READING A NOVEL IN MIDDLE SCHOOL SCIENCE: THE IMPACT OF SOCIOSCIENTIFIC ISSUES

by

Susie Ellen Dobkins

A professional paper submitted in partial fulfillment
of the requirements for the degree

of

Master of Science

in

Science Education

MONTANA STATE UNIVERSITY
Bozeman, Montana

July 2021

©COPYRIGHT

by

Susie Ellen Dobkins

2021

All Rights Reserved

DEDICATION

I dedicate this paper to my seventh-grade life science students this 2020-2021 school year. You have helped me grow as an educator during these uncertain times. You are always so curious, thoughtful, and ready to learn. For that, I am constantly inspired. I cannot wait to see what your future holds.

ACKNOWLEDGEMENTS

Thank you to all of my MSSE classmates and instructors for your support and intellect these past two years. Special shout-out to John Graves, my advisor, on constantly giving unwavering support and flexibility in these uncertain, pandemic times. My science reader, Joe Bradshaw, for giving me guidance throughout the data collection process. Also, the Montana State University Library staff for being amazing resources for help whenever I needed it.

TABLE OF CONTENTS

1. INTRODUCTION AND BACKGROUND 1

Focus Questions 3

2. CONCEPTUAL FRAMEWORK 4

Retention of Information 4
Push for Reading in the U.S. 5
Importance of Socioscientific Issues in Science Education 6
Why Students Need to Understand Socioscientific Issues 7
Socioscientific Reasoning and Novels In The Science Classroom 8

3. METHODOLOGY 10

4. DATA AND ANALYSIS 13

Science Content Questions 13
Global-Mindedness Questions 15
Perspective-Taking Questions 16
Socioscientific Issue Questions 18
Reading In Science Questions 23

5. CLAIM, EVIDENCE, REASONING 26

Claims From the Study 26
Value Of the Study and Consideration For Future Research 28
Impact Of Action Research on The Author 29

REFERENCES CITED 30

APPENDICES 34

APPENDIX A: IRB Approval 35
APPENDIX B: Pre and Post Survey 36

LIST OF FIGURES

Figure Page

1. Figure 1 & 2 14

2. Figure 3 15

3. Figure 4 16

4. Figure 5 17

5. Figure 6 18

6. Figure 7 19

7. Figure 8 20

8. Figure 9 21

9. Figure 10 22

10. Figure 11 23

11. Figure 12 24

12. Figure 13 & 14 25

ABSTRACT

This study was conducted at Eileen Johnson Middle School, a 6-8 public middle school with about 400 students located in Billings, Montana. Since the No Child Left Behind Act in 2002, schools have been under increased scrutiny to raise their student test scores in reading and math. Many schools have begun taking away students' science, social studies, and elective courses if they are testing below average in reading and/or math and placing them in an additional reading and/or math intervention course. This study aimed to see if incorporating a novel in a seventh-grade life science class could have a positive impact on students' enjoyment of reading, science content understanding, build 21st century skills such as perspective-taking and global-mindedness, as well as increase students understanding of socioscientific issues.

Students were given a pre and post survey before beginning their Traits and Reproduction Unit. Students read between five to eight pages of the book per day at the beginning of class. The class then discussed what had occurred during that section and the discussion flowed wherever students wanted it to.

Students in the treatment group showed a medium normalized gain in science content understanding whereas students in the non-treatment group showed a low normalized gain. Students showed a 75% increase in the answer response that showed an understanding of socioscientific issues, empathy, and a desire to be the scientist who cures malaria. Students showed an overall increase in responses that related to socioscientific issues such as who owns scientific information. Students who read the book had a large increase in seeing reading as useful in science.

This study showed larger normalized gains in science content knowledge for the treatment group than the non-treatment group meaning reading a book on socioscientific issues could have helped students understand science content information. It also showed an increase in students understanding of socioscientific issues and global mindedness. In addition, students who read the book had an overwhelming increase in ability to see reading in science as useful in building their knowledge about the world and understanding of science content.

INTRODUCTION AND BACKGROUND

Lockwood Middle School is located in Billings, Montana. There are approximately 340 students in grades 6-8. Lockwood is on the outskirts of Billings in a rural area. The city of Billings has approximately 120,000 people, and is situated in South Central Montana, about 164 miles from the Wyoming border. Located 78 miles north of the Crow Indian Reservation. The community of Lockwood has a population of 8,066 (U.S. Census Bureau) and many of the citizens work at Exxon Mobil, have blue-collar jobs, or commute into Billings for work. A new middle school was built in 2009. Before the new middle school was built K-8 students were housed in the elementary building. Distribution of males and females is equal within the school and 23% of the student body is considered a minority and 48% of students are considered low-income according to free and reduced lunch enrollment (Public School Review, 2021).

The district as a whole is a Title 1 school, with students from preschool through 10th grade on campus. The average graduation rate for all students across Montana was 86.63% during the 2018-2019 school year. While this is higher than many states, many students within the following categories do not have such a high graduation rate. Students who need special education services graduated at a rate of 78.03%, students who are considered economically disadvantaged graduated at a rate of 77.62%, and American Indian students graduated at a rate of 66.73% (OPI Report Card, 2018).

Students at Lockwood Middle School are not tracked in science; however, they are tracked in math which influences which students are in various classes. Montana Science Standards have been based off of the Next Generation Science Standards since

2016. In our school, sixth grade students take earth and space science, seventh grade students take life science, and eighth grade students take physical science. At the end of eighth grade students take a state science assessment called the Montana Science Assessment. Lockwood Middle School science scores for the 2018-2019 school year were 15% novice (state score was 11% novice), 30% nearing proficient (state score was 27% nearing proficient), 45% proficient (state score was 42% proficient), and 10% advanced (state score was 19% advanced) (OPI Report Card, 2018).

While science test scores are lower than the state averages, our reading scores are also of concern. During the 2020-2021 school year reading data was tracked meticulously using AIMSWeb testing to see how the COVID-19 epidemic and our modified schedule had affected our students. From the beginning of the school year (about one month in) to Winter (testing was around February) Tier 1 (rated as above 51% proficiency) went from 65% of the student body to 59% of the student body. Tier 2 (26-50% proficiency) went from 16% of the student body to 21%. Tier 3 (under 25% proficient) went from 18% of the student body to 20% of the student body (unpublished raw data). From August to February, we had a literacy consultant in our school frequently giving teachers new reading strategies and gathering buy-in for implementation. Anecdotally, most teachers were onboard with implementing these strategies despite poor results.

From August to October, we moved from one in-person day of school a week with the rest online to two in-person days a week and the rest online. Online learning was mostly assignments students could do at their own pace with some synchronous online experiences scattered within. At the end of February, we allowed students on campus

four days a week with Friday as an extra homework help day. Due to past and current data trends in reading, teachers were tasked with focusing more on disciplinary and content literacy. For myself, this meant teaching students how to read like a scientist, how to argue like a scientist, and how science literacy is different than literacy in other content areas.

However, reading in science cannot stand alone. As science educators, we are taught that lessons that stand alone do not engage students and are weak in regards to broader contextual connections, global understanding, and long-term learning. This issue with focusing solely on reading in science led me to the focus questions below.

Focus Questions

1. How does reading a novel influence student understanding of socioscientific issues?
2. Is there a relationship between socioscientific understanding and students' perceptions of their global-mindedness, perspective-taking, and empathy?
3. Does reading a book about socioscientific issues have an impact on science content understanding?
4. Does reading a novel in science class increase student's perceived relevance of reading in science?

CONCEPTUAL FRAMEWORK

Retention of Information

How people learn best is a constant topic of conversation in education circles. Storytelling has been touted as one of the most effective ways people remember information. Stories have been dubbed psychologically privileged by psychologists because they are treated differently in our memories (Willingham, 2010). Reading researchers have conducted experiments to see which reading format is the most interesting. Stories are rated higher than other formats even when the same information is given in a different format. However, stories with too much information given were ranked as less interesting because they don't allow people to make inferences about what is going to happen and thus less pathways in the brain are being used. The same goes for stories with too little information and thus making an inference is too difficult (Kim, 1999).

One perspective about reading narrative-writing (stories) specifically is called personalization principle (Arya & Maul, 2012). This principle states that students learn concepts more deeply when what they are reading when there is a more conversational, informal writing style and a more intense social presence (Mayer, 2009). This same study by Arya and Maul (2012) found that embedding narrative into text held true especially with seventh grade students and students from the lower-income, predominantly non-Caucasian school they tested. As can be documented, stories and narratives are an effective way to learn, so why not put them into our curriculum? Why are reading programs pushing short articles over longer text?

Push for Reading in the U.S.

While many educational policies change with rotating presidents, the push for an increased emphasis on reading comprehension and fluency seem to have found a stable place in today's educational world. The No Child Left Behind Act passed in 2002 has had reverberating consequences for K-12 institutions. Many schools, including my own, cut back on social studies, science, and elective courses such as music and art to push additional reading and math courses. Students who require remediation in reading and/or math have an additional reading and/or math intervention course they must take to try and catch up. These changes to curriculum primarily affect students who test below grade level. A survey by the Center on Education Policy found a reduction of instructional time spent on history, music, and other subjects to allow for more math and reading time in 71% of school districts across the United States (Dillon, 2006).

Former Secretary of Education, Margaret Spellings, made statements saying that schools focusing on basic skills is raising performance in many low-performing schools. However, other experts are worried that emphasis on two subjects will teach students that education is just repetition (Dillon, 2006) and may become so disenchanted with education that drop-out rates will increase. Reading, especially in schools who continue to be lacking in meeting state testing requirements, has a huge emphasis in education at this time.

Importance of Socioscientific Issues in Science Education

While there has been a push to increase reading skills and scores, there has also been a push to increase students 21st century skills. Our world is increasingly becoming interconnected due to the swell in technology and science. The Partnership for 21st Century Skills (P21) developed a list of skills our future generations need to be engaged, informed, global citizens. This document, along with the Framework for K-12 Science Education by the National Research Council, allude to the idea that a shared understanding and developing empathy can help increase 21st century skills (Chung et al., 2016).

Building global citizens by emphasizing empathy, perspective-taking, and giving students opportunities to learn about different cultures can occur by studying socioscientific issues. Socioscientific issues (SSIs) are situations between science and society, open to multiple perspectives, and are generally complex (Sadler & Zeidler, 2004; Zeidler & Kahn, 2014). Studying socioscientific issues allows students to take the terms, definitions, and concepts they are learning in class and apply them to real-world contexts (Villarin & Fowler, 2019). As we seek to educate students in twenty-first century skills, we need to stop over-emphasizing content knowledge without incorporating real-world problem-solving and issues. Socioscientific issues have become increasingly more important in the field of science education as a means to make science learning more relevant to students' lives (Cajas, 1999; Pedretti, 1999; Sadler & Zeidler, 2004).

Why Students Need to Understand Socioscientific Issues

Middle school students are at an age developmentally where they are finding their sense of self, experimenting with new values (among other things), (Center for Parenting Education) and developing various skills such as empathy and perspective-taking. Being able to take in multiple perspectives is an important part of scientific literacy and critical thinking (Newton & Zeidler 2020; Seale, 2020).

Perspective-taking has been found to help develop empathy. Lamm et al. analyzed college students who were watching videos of people who were in pain. These students were able to regulate their response emotionally when they were told that the treatment would affect the patients positively (Lamm et al., 2007). Another example in of perspective-taking developing empathy were undergraduate students participating in a course in a National Park using socioscientific issues developed by Herman et al. (2018). Students could express emotional reasoning about how people and nature were impacted by environmental issues when they had the ability to consider the perspectives of the natural and individual entities.

Morality also comes into play with perspective-taking. In a study on genetic engineering as a socioscientific issue, analyses showed that students morals had significant influence on decision-making. This led students to construe the socioscientific issue of genetic engineering as a moral problem (Sadler & Zeidler, 2004).

Since socioscientific issues, by definition, have societal ramifications, students need to be able to use their ability to take in multiple-perspectives, empathize, think in a global-minded way, and knowledge of science to effectively ‘solve’ these issues as future

citizens. After studying college student's ability to construe and resolve genetic engineering dilemmas, researchers found that morality was a huge part in decision-making as moral ramifications on a large scale need to be considered (Sadler & Zeidler, 2004). The authors also made the point that if moral ramifications of policy and societal decisions are not considered, then any conclusions that are drawn are drawn with ignorance. Being able to thoughtfully negotiate a socioscientific issue is needed for all people in our society, not just scientists (Sadler, 2004; Zeidler & Keefer, n.d.). Some of those socioscientific issues affecting today's world are gene therapy, stem cell research, climate change, food production for our growing population, and the extent that artificial intelligence runs our world.

Socioscientific Reasoning and Novels in the Science Classroom

Research with future K-8 educators found changes to educators' perspective-taking and that researching and reading about the issue were critical aspects to their socioscientific understanding (Newton & Zeidler, 2020). With the national push in K-12 schools for more reading-heavy instruction, integrated novels in the science classroom could become more prevalent. This project seeks to understand if developmentally appropriate novels with socioscientific issues and science concepts imbedded in them could change students' soft skills such as perspective-taking/empathy and global-mindedness. In addition, will these soft skills enhance students understanding of sociocientific issues and science content understanding. Overall, since educators have a finite amount of time and many standards and skills to teach, is a novel on socioscientific issues worth their time?

METHODOLOGY

The purpose of this study was to determine if giving students the opportunity to read a science novel over a unit increased their ability to be global-minded citizens, understand other people's perspectives, increase socio-scientific understanding, as well as science content knowledge. The subjects of this study were 99 seventh grade life science students. Montana State University's Institutional Review Board gave this project an exemption (Appendix A).

The project involved forty-six of the students reading the book *Mosquitoes Don't Bite Me* by Pendred Noyce over a four-week period and the fifty-three of those students not reading the book. The book is about a seventh-grade African American girl who conducts a research on why mosquitoes don't bite her. A local medical company developing a drug for malaria finds out and begins testing the young girl and her family. The company takes her to Kenya so they can meet and test the rest of her family. It is in Kenya that the young girl realizes there are many obstacles to people getting the medicine and medical treatment that they need.

All students began the class during this four-week period with either bell work or a retrieval practice quiz. After this activity, students in my first three periods would begin reading the pages assigned for that day. When finished reading the pages, usually about 5-8 pages per day, as a class we would discuss what we had read and the discussion was allowed to meander wherever students wanted to take it. Students in my other three periods would complete the introduction activity and then move on to the next activity without reading.

This novel was read during our traits and reproduction unit. During this unit students were learning about how genes are the instructions for proteins that make up our traits, as well as how these traits run in families. They were engaged in argument with evidence about a young girl who was the only distance runner in a family of sprinters and were trying to figure out how that was possible. This unit also allowed students to learn about heterozygous, homozygous dominant and homozygous recessive traits. Students learned about asexual and sexual reproduction, and how genes are distributed to offspring during that process.

Students were administered the Socioscientific Issues Survey (Appendix B) which was built based off of the PISA Global Competence Questionnaire (2018). The survey was conducted before and after the traits and reproduction unit. The survey was multiple-choice containing twenty-six questions. These questions asked students about perspective-taking, global-mindedness, socioscientific issues, as well as science content. Likert Survey responses were used for some responses with answer choices of Strongly Agree, Agree, Disagree, and Strongly Disagree. Other answer choices related to perspective-taking and global-mindedness were Very Much Like Me, Mostly Like Me, Somewhat Like Me, Not Much Like Me, and Not at All Like Me. Socioscientific and science content questions varied in their answer choice types. The post-survey for the treatment group contained three more questions than the pre-survey. These questions were about how much of the book they read and their enjoyment of the book.

Data for the Socioscientific Issues Survey was analyzed on both the treatment and non-treatment groups. The non-treatment group data was used to compare science content

knowledge against the treatment group as well as for the reading questions. Since the non-treatment group did not discuss the book or socioscientific issues in class, the questions on global-mindedness, perspective-taking, and socioscientific issues were not analyzed. Percent change calculations were made for nearly all questions to see the change in response from pre to post test. Normalized gains were calculated for the science content questions for the non-treatment and the treatment group. Gains of less than 0.3 percent are considered low, gains of 0.3 to 0.7 are medium, and gains greater than 0.7 are considered high (Hake, 1998).

DATA AND ANALYSIS

Science Content Questions

Science content scores for the treatment group showed an increase in science content understanding across all questions (*N*=46). This section of questions was specifically related to a section of the book as well as what students were learning in their traits and reproduction unit. Students in the treatment group had the highest percent increase on the questions relating to interpreting pedigrees with a percent increase of 46% and 48% respectively. The lowest percent increase was 9% relating to a more complex genetics concept of how traits are passed down (Figure 1).

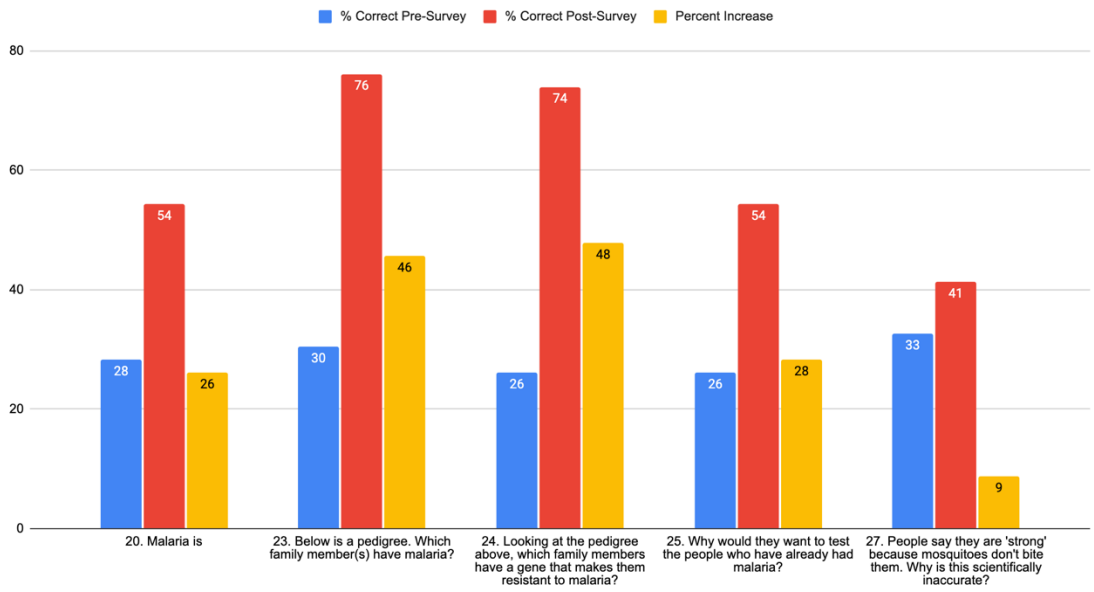


Figure 1. Treatment group pre and post test scores from science content questions relating to traits and reproduction unit, (*N*=46).

Science content scores for the non-treatment group showed different results to the treatment group. While the non-treatment group had a higher post-survey score on question twenty-three, they had a lower percent increase than the treatment group The treatment group had medium normalized gain scores from pre to post survey where the non-treatment group had low normalized gain scores. The treatment group had 0.44 and the non-treatment group had 0.27 (Figure 2).

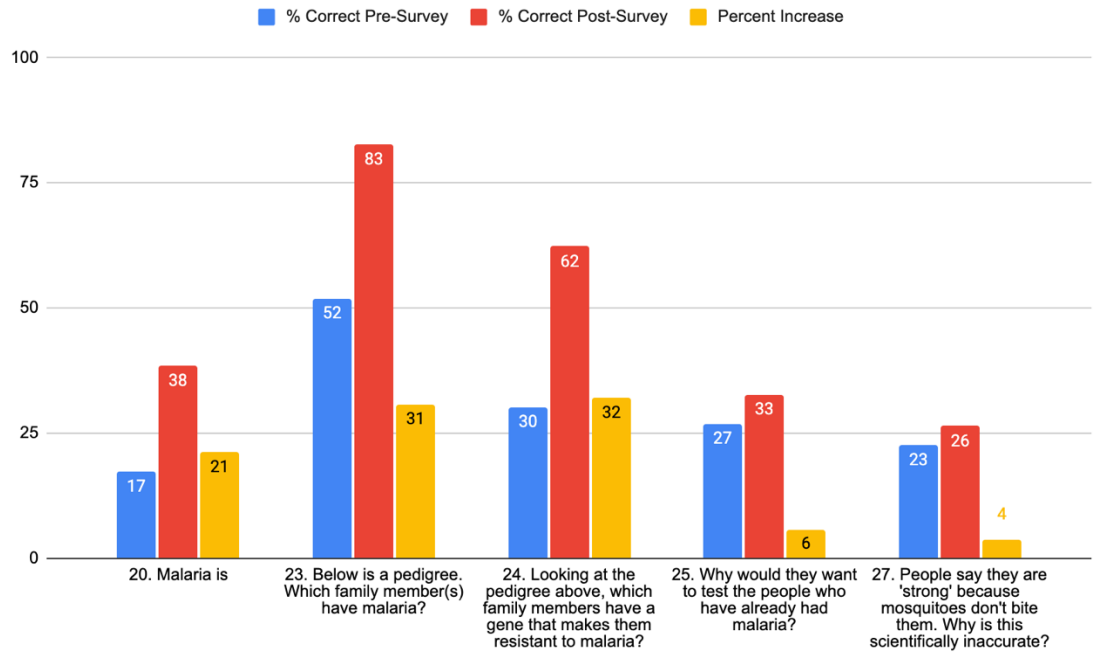


Figure 2. Non-treatment group pre and post test scores from science content questions relating to traits and reproduction unit, (*N*=52 for questions twenty, twenty-three, and twenty-five and *N*=53 for questions twenty-four and twenty-seven).

Global-Mindedness Questions

When answering questions related to global mindedness, the treatment group had a 400% increase in students answering strongly agree when asked students felt they knew about other parts of the world (Question 1). Contrarily, there was a 25% increase in

students answering disagree as well as a 40% decrease in the strongly disagree response when queried about seeing poor conditions and feeling responsible to do something about it (Question 5). Thinking they could do something about the poor conditions in the world yielded a 54% increase in disagree responses and a 50% increase in strongly agree responses (Question 7) (Figure 3).

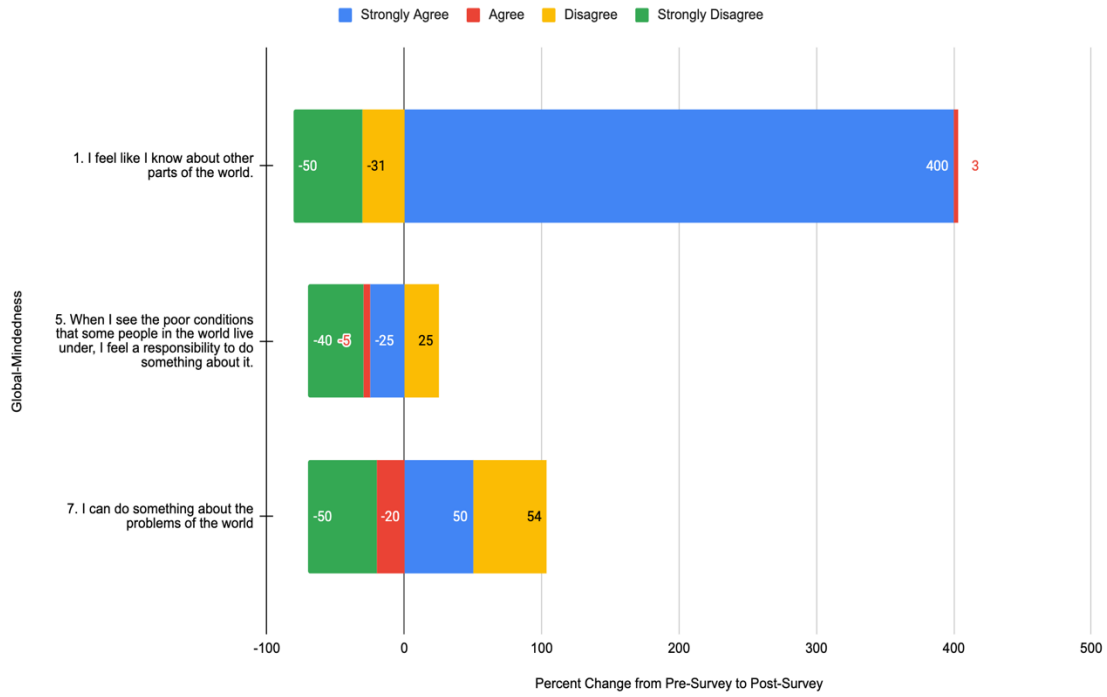


Figure 3. Treatment group four-part Likert responses on global-mindedness, (*N*=46).

There was a 150% increase in mostly like me responses for students in the treatment group when asked if they wanted to learn about people in different parts of the world and a 67% decrease in not at all like me responses (Question 8) (Figure 4).

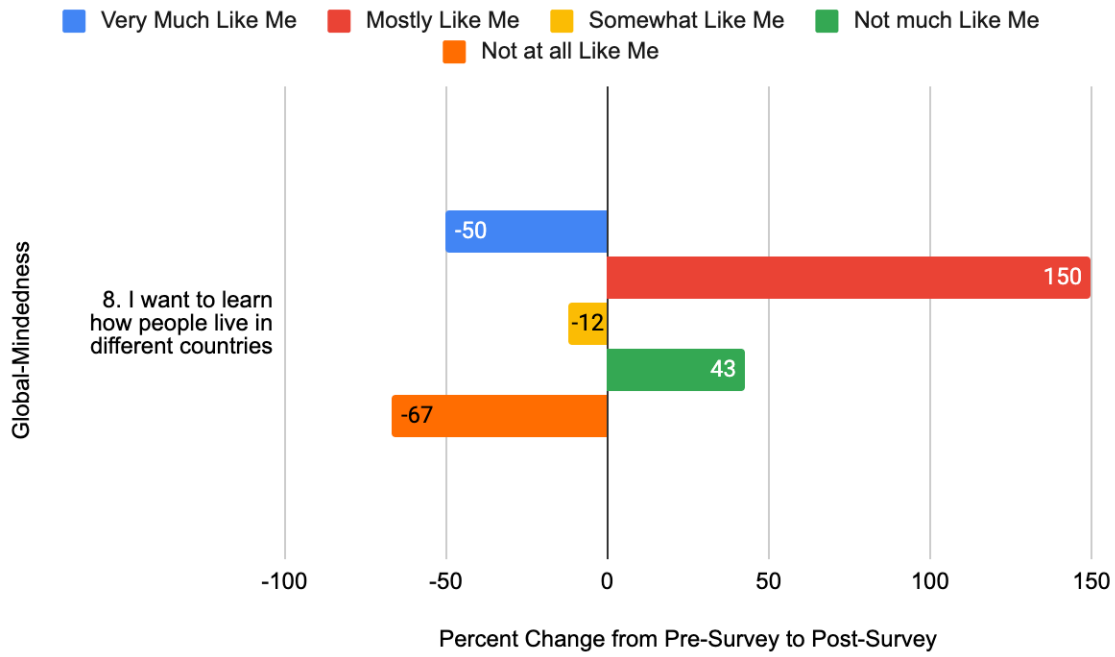


Figure 4. Treatment group five-part Likert responses on global-mindedness, (*N*=46).

Perspective-Taking Questions

Responses relating to perspective-taking had mixed results for the treatment group. There was a 100% decrease in strongly disagree responses and a 75% increase in disagree responses when asked if students feel open-minded and respectful of the opinion of others (Question 2). This shows that students changed their responses from strongly disagree to disagree. There was also a 38% increase in strongly agree responses and a 13% decrease in agree responses. When asked about what makes someone a bad person, the results showed a 150% increase in strongly agree responses and a 15% decrease in agree responses (Question 18) (Figure 5).

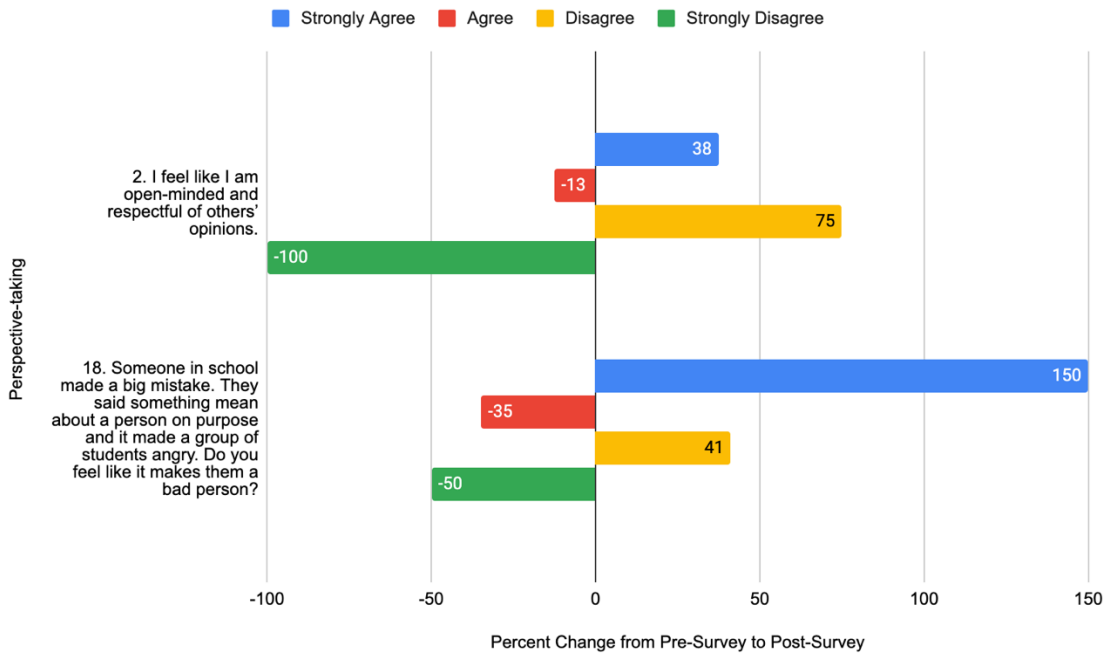


Figure 5. Treatment group responses for perspective-taking questions, four-answer questions, (*N*=46).

The second section of perspective-taking questions had a myriad of responses. When asked if students gathered information from all sides beyond making a decision, there was a 167% increase in not much like me responses and a 57% increase in mostly like me responses (Question 10). Additionally, there was a 63% decrease in very much like me responses, a 27% decrease in somewhat like me responses, and a 67% decrease in not at all like me responses. When students were asked if there are two sides to every story, results indicated a 75% increase in mostly like me responses and a 13% increase in very much like me responses with decreases in the neutral and negative responses. Mostly like me responses for question twelve showed a 38% increase with a 0% increase in not much like me and mostly like me responses; neutral and not at all like me responses decreased (Question 11). When asked if students taking into account the

feelings of others before criticizing, there was a 25% increase in mostly like me responses and a 17% increase in somewhat like me responses. For the same question there was a 25% decrease in very much like me, a 27% decrease in not much like me, and a 17% decrease in not at all like me responses (Question 13) (Figure 6).

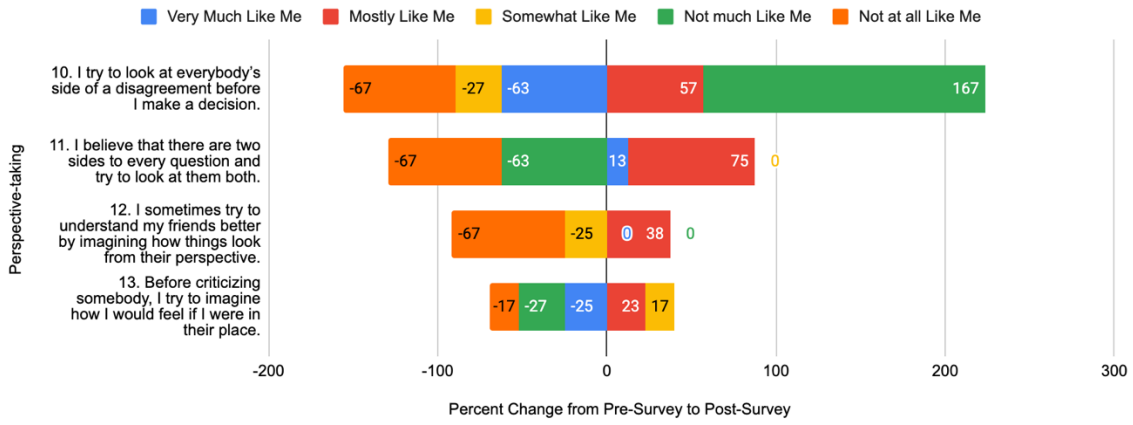


Figure 6. Treatment group responses to perspective-taking questions (five-part responses), (*N*=46).

Socioscientific Issues Questions

When students were presented with data that suggests that millions of people die of malaria each year and asked their feelings, the results showed a 75% increase in the response showing empathy as well as a personal interest in finding the cure for malaria (Question 14). For the same question there was a 6% increase in the response showing empathy, an 18% decrease in the more neutral response, and an 11% decrease in the apathetic response (Figure 7).

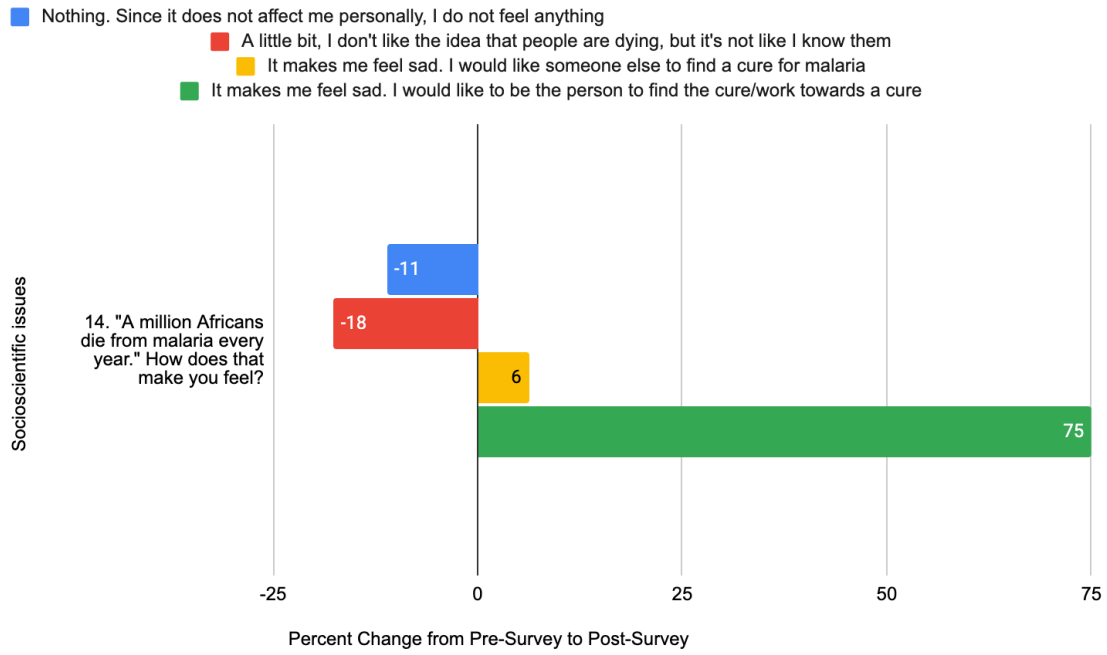


Figure 7. Treatment group responses to question fourteen, (*N*=46).

When asked if it is ethical to gather health data on humans, a 16% decrease in the positive response towards testing drugs on humans and a 200% increase on the negative, no-human testing response (Question 15). There was a 75% increase in the response that did not believe in making humans suffer for the greater good and a 33% increase in the response that said we should only test on other animals, not humans (Figure 8).

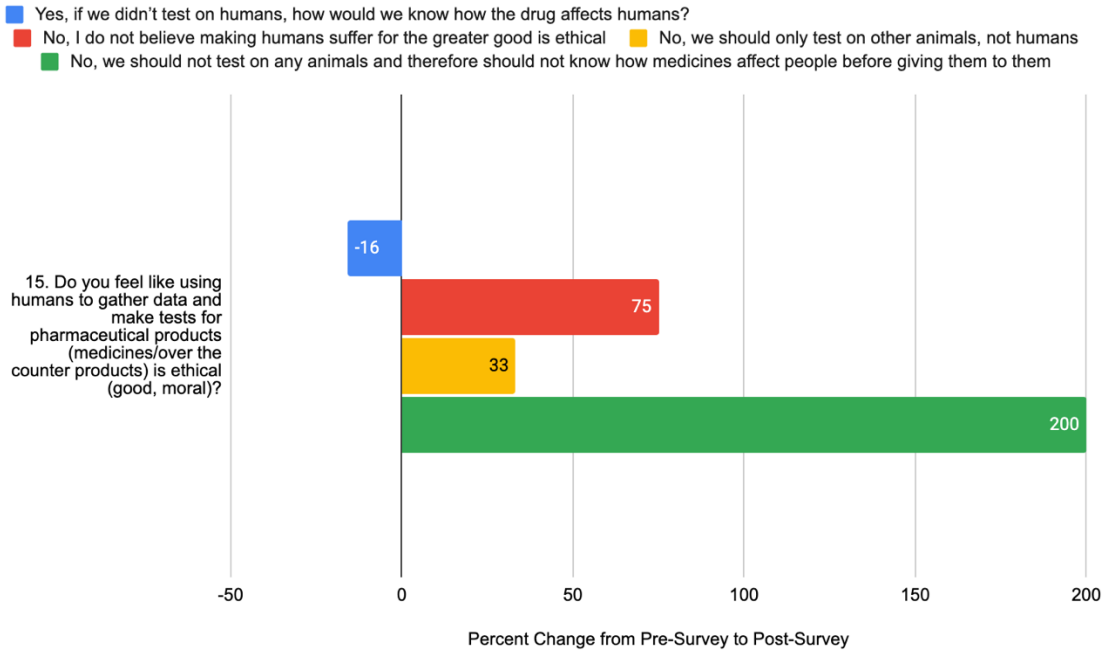


Figure 8. Treatment group change in responses from pre-survey to post-survey for question fifteen, (*N*=46).

When asked about health services in rural versus metropolitan areas, student responses decreased in one-choice options and a 44% increase in the all of the above response. However, the answer choice about cost did see a 50% increase and the response about medicines not working on malaria anymore saw a 100% decrease (Question 21) (Figure 9).

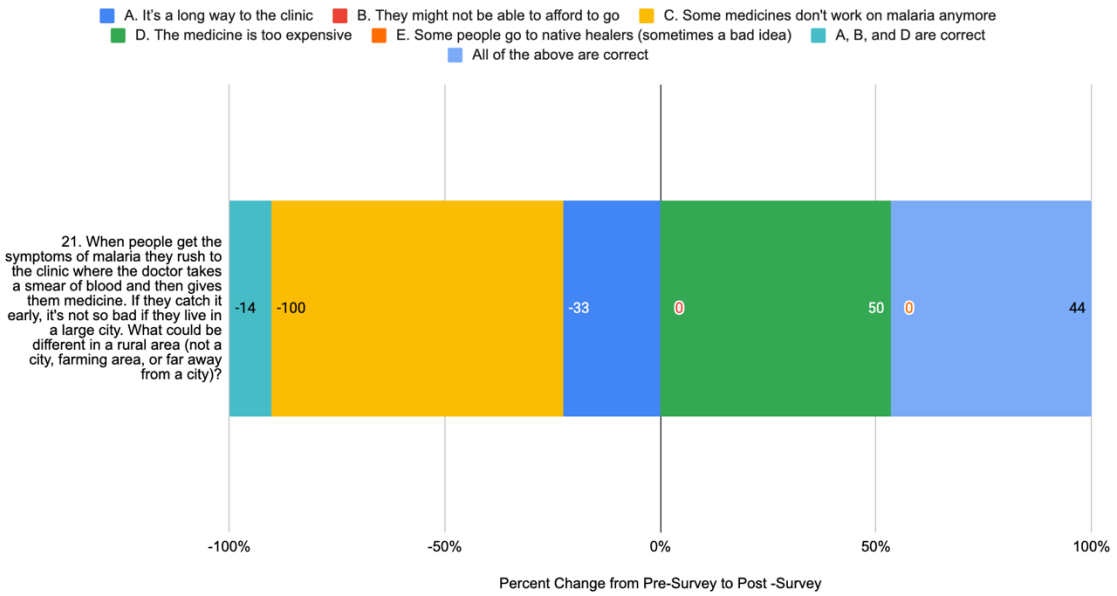


Figure 9. Treatment group results for question twenty-one on percent change from pre to post survey (*N*=46).

When asked about the use of cloned cells, students reported a 62% and 14% increase in the strongly disagree and disagree response and an 80% and 43% decrease in the strongly agree and agree responses (Question 17). When asked about the merits of assisting research labs, at no cost, there was a 100% increase in the disagree response and a 0% increase in the strongly disagree response (Question 22). There was a 17% and 19% decrease in the strongly agree and agree response. When aske about over-the-counter medication being available to sick individual, there was a 22% increase in disagree responses, a 50% decrease in strongly agree responses, and a 13% decrease in agree responses (Question 26) (Figure 10).

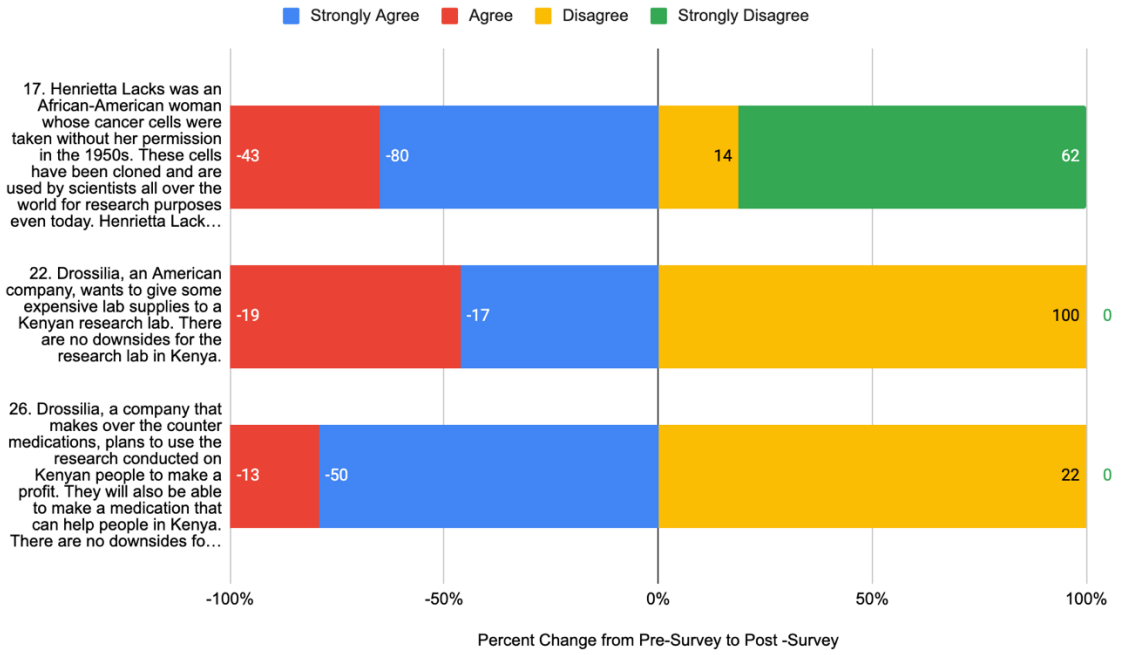


Figure 10. Treatment group results for questions seventeen, twenty-two, twenty-six on percent change from pre to post survey, (*N*=46).

When asked why giving malaria drugs was an issue, there was a 100% increase in the correct response as well as a 16% increase in the all of the above response (Question 28). There was a decrease in one-question answer responses with more students choosing the multi-answer options (Figure 11).

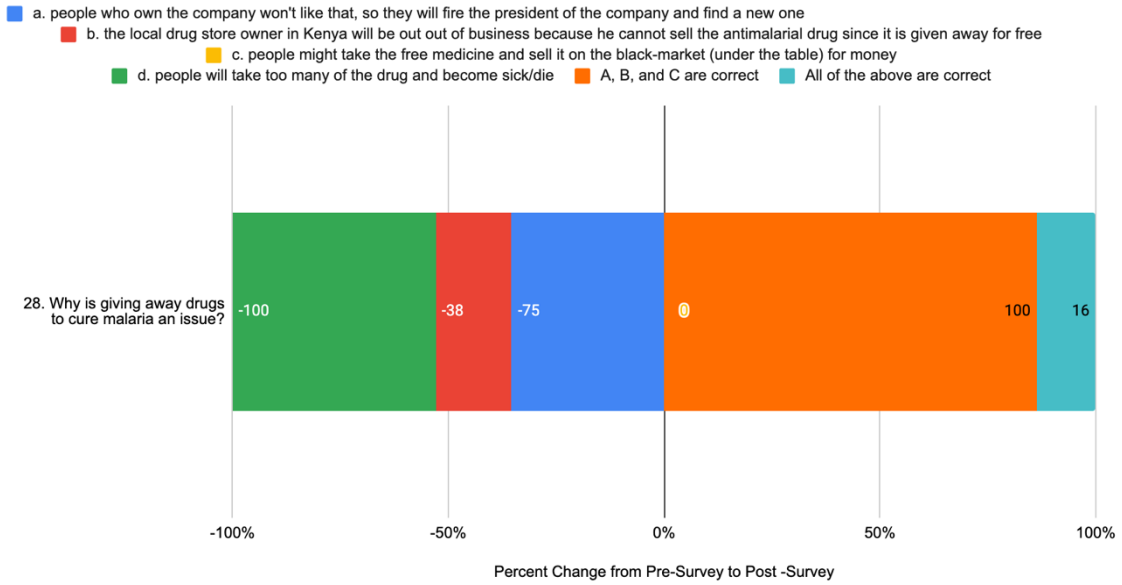


Figure 11. Treatment group results for question twenty-eight on percent change from pre to post survey, (*N*=46).

Reading in Science Questions

When students were asked about how much reading novels in science class helped them learn and gain new world perspectives, the treatment group saw an increase in positive responses and a decrease in negative responses. The most striking was the 600% increase in students who said strongly agree when answering about how reading science novels helps them understand novels better. For the non-treatment group, or students who did not read the novel in class, the results were close to the opposite. When asked if reading novel changed their world view perspective, the non-treatment group reported a 39% increase in disagree responses and a decrease in all other responses (Figure 12).

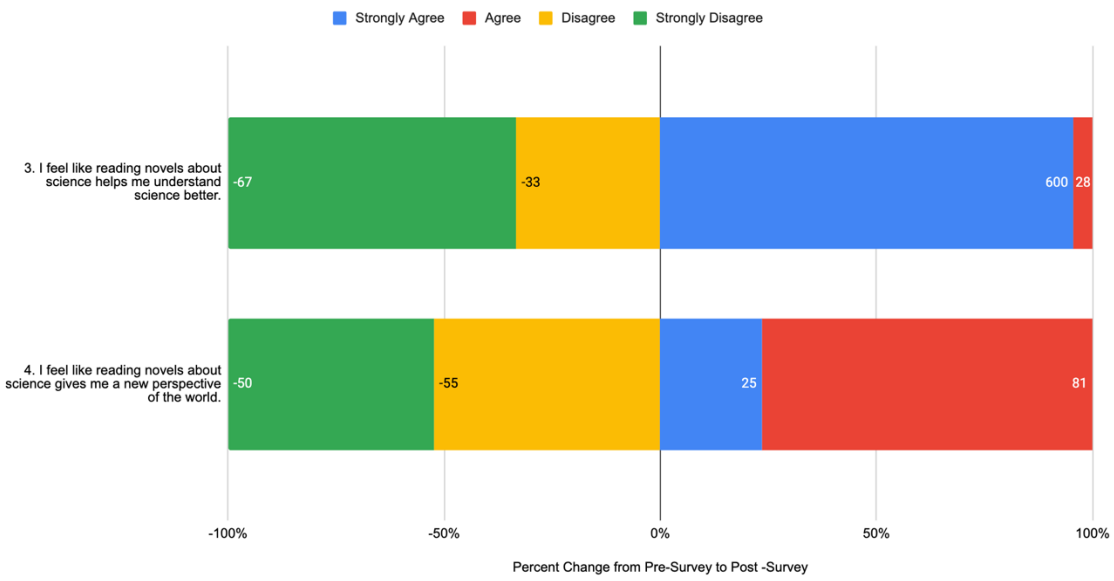


Figure 12. Treatment group percent change results from pre-survey to post-survey on questions three and four regarding reading in science, (*N*=46).

Overall, 39% of students in the treatment group said they liked reading the book in class each day, 50% liked it some days and some days did not, and 11% did not like reading the book in class. Student responses were not deleted if students had significant absences during the unit of study, even though that could have impacted student responses (Figure 13).

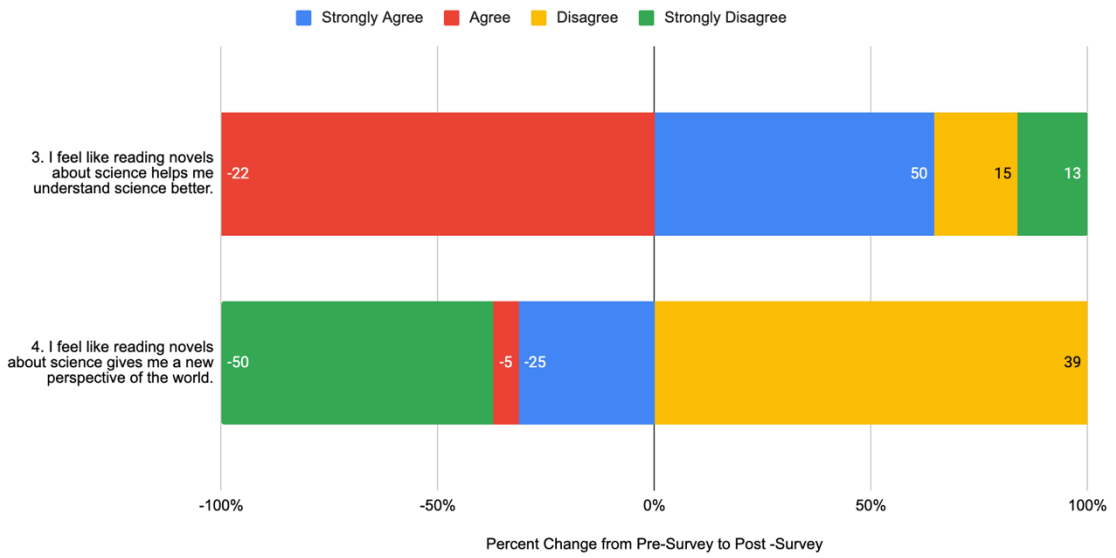


Figure 13. Non-treatment group percent change results from pre-survey to post-survey on questions three and four regarding reading in science, (*N*=53).

Finally, when queried about students' responses to the enjoyment of reading, the majority reported feeling neutral (Question 14)(Figure 14).

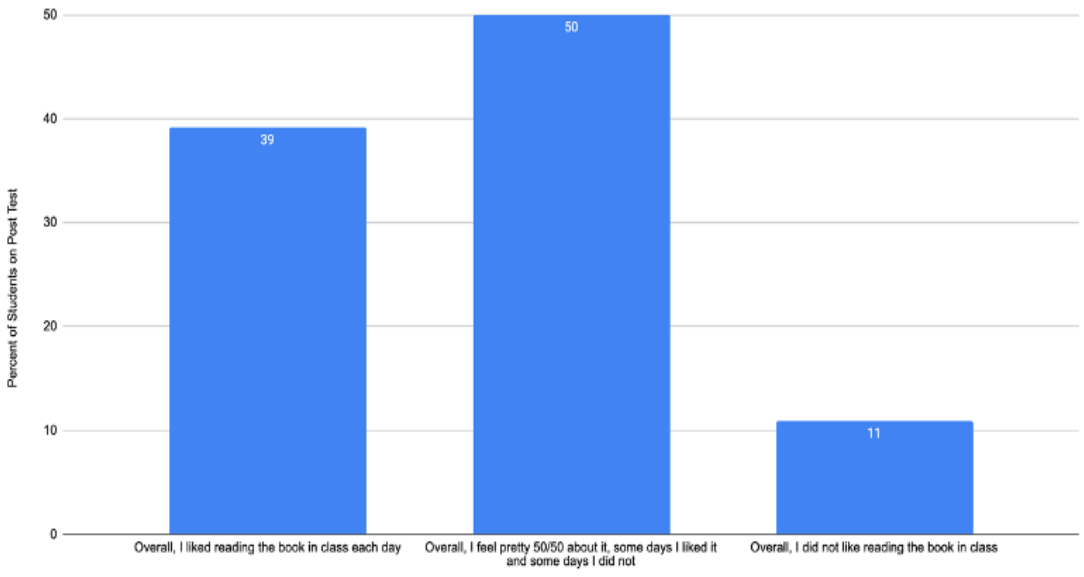


Figure 14. Students' responses about enjoyment of reading the book, (*N*=46).

CLAIM, EVIDENCE, REASONING

Claims From the Study

Due to the small sample size of this study, the results are not statistically significant however they are practically significant. However, claims can still be made based on the data above. The first focus question of this study was How does reading a novel influence student understanding of socioscientific issues? Overall, the treatment group saw an increase in positive responses (or negative responses, if the question was steered that way) to questions on socioscientific issues. The most striking of these results was from question fourteen which stated "A million Africans die from malaria every year. How does that make you feel?" (Question 14). There was a 75% increase in the response that showed empathy and a desire to be the person who discovers a cure for malaria. Similar response changes were seen across all questions relating to socioscientific issues. For questions seventeen, twenty-two, and twenty-six, students were asked to evaluate whether something was morally acceptable to do (negative responses were appropriate here) and there was an increase in the moral response across all questions.

Focus question two stated: Is there a relationship between socioscientific understanding and students' perceptions of their global-mindedness, perspective-taking, and empathy? Perspective-taking had the most mixed results. Some questions students had an increase in perspective-taking and other questions students had a decrease in their perspective-taking. Therefore, perspective-taking was not influenced here. Global mindedness had an increase in positive responses. There was a 400% increase in students saying *strongly agree* for question one (I feel like I know about other parts of the world).

While empathy was not directly tested in this study, having a global-minded attitude and an ability to take multiple-perspectives has been linked to empathy.

Focus question three stated: Does reading a book about socioscientific issues have an impact on science content understanding? For this question, both the treatment group and the non-treatment group data were analyzed. There was an average increase in correct answers across all science content questions of 31.4% for the treatment group and a 18.8% for the non-treatment group. This shows that, while not statistically significant, there was a positive increase in science content learning when incorporating the novel into class.

Focus question four stated: Does reading a novel in science class increase students' connections between science reading and learning? Both the treatment group and non-treatment group were asked questions about reading in science and how it helps them learn as well as if reading novels in science gives them a new perspective of the world. Students in the treatment group had an average increase in strongly agree and agree responses of 183.5% across both questions. Students in the non-treatment group had an average increase of 25% strongly agree responses and a 37.75% increase in disagree and strongly disagree responses. Overall, reading a novel on socioscientific issues in science class did seem to have a positive effect on students' connections between reading and science.

Value of the Study and Consideration for Future Research

This study shows that reading a novel in a science class, specifically one with a socioscientific theme, has an impact on student learning and soft skills. Schools,

specifically schools with low test scores, are pushing reading into every subject area due to national testing requirements that focus heavily on reading. While reading skills are important, there is no one-size-fits-all approach to reading the works for everyone. Many schools are steering away from reading novels and instead encourage teachers to have students read and annotate short articles. However, there is a place for reading novels in science, especially if these novels are chosen carefully for science content and, if applicable, socioscientific issues embedded within.

Furthermore, students had a more positive outlook on reading after completing the novel and felt that it helped them gain new perspectives about the world. This study had multiple purposes, but overall, I just wanted students to be reading more, learn about the world, and broaden their socio-emotional skills. Nearly all of these goals were obtained in four short weeks in the classroom, reading only five to seven minutes per day. Instead of a 'drive-by' article that students don't connect with, students could develop connections with the characters and their classmates as we discussed what we read each day.

I would love to see what could happen if a relevant novel could be found for multiple units throughout the year. I can only imagine how students socioemotional and reading skills would develop if they could get excited about another book in science class. To take reading in the classroom further, I would love it if these novels could be interdisciplinary, where multiple classes are using the novel to base their curriculum off of to give students an even broader depth of understanding.

Impact of Action Research on the Author

Overall, I enjoyed collecting and analyzing data from my students. I learned many things, including ways to make my life easier when collecting data and refreshed my brain on how to do descriptive statistics. Many of the results I found caught me by surprise. Often times in the classroom what we think is happening is not necessarily true. Gathering quantitative data on topics that are normally more qualitative was eye-opening. I am excited to continue my action research with other topics I have been curious about in the future.

REFERENCES CITED

"American Community Survey 5-Year Data (2009-2019)." *United States Census Bureau.* https://www.census.gov/data/developers/data-sets/acs-5year.html

Arya, D. J., & Maul, A. (2012). The role of the scientific discovery narrative in middle school science education: An experimental study. *Journal of Educational Psychology, 104*(4), 1022-1032. http://dx.doi.org.proxybz.lib.montana.edu/10.1037/a0028108

Cajas, F. (1999). Public understanding of science: Using technology to enhance school science in everyday life. *International Journal of Science Education, 21*(7), 765-773.

Capps, D. K., & Crawford, B. A. (2013). Inquiry-based instruction and teaching about nature of science: Are they happening? *Journal of Science Teacher Education*, *24*(3), 497-526.

Carrier, S. J. (2011). Effective strategies for teaching science vocabulary. *LEARN North Carolina: UNC-Chapel Hill, NC*.

Cepeda, N. J., Vul, E., Rohrer, D., Wixted, J. T., & Pashler, H. (2008). Spacing effects in learning: A temporal ridgeline of optimal retention. *Psychological Science, 19*(11), 1095-1102.

Cervetti, G. N., Bravo, M. A., Hiebert, E. H., Pearson, P. D., & Jaynes, C. A. (2009). Text genre and science content: Ease of reading, comprehension, and reader preference. *Reading Psychology*, *30*(6), 487-511.

Chung, Y., Yoo, J., Kim, S-W., Lee, H., & Zeidler, D. L. (2016). Enhancing students' communication skills in the science classroom through socioscientific issues. *International Journal of Science and Mathematics Education, 14*(1), 1-27.

"Developmental Tasks." The Center for Parenting Education, centerforparentingeducation.org/library-of-articles/child development/developmental-tasks/

Fang, Z., Lamme, L., Pringle, R., Patrick, J., Sanders, J., Zmach, C., ... & Henkel, M. (2008). Integrating reading into middle school science: What we did, found and learned. *International Journal of Science Education*, *30*(15), 2067-2089.

Gao, L., Mun, K. & Kim, SW. (2019). Using socioscientific issues to enhance students' emotional competence. *Res Sci Educ.* https://doi.org/10.1007/s11165-019-09873-1.

"Global Competence Questionnaire - PISA." (2018). *OECD*, www.oecd.org/pisa/innovation/global-competence/

Hake, R. R. (1998). Interactive-engagement versus traditional methods: A six-thousand-student survey of mechanics test data for introductory physics courses. *American Journal of Physics*, *66*(1), 64-74.

Herman, B. C., Zeidler, D. L., & Newton, M. (2018). Students' emotive reasoning through place-based environmental socioscientific issues. *Research in Science Education.*

Hsu, Y., Yen, M., Chang, W. *et al.* (2016). Content analysis of 198-2012 empirical studies in science reading using a self-regulated learning lens. *International Journal of Science and Math Education,* 14, 1–27.

Kim, S-I. (1999). Causal bridging inference: A cause of story interestingness. *British Journal of Psychology*, *90*(1), 57.

Klaver, Lida T, & Walma van der Molen, Juliette H. (2021). Measuring Pupils' Attitudes Towards Socioscientific Issues: Development and Validation of a Questionnaire. *Science & Education, 30*(2), 317-344.

Lamm, C., Batson, C. D., & Decety, J. (2007). The neural substrate of human empathy: Effects of perspective-taking and cognitive appraisal. *Journal of Cognitive Neuroscience*, *19*(1), 42–58.

Linbearger, D. L., and S. E. Vaala. 2010. "Screen Media and Language Development in Infants and Toddlers: *An Ecological Perspective*." *Developmental Review* 30 (2): 176–202.

Lockwood Middle School (2021). [MS Mid-year data analysis and goal setting PD] [Unpublished raw data].

"Lockwood Middle School Profile." (2021). *Public School Review*, www.publicschoolreview.com/lockwood-middle-school-profile.

Mayer, D. A. (2009). Multimedia learning. Cambridge University Press.

Newton, M. H. & Zeidler, D. L. (2020) Developing socioscientific perspective Taking. *International Journal of Science Education, 42*(8), 1302-1319. https://doi.org/10.1080/09500693.2020.1756515

Norris, S. P. & Phillips, L. M. (2003). How literacy in its fundamental sense is central to

scientific literacy. *Science Education, 87*(2), 224–240.

"OPI Report Card." (2018). *Report Card*. opi.mt.gov/Leadership/Academic-Success/Every-Student-Succeeds-Act-ESSA/Report-Card.

O'Reilly, T., & McNamara, D. S. (2016). The impact of science knowledge, reading skill, and reading strategy knowledge on more traditional "high-stakes" measures of high school students' science achievement. *American Educational Research Journal, 44*(1), 161-196.

Pedretti, E. (1999). Decision making and STS education: Exploring scientific knowledge and social responsibility in schools and science centers through an issues-based approach. *School Science and Mathematics, 99*(4), 174-181.

Pressley, M., Wood, E., Woloshyn, V. E., Martin, V., King, A., & Menke, D. (1992). Encouraging mindful use of prior knowledge: Attempting to construct explanatory answers facilitates learning. *Educational psychologist*, *27*(1), 91-109.

Radcliffe, R., Caverly, D., Peterson, C., & Emmons, M. (2004). Improving textbook reading in a middle school science classroom. *Reading Improvement*, *41*, 145-156.

Sadler, T. D. (2004). Informal reasoning regarding socioscientific issues: A critical review of the research. *Journal of Research in Science Teaching, 41*(5), 513–536.

Sadler, T., & Zeidler, D. L. (2004). The morality of socioscientific issues: Construal and resolution of genetic engineering dilemmas. *Science Education (Salem, Mass.), 88*(1), 4-27.

Dillon, S. (2006). Schools cut back subjects to push reading and math. *The New York times*, p. A1.

Seale, C. (2020). *Thinking like a lawyer: A framework for teaching critical thinking to all students.* Sourcebooks.

Spilich, G. J., Vesonder, G. T., Chiesi, H. L., & Voss, J. F. (1979). Text processing of domain-related information for individuals with high and low domain knowledge. *Journal of verbal learning and verbal behavior*, *18*(3), 275-290.

Timmerman, B. (2002). Keeping science current. *Science Scope*, *25*(6), 12-15.

Villarin, L. J., Ramirez, & Fowler, S. R. (2019). Socioscientific issues to promote content knowledge & socioscientific reasoning in Puerto Rican High School students. *The American Biology Teacher, 81*(5), 328-332.

Wang, L., Lee, H., & Ju, D-Y. (2019). Impact of digital content on young children's reading interest and concentration for books. *Behaviour & Information Technology, 38*(1), 1-8.

Willingham, D. T. (2021). Why do students remember everything that's on television and forget everything I say? *American Educator, 45*(2), 34.

Wu, Y. - T., & Tsai, C. - C. (2011). High school students' informal reasoning regarding a socio-scientific issue, with relation to scientific epistemological beliefs and cognitive structures. *International Journal of Science Education*, *33*(3), 371-400.

Zeidler, D. L., & Kahn, S. (2014). *It's debatable!: Using socioscientific issues to develop scientific literacy K-12*. NSTA press.

Zeidler, D. L, & Keefer, M. (n.d.). The role of moral reasoning and the Ssatus of socioscientific issues in science education. In *The Role of Moral Reasoning on Socioscientific Issues and Discourse in Science Education* (Science & Technology Education Library, pp. 7-38). Dordrecht: Springer Netherlands.

APPENDICES

APPENDIX A

IRB APPROVAL

MONTANA STATE UNIVERSITY
Request for Designation of Research as Exempt
MSSE Research Projects Only
(5/16/14)

To qualify as exempt, this research **must**: 1) involve minimal risk and 2) be conducted in established or commonly accepted educational settings, involving normal educational practices. These include, for example, research on regular and special education instructional strategies or research on the effectiveness of or comparison between instructional techniques, curricula, or classroom management methods.

PLEASE TYPE YOUR RESPONSES. Applications can be emailed to irb@montana.edu. Submit application, along with any surveys, subject consent forms, and all other relevant materials. For information and/or assistance call 406-994-4706.

Please type responses in bold. Do not type in all capitals.

Delete above two text boxes of instructions (and this sentence) prior to submission and/or printing.

****

THIS AREA IS FOR INSTITUTIONAL REVIEW BOARD USE ONLY. DO NOT WRITE IN THIS AREA.
Confirmation Date: 4/27/21 Mark T. Quinn
Application Number:

****

DATE of SUBMISSION:

-Okay as exempt
-MSSE Classroom assessment
-Little/no risk
-No concerns
MQ 4/27/21

Address each section – do not leave any section blank.

I. INVESTIGATOR: Susie Dobkins

Name: Susie Dobkins
Home or School Mailing Address: 441 Byrd St. Billings, MT 59101
Telephone Number: 206-450-7082
E-Mail Address: susiedobkins@gmail.com
DATE TRAINING COMPLETED: ___April 19th, 2020_____ *[Required training: CITI training: see website for link]*

Investigator Signature Susi Dobkins

Name of Project Advisor: John Graves
E-Mail Address of Project Advisor: graves@montana.edu

II. TITLE OF RESEARCH PROJECT: Using a novel in middle school science to build socioscientific understanding

III. BRIEF DESCRIPTION OF RESEARCH METHODS (If using a survey/questionnaire, provide a copy).
Pre-Survey, Post-Survey, Post-Interview with select students

APPENDIX B

PRE AND POST STUDENT SURVEY

Name:_____ Pre-Survey and Post Survey (*Note: Post Survey had questions I, II, and III for treatment groups only)

Participation is voluntary and you can choose to not answer any questions you do not want to answer and/or you can stop at any time. Participation or non-participation will not affect your grade or class standing.

I. How much of the book "Mosquitoes Don't Bite Me" did you read?
   A. Every part we read in class
   B. About ½ of what we read in class
   C. Less than ½ of what we read in class

II. Did you enjoy reading the book?
   A. Overall, I liked reading the book in class each day
   B. Overall, I feel pretty 50/50 about it, some days I liked it and some days I did not
   C. Overall, I did not like reading the book in class

III. Explain your answer to the above question (what did you like about reading the book in class, what did you not like?)

1. I feel like I know about other parts of the world. Construct: global-mindedness.
   a. Strongly Agree
   b. Agree
   c. Disagree
   d. Strongly Disagree

2. I feel like I am open-minded and respectful of others' opinions. Construct: perspective-taking.
   e. Strongly Agree
   f. Agree
   g. Disagree
   h. Strongly Disagree

3. I feel like reading novels about science helps me understand science better. Construct: reading in science
   i. Strongly Agree
   j. Agree
   k. Disagree
   l. Strongly Disagree

4. I feel like reading novels about science gives me a new perspective of the world. Construct: reading in science
   m. Strongly Agree
   n. Agree
   o. Disagree
   p. Strongly Disagree

5. When I see the poor conditions that some people in the world live under, I feel a responsibility to do something about it. *Construct: global mindedness
   q. Strongly Agree
   r. Agree
   s. Disagree
   t. Strongly Disagree

6. I think my behavior can impact people in other countries *Construct: global mindedness

   u. Strongly Agree

v. Agree
w. Disagree
x. Strongly Disagree

7. I can do something about the problems of the world *Construct: global mindedness

y. Strongly Agree
z. Agree
aa. Disagree
bb. Strongly Disagree

8. I want to learn how people live in different countries * Construct: global-mindedness

A. Very much like me
B. Mostly like me
C. Somewhat like me
D. Not much like me
E. Not at all like me

10. I try to look at everybody's side of a disagreement before I make a decision *construct: perspective-taking

F. Very much like me
G. Mostly like me
H. Somewhat like me
I. Not much like me
J. Not at all like me

11. I believe that there are two sides to every question and try to look at them both *construct: perspective-taking

K. Very much like me
L. Mostly like me
M. Somewhat like me
N. Not much like me
O. Not at all like me

12. I sometimes try to understand my friends better by imagining how things look from their perspective *construct: perspective-taking

P. Very much like me
Q. Mostly like me
R. Somewhat like me
S. Not much like me
T. Not at all like me

13. Before criticizing somebody, I try to imagine how I would feel if I were in their place *construct: perspective-taking

U. Very much like me
V. Mostly like me
W. Somewhat like me
X. Not much like me
Y. Not at all like me

Book-Specific Questions

Construct: socioscientific issues
14. "A million Africans die from malaria every year." How does that make you feel?
A) Nothing. Since it does not affect me personally, I do not feel anything
B) A little bit, I don't like the idea that people are dying, but it's not like I know them
C) It makes me feel sad. I would like someone else to find a cure for malaria
D) It makes me feel sad. I would like to be the person to find the cure/work towards a cure

15. Do you feel like using humans to gather data and make tests for pharmaceutical products (medicines/over the counter products) is ethical (good, moral)? *construct: socioscientific issue
a) Yes, if we didn't test on humans, how would we know how the drug affects humans?
b) No, I do not believe making humans suffer for the greater good is ethical
c) No, we should only test on other animals, not humans
d) No, we should not test on any animals and therefore should not know how medicines affect people before giving them to them

16. Do you think scientists sometimes make up data? *construct: scientific literacy
a. Strongly Agree
b. Agree
c. Disagree
d. Strongly Disagree

17. Henrietta Lacks was an African-American woman whose cancer cells were taken without her permission in the 1950s. These cells have been cloned and are used by scientists all over the world for research purposes even today. Henrietta Lacks was never paid for her cells nor given any kind of financial compensation (payment). Do you feel like this was an okay thing to do? *construct: socioscientific reasoning
cc. Strongly Agree
dd. Agree
ee. Disagree
ff. Strongly Disagree

18. Someone in school made a big mistake. They said something mean about a person on purpose and it made a group of students angry. Do you feel like it makes them a bad person? Construct: perspective-taking
gg. Strongly Agree
hh. Agree
ii. Disagree
jj. Strongly Disagree
20. Malaria is *construct: science concept

a. A disease given to people by any kind of insect and is given to people equally all over the world
b. A parasite that enters a person's red blood cells and multiples there. It makes red blood cells burst, giving them anemia
c. A parasite that enters a person's red blood cells and multiples there. It makes red blood cells burst, giving them too little blood to allow the heart to pump
d. A disease only found in places like Iceland and Finland

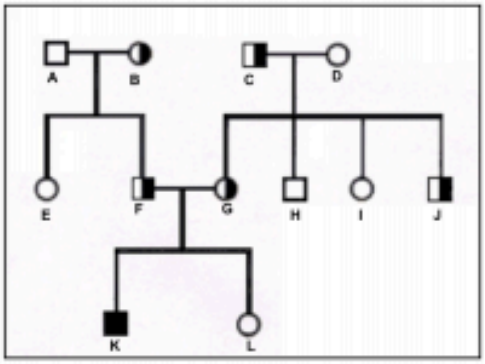
21. When people get the symptoms of malaria they rush to the clinic where the doctor takes a smear of blood and then gives them medicine. If they catch it early, it's not so bad if they live in a large city. What could be different in a rural area (not a city, farming area, or far away from a city)? *Construct: socioscientific issue

a. It's a long way to the clinic
b. They might not be able to afford to go
c. Some medicines don't work on malaria anymore
d. The medicine is too expensive
e. Some people go to native healers (sometimes a bad idea)
f. A, B, and D are correct
g. All of the above are correct

22. Drossilia, an American company, wants to give some expensive lab supplies to a Kenyan research lab. There are no downsides for the research lab in Kenya. Construct: socioscientific issue

kk. Strongly Agree
ll. Agree
mm. Disagree
nn. Strongly Disagree

23. Below is a pedigree. Which family member(s) have malaria? *Construct: science concept



a. A, D, E, H, I, L
b. K
c. B, C, F, G, J
d. All of the above

24. Looking at the pedigree above, which family members have a gene that makes them resistant to malaria? *Construct: science concept

e. A, D, E, H, I, L
f. K
g. B, C, F, G, J
h. All of the above

25. Many people from one family are being tested to see if they have a compound that repels mosquitoes. They are even testing people who have already had malaria (a disease only given to people by mosquitoes). Why would they want to test the people who have already had malaria? Concept: science concept

a. Testing these people who have already had malaria can help them rule out compounds that the family members who repel mosquitoes and them share
b. Testing these people can show them which compounds are good and bad
c. Testing these people allows them to find the compound that repels mosquitoes since they already had malaria
d. Testing these people who have already had malaria can help them gather compounds that the family members who repel mosquitoes and them share

26. Drossilia, a company that makes over the counter medications, plans to use the research conducted on Kenyan people to make a profit. They will also be able to make a medication that can help people in Kenya. There are no downsides for the people in Kenya. *construct: socioscientific issue

oo. Strongly Agree
pp. Agree
qq. Disagree
rr. Strongly Disagree

27. People say they are 'strong' because mosquitoes don't bite them. Why is this scientifically inaccurate? *Construct: science concept

a. Some people are stronger, and it's because they do not have any mutations while other people do
b. Some people are not stronger, they just have a mutation that allows them to survive better than others
c. Just because mosquitoes don't bite you, doesn't make you strong
d. Some people are not stronger, they gained immunity to mosquitoes throughout their lifetime, which they passed on to their children

28. Why is giving away drugs to cure malaria an issue? *Construct: socioscientific issue

a. people who own the company won't like that, so they will fire the president of the company and find a new one
b. the local drug store owner in Kenya will be out out of business because he cannot sell the antimalarial drug since it is given away for free
c. people might take the free medicine and sell it on the black-market (under the table) for money
d. people will take too many of the drug and become sick/die
e. A, B, and C are correct
f. All of the above are correct