to use this comic book activity to examine a topic that was normally not covered in their regular math class. Because of the additional member in this group, there were a lot more speech balloons throughout the comic book and there always seemed to be two people talking at once. While some might find that a little distracting at times, this does show that these students were starting to see the value of others and the benefits of having a diverse group even if the group members' mathematical interests were similar.



Fig. 2: Page from *The Subtractors*

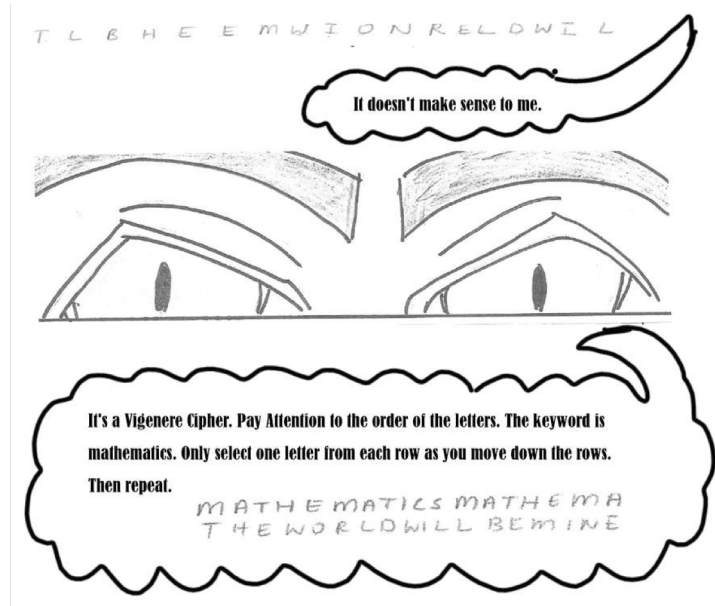


Fig. 3: Vigenere Cipher

The Adventures of Supercow and Frost

The authors of the third comic book were three female students. Unlike the other two groups, this group did not provide any background about their characters. The three female superheroes were from the same neighborhood and while two were friends prior to meeting for this adventure, there was no discussion of previous meetings or encounters. One character had a watch that could detect crime and on the way to the crime scene or what they thought was a crime scene, they met a third superhero, Monkeyous. In *The Adventures of Supercow and Frost*, an evil villain was about to use a mirror to direct a powerful sunbeam to destroy part of the city in which the three superheroes lived. The superheroes needed to build a shield that would protect their city from the sunbeam. The story in *The Adventures of Supercow and Frost* was not as linear as that of the previous two comic book stories. At any given time, one or all of the three superheroes would for no reason suddenly change into their animal characters as they worked to come up with a solution. In another odd twist to the story, the superheroes found and had to prove the candy was just M&Ms and Skittles and not memory-erasing pills. Although entertaining, the writing in this story could certainly have used further revision.

This group of students had selected a math topic which most closely related to what the students were studying in their current math class. This topic dealt with the area of polygons. However, the students decided to extend this math beyond just using the formula

for finding the area of a regular polygon. In order to make the story more realistic, the superheroes in the story needed to build an irregular shaped shield rather than a regular shaped shield. While finding the area of irregular polygons had been discussed in their math class, the students researched a different way of finding the area by using coordinates and adding or subtracting the areas of different trapezoids created by their sides and the x-axis (Fig. 4). Like the student authors in *The Subtractors*, these students used this activity as an opportunity to extend their study of a math topic that would not have been introduced in as much detail in their regular class.

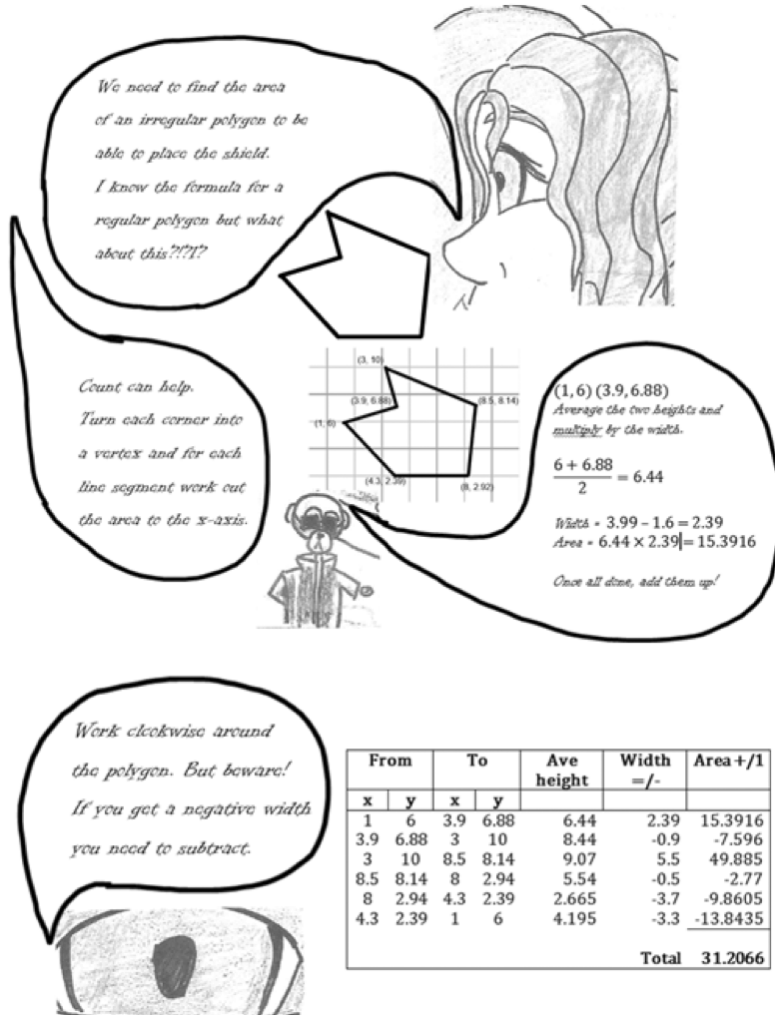


Fig. 4: Page from *The Adventures of Frost and Supercow*

Rubric for Comic Book Assignment			
Completeness	Elaborate story created and complete matching illustrations	Story created but does not elaborate on details. Some matching illustrations	Story is not complete or difficult to follow. Illustrations incomplete and not matching
Writing Skill	Story and illustrations well organized and situations clearly explained	Story and illustration lack clarity in places	Story missing important information or elements to convey to situation
Creativity	Ideas shared are original, humorous, and sophisticated	Most of the ideas are original and humorous	Ideas are not original
Visual Appeal	Multiple backgrounds, characters, and props are used	Some backgrounds, characters, and props are used	Limit use of backgrounds, characters, and props
Mathematical Complexity	Challenging mathematics concepts fully explained and used in appropriate ways	Mathematics concepts introduced but not always used appropriately	Mathematical concepts not clearly used

Fig. 5: Evaluation Rubric

Evaluation and Findings

A rubric was created to evaluate the students' work (Fig. 5). While the rubric was handed to the students at the beginning of the project, they were given feedback throughout the project on ways to improve or clarify their work. Students were asked to submit drafts of their character traits and the storyplot at various points. This gave the students opportunities to make changes before they started to write the comic book and create illustrations.

The gender breakdown of the superheroes in each group was the same as that of the authors. When asked to create characters all groups made their characters about 10 years older than themselves. Nevertheless, the groups gave their characters the same characteristics and traits as their 13-year-old selves. The all-male group tended to have a darker story. That group's characters backgrounds seemed to be sadder than the backgrounds of the group that had a combination of male and female students. There was also a lot more fighting in the all-male authored story than in the other two comic book stories. In the two groups that had female students, animals played a role although in both cases it was not a significant role.

There was also a lot more dialogue among the characters in comic books written by groups of female students. This talk was often centered on getting various ideas about how to proceed to solve the problem and trying to pick the best solution. The comic book activity gave these often quite female students an opportunity to talk together. The female characters in the comic book story that had both male and female superheroes spoke much more freely and frequently than their counterparts in the classroom. The comic book activity appeared to give these female students a voice and confidence to discuss mathematical concepts in front of their male peers.

Conclusion

The project described in this article set out to teach students in a mathematics class about diversity issues. In the end, apart from having different superpowers, the characters in the comic book stories were not very different from their real life counterparts. However, while the students were brainstorming their characters and stories, the student groups had lively discussions about different abilities and how those differences can be useful when working to solve a problem, be it mathematical or societal. Even within a basically homogenous math class, this project led to students talking about characters that were diverse and different from the students' own experience. This supports what Moyer, Cai, and Grampp (1997) suggest when talking about student diversity: "each student can learn by making unique contributions to the group exploration, and each can learn through the group's resolution of diverse points of view" (p. 152). By being given the opportunity to create a world and characters for their comic books, all these students contributed to what should be in that world and how it should be different from and better than their own world.

In addition to thinking about diversity, this activity also allowed the students to become more involved in working with challenging mathematical tasks. Students researched math topics that went beyond those they had studied in their regular math classes. Following this research, the students then had to work to incorporate those independently studied math concepts into their comic book stories. By encouraging further exploration of math topics, this project actively engaged students in new learning. Even students that were normally quite passive during their regular math class became excited by working on this project. This comic book writing project became a super way to teach students about math and the value of diversity.

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