Evaluation of Generation Genius Science Videos

Submitted to: Generation Genius

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March 2018

WestEd
WestEd.org

Study Overview

Generation Genius is a classroom tool that helps teachers integrate the Next Generation Science Standards into their classroom through the use of educational science videos. During February 2018, WestEd was funded by Generation Genius to conduct an independent evaluation of their science video, "Collisions and Energy of Moving Objects." The goal of the evaluation was to examine changes to student engagement in science, perceptions of STEM, and learning after watching a Generation Genius video, and to gather student feedback to improve the videos for future use by teachers and students.

Research Questions

The research questions that guided this study were:

1. Do students report feeling more engaged in science after watching a Generation Genius science video?
2. Do students report that their perceptions of STEM changed after watching a Generation Genius science video?
3. Do students report that they learned scientific concepts after watching a Generation Genius science video?
4. How can the Generation Genius science videos be improved?

Study Activities

WestEd recruited fourth grade teachers and their students to participate in the evaluation of the Generation Genius science video, "Collisions and Energy of Moving Objects," a 12-minute video aligned to the Next Generation Science Standards PS3.A (Definitions of Energy), PS3.B (Energy Transfer), and PS3.C (Relationship Between Energy and Forces).

Participating teachers were asked to show the science video to their students. After watching the video, teachers administered a post-survey on student engagement in science, perceptions of STEM, and learning to their students. At the end of the study, teachers were invited to complete an optional post-survey to provide teacher feedback on the science video. WestEd provided detailed instructions to participating teachers that described the study activities and provided instructions for administering the post-survey to students. Teachers were asked to complete the study activities over the course of one day in their classrooms.

Instruments

Data for the evaluation consisted of a student post-survey and an optional teacher post-survey.

Student Post-Survey

After watching the Generation Genius science video, students completed an online survey related to student engagement in science, perceptions of STEM, and learning of scientific concepts presented in the video. In addition, the survey collected student feedback related to the video itself.

The survey included 20 items in total, with a mix of four-point Likert items, multiple choice items, and open-ended response items. Researchers developed four Likert items to address students' engagement in science; four Likert items to address students' perceptions of STEM; three Likert items and two multiple choice items to address student learning of science concepts; and four Likert items, one multiple choice item, and two open-ended response items to gather student feedback on the Generation Genius video. The Likert items used a typical four-point scale, with responses of "Strongly agree," "Agree," "Disagree," and "Strongly disagree." Data

was also collected on the student's gender. The complete student survey is presented in Appendix A.

Optional Teacher Post-Survey

At the end of the study, teachers were asked to complete an optional online survey to provide their feedback on the Generation Genius science video. The survey included six items in total, with a mix of six-point Likert items and open-ended response items. Researchers developed four Likert items to gather teachers' opinions about the Generation Genius video. The Likert items used a six-point scale, with responses of "Strongly agree," "Agree," "Neither Agree Nor Disagree," "Disagree," "Strongly disagree," and "Not Sure (would need to view more videos)." The complete teacher survey is presented in Appendix B.

Data Analysis

Data from the closed-ended items on student survey were analyzed descriptively using statistical analysis software. In addition, the data from the closed-ended items were analyzed to determine if there were any differences in responses among boys and girls, and among students from Title I and non-Title I schools. These data were analyzed using a crosstab analysis and the chi-square test of independence.

Sample

Teachers were recruited from public elementary schools in the greater San Francisco Bay Area. A total of 15 fourth grade teachers and their students (n=439) participated in the Generation Genius study. Teachers were classified as teaching at a Title I school or a non-Title I school based on information publically available through eddata.gov. The primary goal of Title I schools in the state of California is to "ensure that all students, particularly those who are low-achieving, demonstrate proficient and advanced levels of achievement on State academic achievement standards" (https://www.cde.ca.gov/sp/sw/rt/index.asp). Generally, Title I schools serve areas where at least 40% of the students in the school are from low-income families.

Table 1 below provides a summary of teacher and school demographics, segmented by the school's Title I status.

Table 1. Teacher and school demographic information.

	Title I Schools	Non-Title I Schools
Number of Teachers	8	7
Number of Schools	7	5
% Free and Reduced Lunch Range	51.1% - 94.4%	10.5% - 32.1%
Average Number of Students Per Class	24.1	31.7

A total of 439 students responded to the student survey. Students were asked to self-report their gender as part of the survey. A summary of student respondents is provided in the Tables 2 and 3 below.

Table 2. Summary of students, by gender.

Student Gender	
Number of Boys	228
Number of Girls	211
Total	439

Table 3. Summary of students, by school status.

Student Title I Status	
Title I	217
Non-Title I	222
Total	439

Findings

Findings related to each of the research questions are presented in the following section.

Research Question 1 - Do students report feeling more engaged in science after watching a Generation Genius science video?

The student survey contained four items related to the research question, "Do students report feeling more engaged in science after watching a Generation Genius science video?" Figure 1 below presents the percentage of students that responded with "Strongly Agree," "Agree," "Disagree," and "Strongly Disagree" for each item.

Student responses to these items indicate that the majority of students did feel more engaged in science after watching a Generation Genius science video. Over 80% of students "Strongly Agreed" or "Agreed" that the video made them want to try their own science activities, made them want to learn more about science, made them think that science activities are cool, and made them think that science is fun.

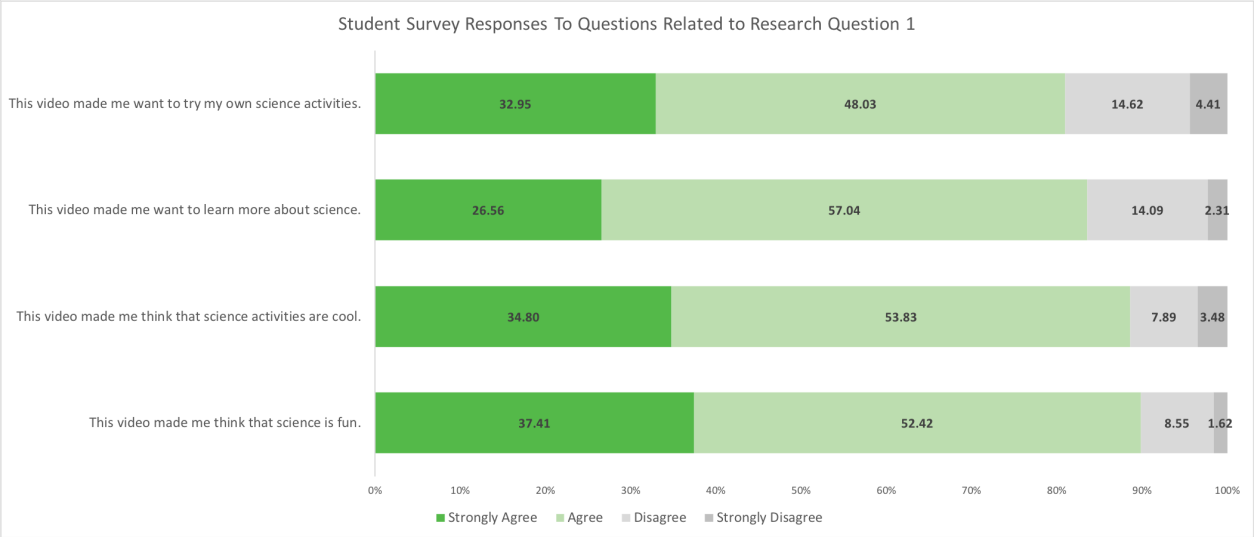


Figure 1. Student responses to items related to Research Question 1.

Research Question 2 - Do students report that their perceptions on STEM changed after watching a Generation Genius science video?

The student survey contained four items related to the research question, "Do students report that their perceptions on STEM changed after watching a Generation Genius science video?" Figure 2 below presents the percentage of students that responded with "Strongly Agree," "Agree," "Disagree," and "Strongly Disagree" for each item.

Student responses to these items indicate that students did report that some of their perceptions of STEM changed after watching a Generation Genius science video. Over 85% of students "Strongly Agreed" or "Agreed" that the video made them think that it is important to learn science, and over 70% of students reported that the video made them think that anyone can be a scientist. In addition, over 75% of students "Strongly Disagreed" or "Disagreed" that the video made them think that science is hard. However, only about 25% of students reported that the video made them want to be a scientist when they grew up.

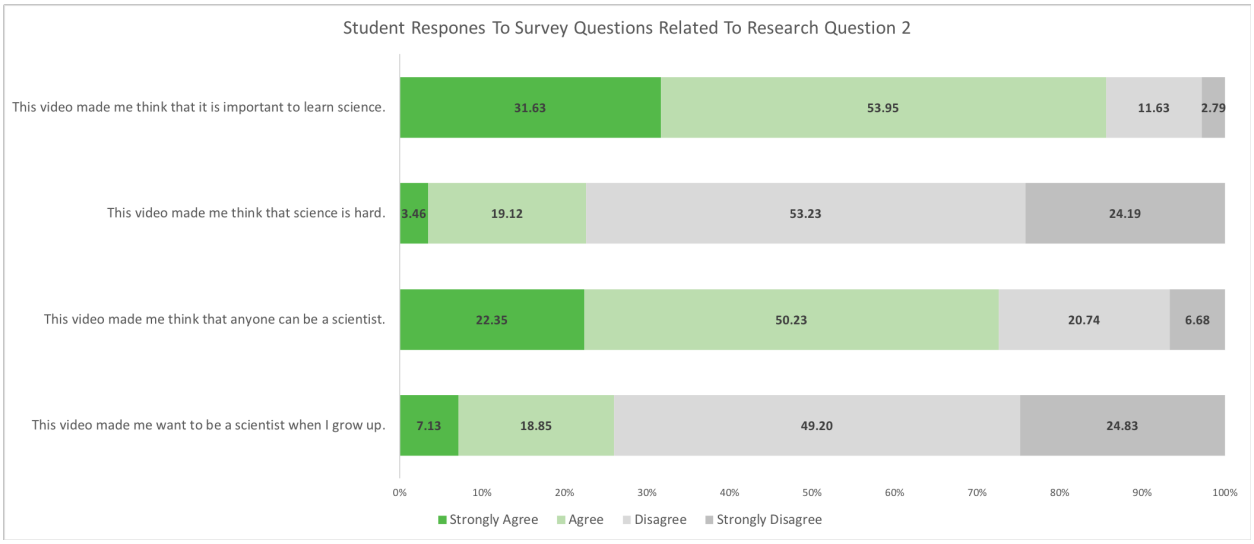


Figure 2. Student responses to items related to Research Question 2.

Research Question 3 - Do students report that they learned scientific concepts after watching a Generation Genius science video?

The student survey contained five items related to the research question, "Do students report that they learned scientific concepts after watching a Generation Genius science video?" Figure 3 below presents the percentage of students that responded with "Strongly Agree," "Agree," "Disagree," and "Strongly Disagree" for each item.

Student responses to these items indicate that students did report that they learned scientific concepts after watching a Generation Genius science video. Over 90% of students reported that the video helped them learn. Students felt the video helped them learn about energy (93.74%) slightly more so than it helped them learn about collisions (82.26%).

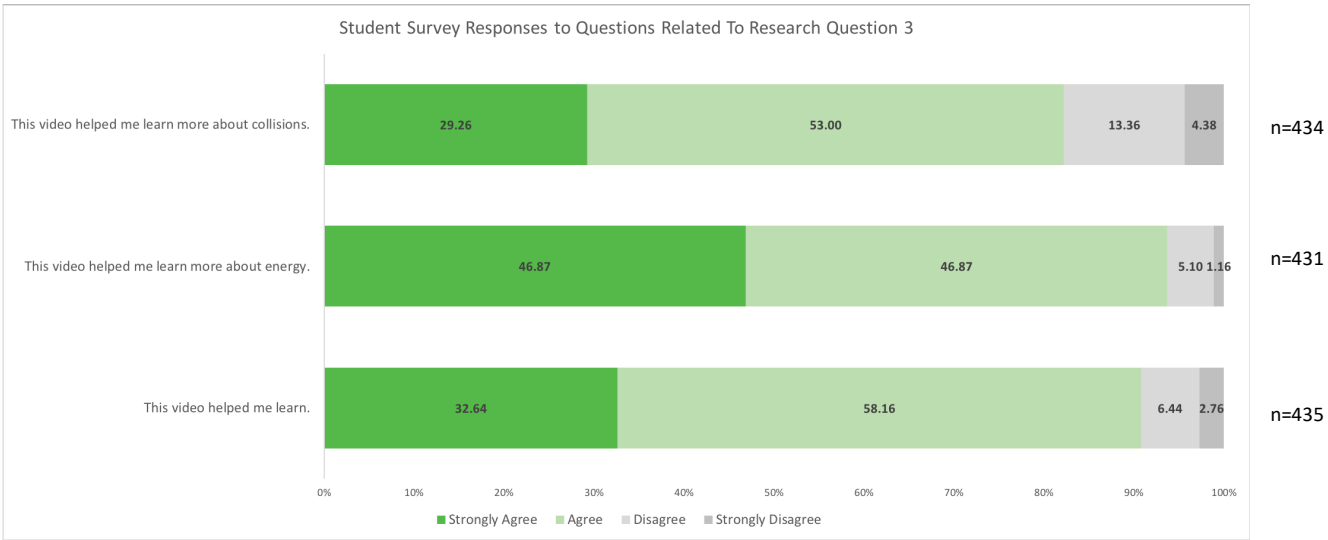


Figure 3. Student responses to items related to Research Question 3.

In addition, students were asked two multiple choice questions that assessed them on science concepts that were covered in the video. Figures 4 and 5 below present the percentage of students that selected each answer choice. Over 90% of students answered the question about energy correctly, while only 70% of students answered the question about collisions correctly. These responses are consistent with students' reports that the video helped them learn about energy more so than it did collisions.

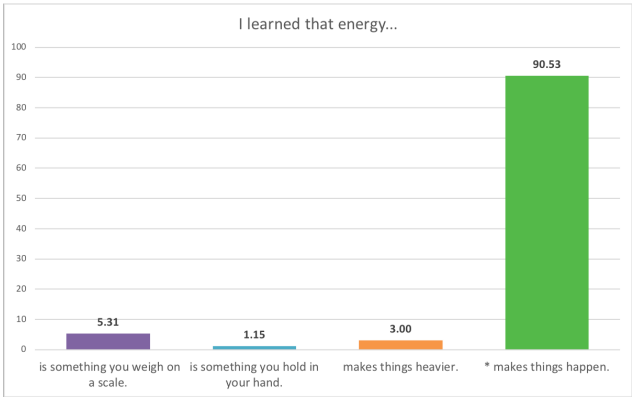


Fig 4. Multiple choice item related to energy. n=433; *Indicates the correct answer choice.

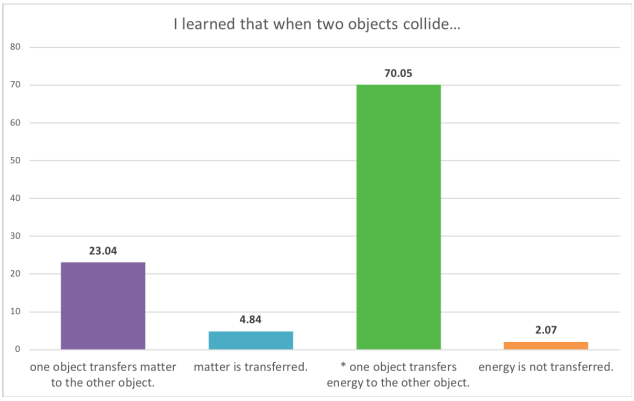


Fig 5. Multiple choice item related to collisions. n=434; *Indicates the correct answer choice.

Research Question 4 - How can the Generation Genius science videos be improved?

The student survey contained seven items related to the research question, "How can the Generation Genius science videos be improved?" Figure 6 below presents the percentage of students that responded with "Strongly Agree," "Agree," "Disagree," and "Strongly Disagree" for each item.

Student responses to these items indicate that while students responded positively to the Generation Genius video, there is still some room for improvement. Over 90% of students "Strongly Agreed" or "Agreed" that they thought the video was entertaining, and over 90% of students "Strongly Disagreed" or "Disagreed" that they

got bored while watching the video. Only 60% of students reported that the video made them laugh, and only 60% of students reported they would watch the video for fun on the weekend.

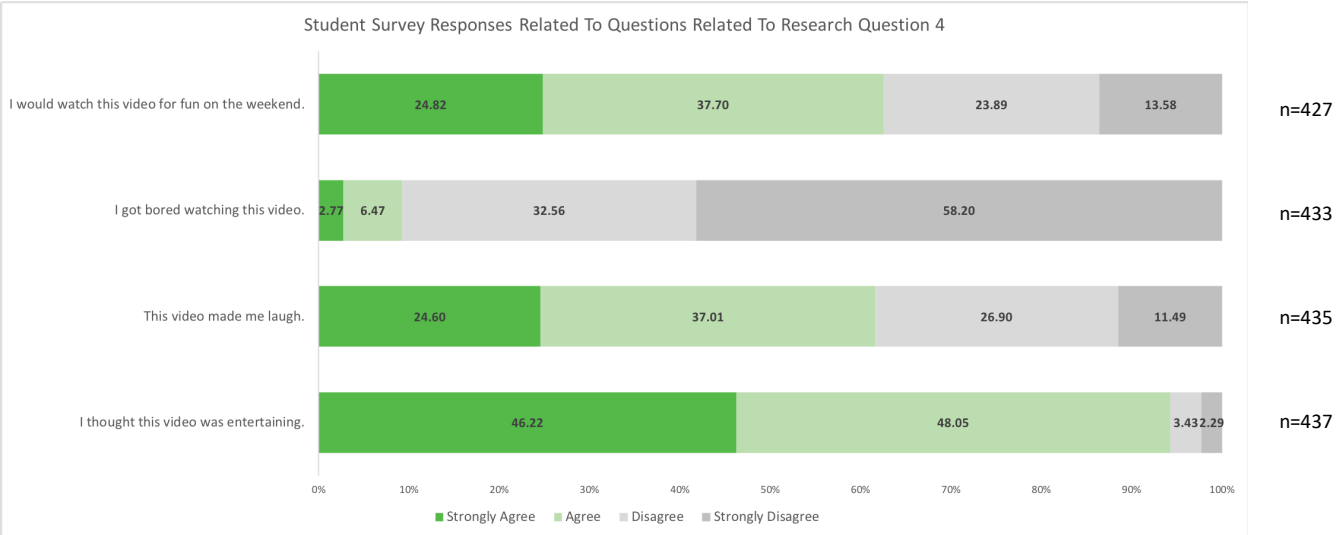


Figure 6. Student responses to items related to Research Question 4.

In addition, students were asked to choose their favorite character from among the five characters in the video. Figure 7 below presents students' choices. In order of preference, students' favorite characters were Bert, Izzy, Zoe, Dr. Jeff, and Dr. Jeff's Mom.

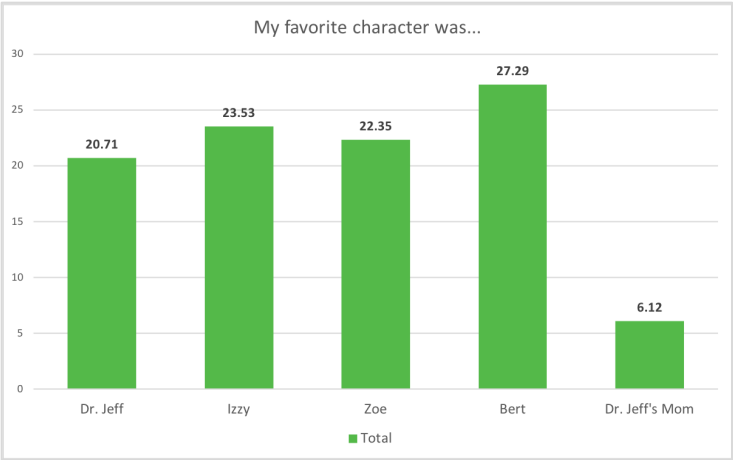


Figure 7. Students' favorite character. n=425

OPEN-ENDED RESPONSES

Students were also asked two open-ended questions, in order to collect feedback around students' likes and dislikes related to the video. A sample of student responses is included below. The complete set of student responses to the open-ended questions is included in Appendix C.

Students were asked to indicate their "favorite thing about the video." Sample responses include:

- "They explained things very clearly. They used some scientific words and they were smart and funny in the video. Good actors too. I learned a lot."

- "The slow motion parts when something hits something else."
- "Zoe showed us about the books falling down on a pencil and made the cup fall full of candy in a bowl!"
- "That they made science fun."
- "When Bert told Dr. Jeff tell my mom I love her then Dr. Jeff said that you don't have a mom and then Bert said then tell your mom I loved her."
- "The part where Izzy and Jeff's mom bumped each other in those suits"

Students were asked to indicate "one thing [they] didn't like about the video." Sample responses include:

- "How it didn't explain why heat and energy are transferred through collisions."
- "That it doesn't have enough tests to prove what is happening."
- "I did not like that they did not show us more experiments."
- "Sometimes, it shows things too fast and I didn't have time to follow and understand."
- "When Zoe was explaining how to make the candy thing, she explained really fast so I could not hear what she said or how to build it."
- "When it said 10mph when Dr. Jeff's Mom hit Izzy which was not true in my opinion."
- "It didn't tell if the weight was lighter when Dr. Jeff's mom hit Izzy."
- "When Dr. Jeff hit the ball with the baseball bat. He could of broke something."

ANALYSIS OF STUDENT SURVEY DATA BY GENDER

Student response data were analyzed to determine if there was any statistically significant difference in responses between boys and girls.[1] For all but one item on the survey, there were no statistically significant differences in how boys and girls responded to the items. In other words, boys and girls responded similarly to the items, with similar numbers of boys and girls choosing each response choice ("Strongly Agree," "Agree," "Disagree," and "Strongly Disagree"). Appendix D presents graphs for each survey item showing student response choices by gender.

Only one item, which asked about students' favorite character in the video, showed statistically significant differences by gender ($\chi^2(4)=137.045$, $p<.001$). Figures 8 and 9 below show student responses to this item, presented first in aggregate and then by student gender.

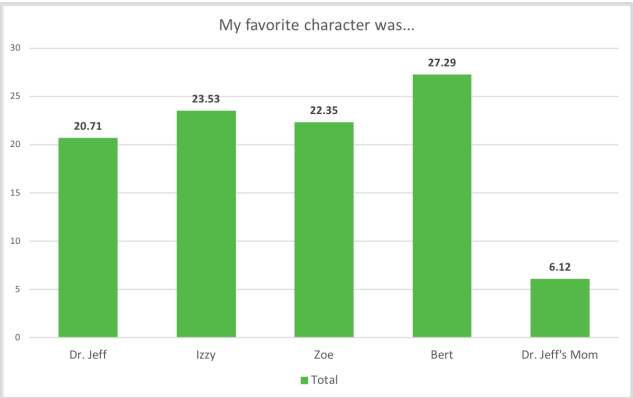


Fig 8. Students' favorite character. n=425

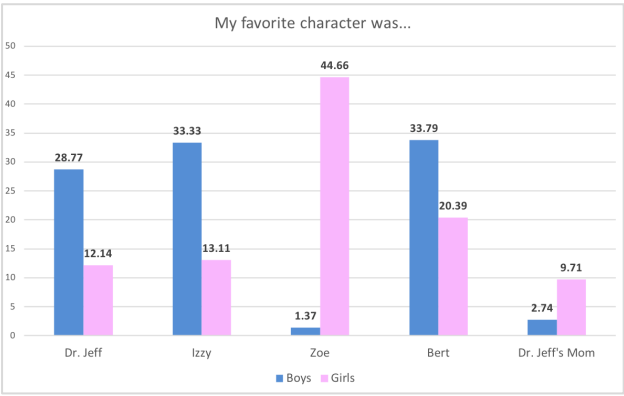


Fig 9. Students' favorite character, by gender. n=425

[1] A significance level of $p<.05$ was used.

As the data show, significantly more girls than boys reported the female characters in the video were their favorites. 22.35% of all students reported that Zoe was their favorite character. However, when analyzed by gender, almost half of all girls (44.66%) reported that Zoe was their favorite character, in contrast to only 1.37% of all boys. Further, only 6.32% of all students reported that Dr. Jeff's Mom was their favorite character. However, when analyzed by gender, 9.71% of all girls reported her to be their favorite character. Boys also overwhelmingly reported that the male characters were their favorites.

ANALYSIS OF STUDENT SURVEY DATA BY SCHOOL TYPE

Student response data was analyzed to determine if there was any statistically significant difference in responses between students from Title I schools and non-Title I schools.

Statistically significant differences were found for 10 of the items.[2] However, the differences were not of practical significance for five of those 10 items. For those five items, students' responses only differed in the number of students from each group who "Strongly Agreed" and "Agreed" with an item (and similarly, the number of students who "Strongly Disagreed" and "Disagreed" with an item). However, when the responses from students who "Strongly Agreed" and "Agreed" with an item were combined, the aggregate number of students who overall agreed with the statement did not differ significantly across the two groups. In other words, the overall number of students who agreed vs. disagreed with the statements did not differ significantly among students from Title I vs. non-Title I schools.

The remaining five items did show statistically significant differences among responses from students from Title I vs. non-Title I schools. Figures 10-14 below show student responses to these items, segmented by school status.

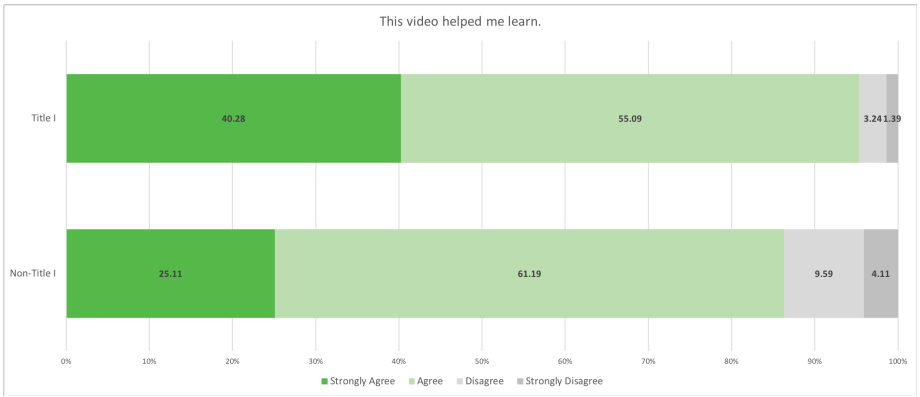


Figure 10. Student responses, by Title I status. ($\chi^2(3)=18.081$, $p<.001$; $n=435$)

[2] Statistically significant differences were found at the p<.05 level for Items 1, 2, 3, 8, 9, 10, 12, 14, 15, and 17.

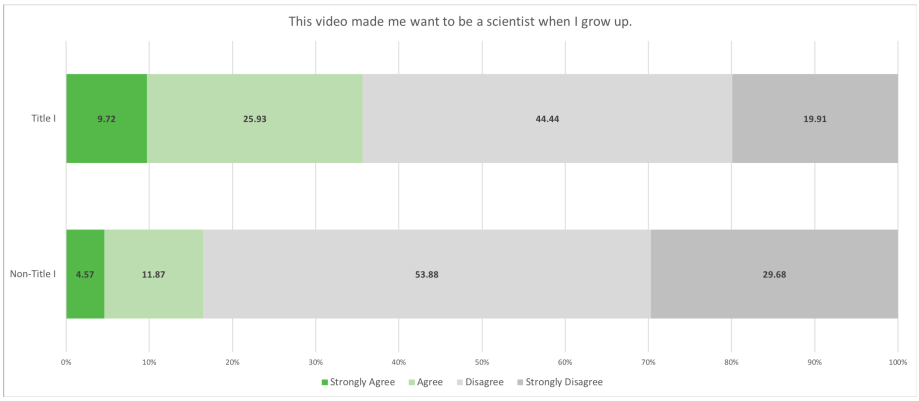


Figure 11. Student responses, by Title I status. ($\chi^2(3)=21.602$, $p<.001$; n=435)

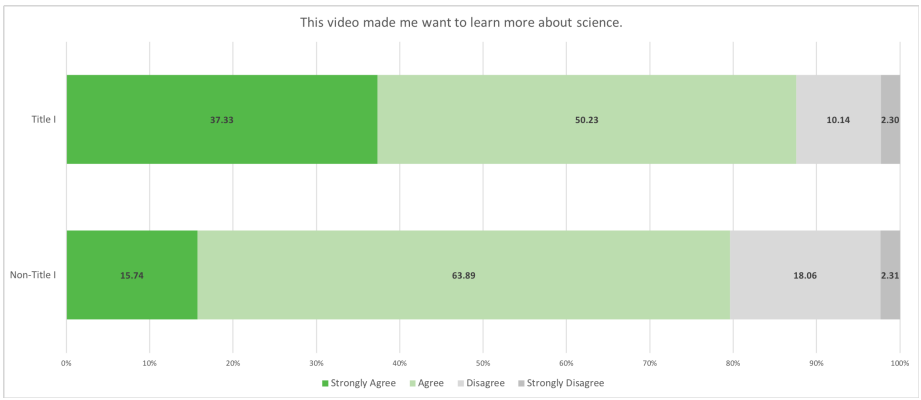


Figure 12. Student responses, by Title I status. ($\chi^2(3)=27.349$, $p<.001$; n=433)

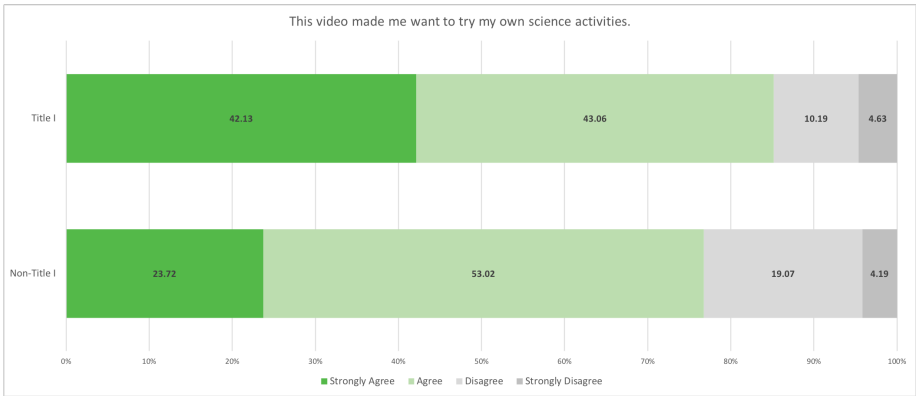


Figure 13. Student responses, by Title I status. ($\chi^2(3)=19.179$, $p<.001$; n=431)

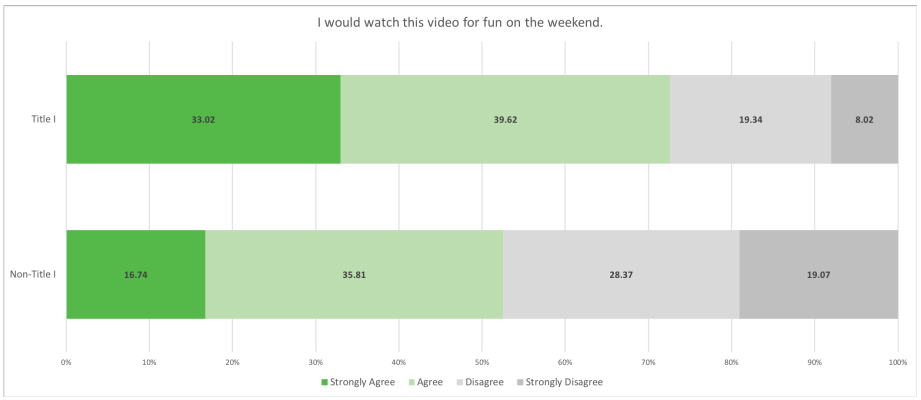


Figure 14. Student responses, by Title I status. ($\chi^2(3)=25.043$, $p<.001$; $n=427$)

As the data shows, students from Title I schools responded more positively to these items than students from non-Title I schools. For these items, the overall number of students who generally agreed with the statements was significantly higher for students from Title I schools. In addition, students from Title I schools felt more strongly about these items, with the number of students who indicated that they "Strongly Agreed" with the items being significantly higher for students from Title I schools.

FINDINGS FROM OPTIONAL TEACHER SURVEY

After having students watch the Generation Genius video and complete the student survey, teachers were provided with an optional teacher survey to complete. 10 out of 15 teachers responded to the optional survey. Figure 15 on the next page presents the percentage of teachers that responded with "Strongly Agree," "Agree," "Disagree," and "Strongly Disagree" for each item.

Overall, teachers responded positively to the video. All teachers chose positive or neutral answers in their responses to the items; no teachers responded with negative answers. The majority of teachers strongly agreed that the Generation Genius videos could help students learn scientific concepts, could help positively change students' perceptions of science, and could help students feel more excited about learning science. In addition, half of all responding teachers indicated they would use the Generation Genius videos in their science class.

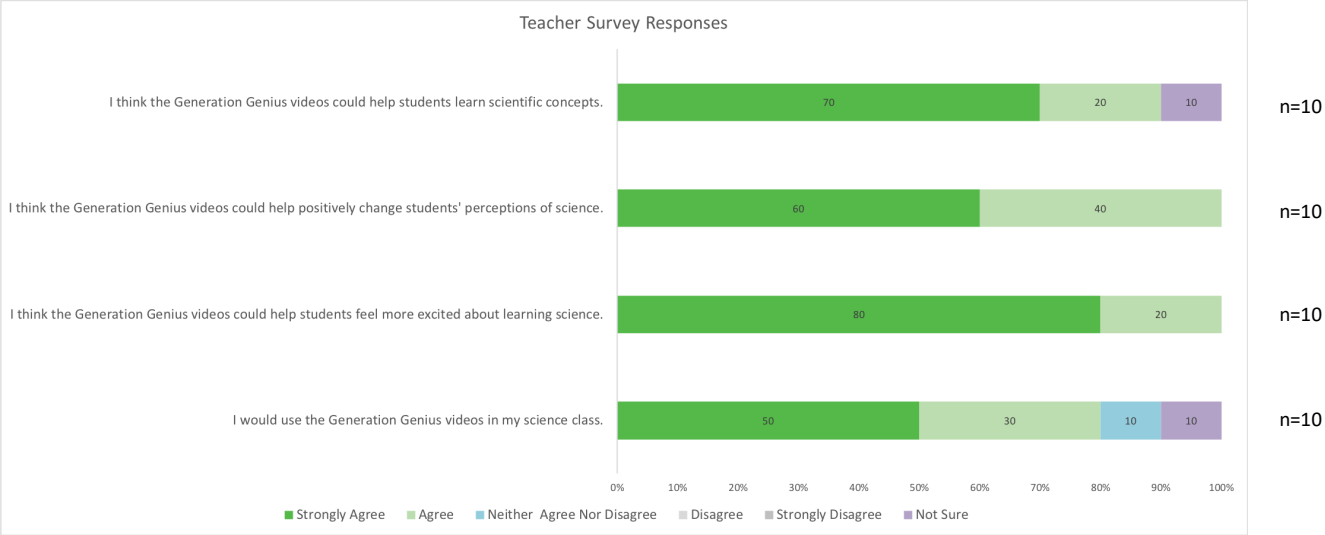


Figure 15. Teacher responses to items on optional teacher survey.

OPEN-ENDED RESPONSES

Teachers were asked two open-ended questions, in order to collect feedback around teachers' suggestions for improvement and around student reactions to the video. A sample of teacher responses is included below. The complete set of teacher responses to the open-ended questions is included in Appendix C.

Teachers were asked to provide suggestions for improving the Generation Genius videos. Sample responses include:

- "I think the videos are engaging and well done. However, it is not clear if there is an activity component that would go along with the video to make it more applicable. I think having an activity piece with this would make it more relatable and relevant."
- "Have an extension piece for more personalized learning."
- "Examples of collision are given but I think diagrams, especially labeled video stills, would be ideal."
- "It would be interesting to have some interaction with the video."
- "Having some material lists and teacher tools would be helpful too."
- "Showing key words spelled out in addition to saying them."
- "The video could have some pauses with questions or reflections so the students could reflect and keep tracking of their learning when watching educational videos."
- "Spanish translation" or "option for closed-captioning"

Teachers were asked if they wanted to share any information about their students' reactions to the video. Sample responses include:

- "Initially, a few students were not excited about a science video. Those same students were animated as they watched and discussed the video after finishing the survey."
- "The students were all pretty excited about it. I think videos are a great hook to start new lessons."
- "Students liked seeing the different examples showing the concept. They also liked how the terms were explained and the captions with meaning of terms."
- "My students enjoyed the science aspect. For example, they were 'wowed' by the baseball hitting the ball in slow motion. Clips like that are what really got students engaged."

Conclusion

Overall, the Generation Genius video, "Collisions and Energy of Moving Objects," was well received by students and teachers. The majority of students reported feeling more engaged in science after watching the video, as evidenced by agreement to statements about wanting to try their own science activities, wanting to learn more about science, thinking that science activities are cool, and thinking that science is fun after watching the video. Students also reported that the video changed some of their perceptions of STEM, by agreeing that the video made them think that it is important to learn science and that the video made them think that anyone can be a scientist. However, in contrast to this, few students agreed that the video made them want to be a scientist when they themselves grew up. Students reported that the video helped them learn about energy and collisions, with the majority of students able to correctly answer two items related to science content on the post-survey. Lastly, the majority of students reported that the Generation Genius video was entertaining, that the video made them laugh, and that they would watch the video for fun on the weekend.

The student survey data was analyzed by gender, showing that girls strongly identified with the female characters in the video and that boys identified with the male characters. The student survey data was also analyzed by school status (Title I vs. non-Title I), showing that students from Title I schools responded more positively to statements saying that the video helped them learn, the video made them want to be a scientist when they grew up, the video made them want to learn more about science, the video made them want to try their own science activities, and that they would watch the video for fun on the weekend.

The Generation Genius videos have the potential to impact students' attitudes towards science and mastery of science concepts. Recommendations for future development include:

- Continuing to develop strong female characters within the show
- Slowing down explanations of the science concepts within the videos
- Adding more detailed explanations around the science experiments or examples shown in the video, including DIY with Zoe
- Including a list of associated activities or handouts for each video, including options for hands-on in-class activities and opportunities to personalize instruction

Further research is recommended on a broader selection of Generation Genius videos, as well as on the implementation of the videos and supporting educator materials in the classroom.

Appendix A: Student Survey

Generation Genius Student Survey

Thank you for sharing what you think about the video!

Your answers will be anonymous. That means we will not know who is answering the questions.

There are no right answers to the questions. You will not be graded on your answers. Also, we will not share your answers with your teacher. Please let us know what you really think!

There are 20 questions in the survey.

1

Generation Genius Student Survey

I identify as a:

- ◯ Boy
- ◯ Girl

My teacher's last name is:

2

Generation Genius Student Survey

1. I thought this video was entertaining.

Strongly Disagree	Disagree	Agree	Strongly Agree
○	○	○	○

2. This video helped me learn.

Strongly Disagree	Disagree	Agree	Strongly Agree
○	○	○	○

3. This video made me want to be a scientist when I grow up.

Strongly Disagree	Disagree	Agree	Strongly Agree
○	○	○	○

4. This video made me think that science is fun.

Strongly Disagree	Disagree	Agree	Strongly Agree
○	○	○	○

5. This video made me laugh.

Strongly Disagree	Disagree	Agree	Strongly Agree
○	○	○	○

3

Generation Genius Student Survey

6. This video helped me learn more about energy.

Strongly Disagree	Disagree	Agree	Strongly Agree
○	○	○	○

7. This video made me think that anyone can be a scientist.

Strongly Disagree	Disagree	Agree	Strongly Agree
○	○	○	○

8. This video made me think that science activities are cool.

Strongly Disagree	Disagree	Agree	Strongly Agree
○	○	○	○

9. This video helped me learn more about collisions.

Strongly Disagree	Disagree	Agree	Strongly Agree
○	○	○	○

10. I got bored watching this video.

Strongly Disagree	Disagree	Agree	Strongly Agree
○	○	○	○

4

Generation Genius Student Survey

11. I learned that energy...

- ◯ is something you weigh on a scale.
- ◯ is something you hold in your hand.
- ◯ make things heavier.
- ◯ makes things happen.

12. I learned that when two objects collide...

- ◯ one object transfers matter to the other object.
- ◯ matter is transferred.
- ◯ one object transfers energy to the other object.
- ◯ energy is not transferred.

Generation Genius Student Survey

13. This video made me think that science is hard.

Strongly Disagree	Disagree	Agree	Strongly Agree
○	○	○	○

14. This video made me want to learn more about science.

Strongly Disagree	Disagree	Agree	Strongly Agree
○	○	○	○

15. This video made me want to try my own science activities.

Strongly Disagree	Disagree	Agree	Strongly Agree
○	○	○	○

16. This video made me think that it is important to learn science.

Strongly Disagree	Disagree	Agree	Strongly Agree
○	○	○	○

17. I would watch this video for fun on the weekend.

Strongly Disagree	Disagree	Agree	Strongly Agree
○	○	○	○

6

Generation Genius Student Survey

18. My favorite character was:

- ◯ Dr. Jeff
- ◯ Bert
- ◯ Izzy
- ◯ Dr. Jeff's Mom
- ◯ Zoe

19. My favorite thing about the video was:

20. One thing I didn't like about the video was:

7

Appendix B: Optional Teacher Survey

Generation Genius Teacher Survey

1. Please rate your agreement with the following statements.

	Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree	Not Sure (would need to view more videos)
I would use the Generation Genius videos in my science class.	○	○	○	○	○	○
I think the Generation Genius videos could help students feel more excited about learning science.	○	○	○	○	○	○
I think the Generation Genius videos could help positively change students' perceptions of science.	○	○	○	○	○	○
I think the Generation Genius videos could help students learn scientific concepts.	○	○	○	○	○	○

2. Do you have any suggestions for improving the Generation Genius videos?

3. Is there anything else you'd like to tell us about your students' reactions to the video?

1

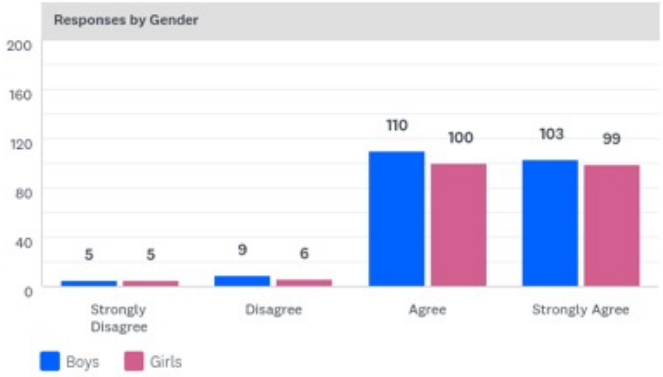
Appendix C: Open-Ended Response Data

The spreadsheet titled "Generation Genius Open-Ended Survey Responses.xlsx" accompanies this report and presents the open-ended response data collected via the student survey and the optional teacher survey.

Appendix D: Responses to Items by Gender

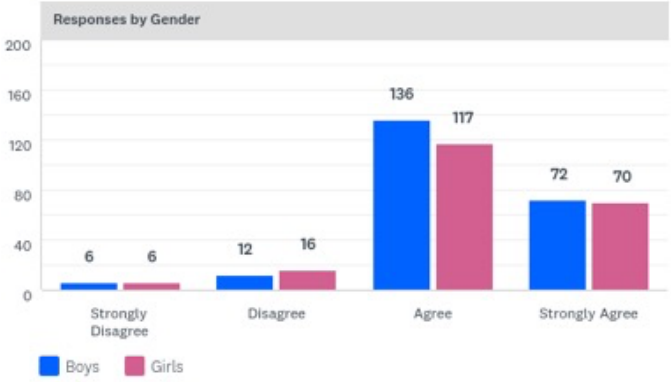
1. I thought this video was entertaining.

Answered: 437



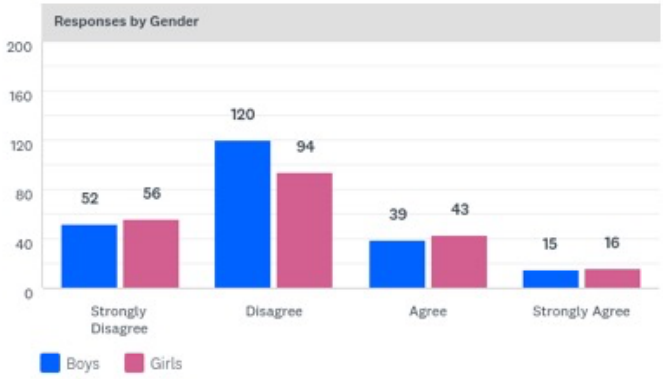
2. This video helped me learn.

Answered: 435



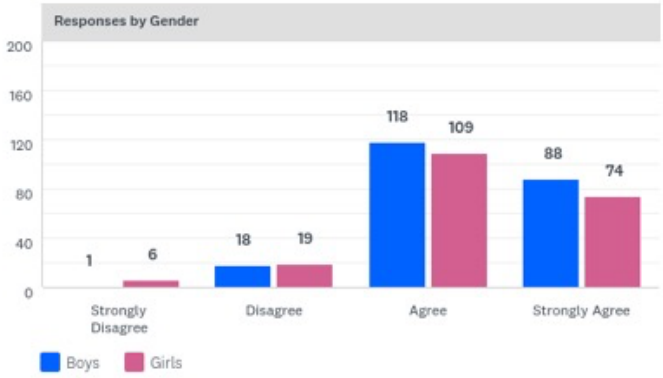
3. This video made me want to be a scientist when I grow up.

Answered: 435



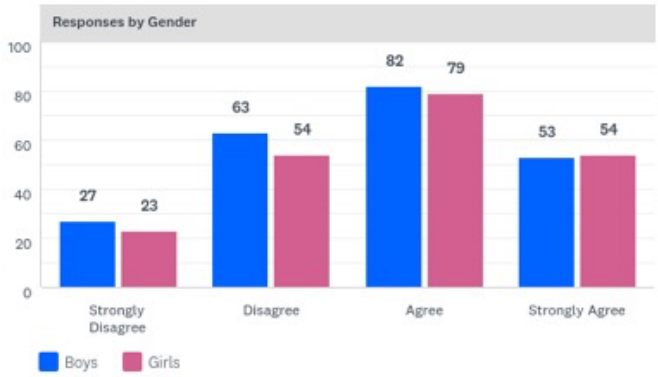
4. This video made me think that science is fun.

Answered: 433



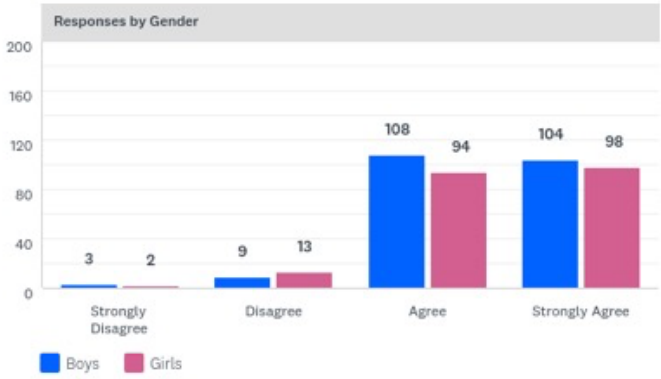
5. This video made me laugh.

Answered: 435



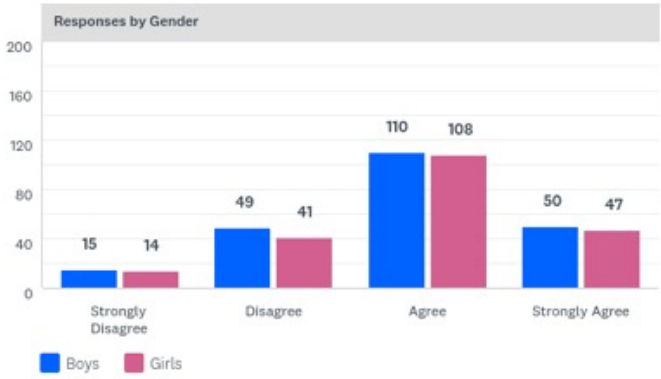
6. This video helped me learn more about energy.

Answered: 431



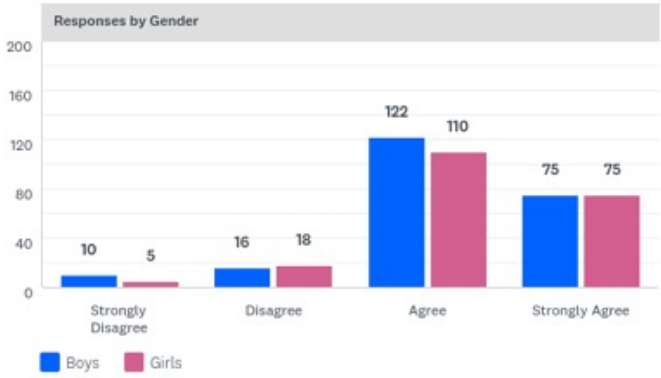
7. This video made me think that anyone can be a scientist.

Answered: 434



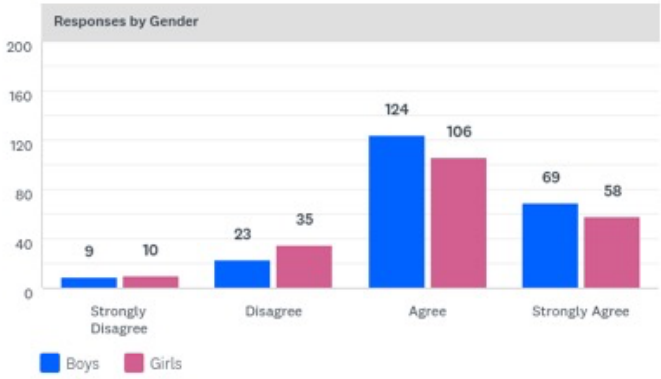
8. This video made me think that science activities are cool.

Answered: 431



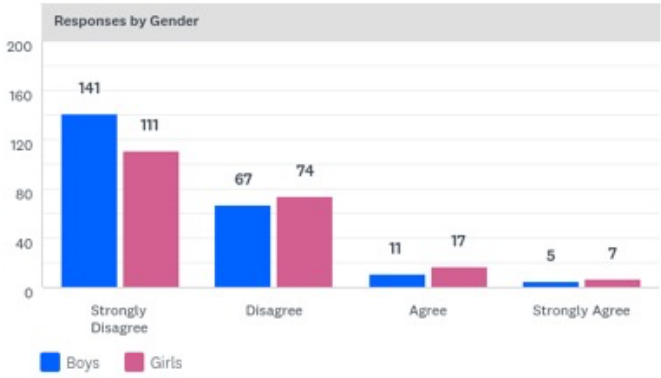
9. This video helped me learn more about collisions.

Answered: 434



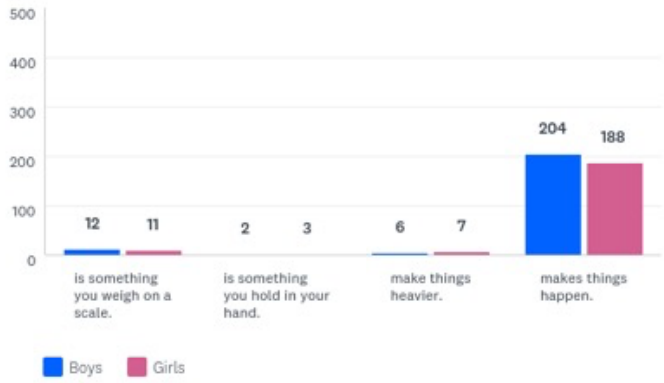
10. I got bored watching this video.

Answered: 433



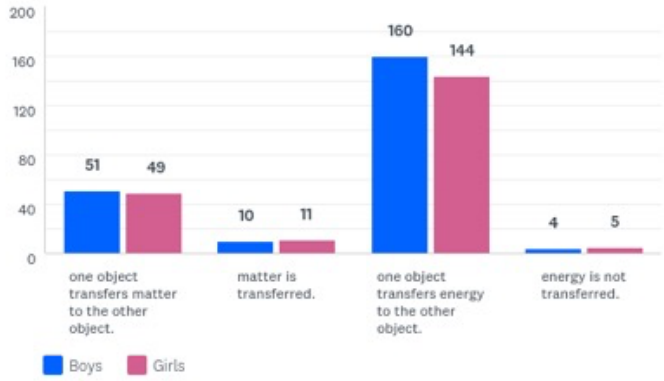
11. I learned that energy...

Answered: 433



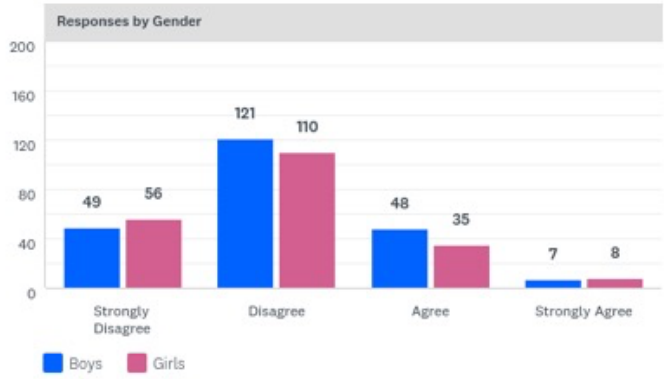
12. I learned that when two objects collide...

Answered: 434



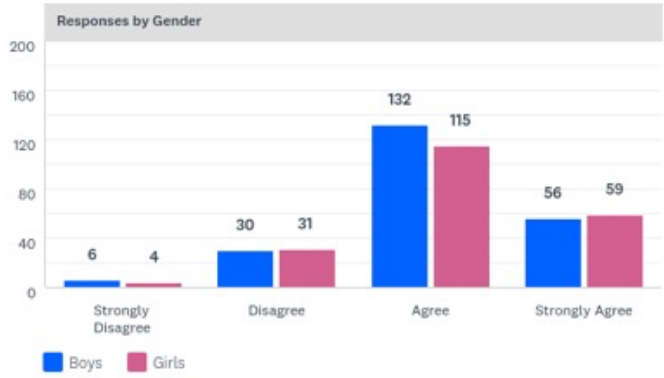
13. This video made me think that science is hard.

Answered: 434



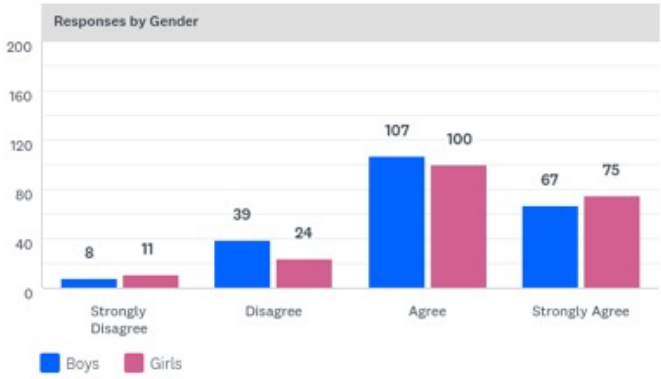
14. This video made me want to learn more about science.

Answered: 433



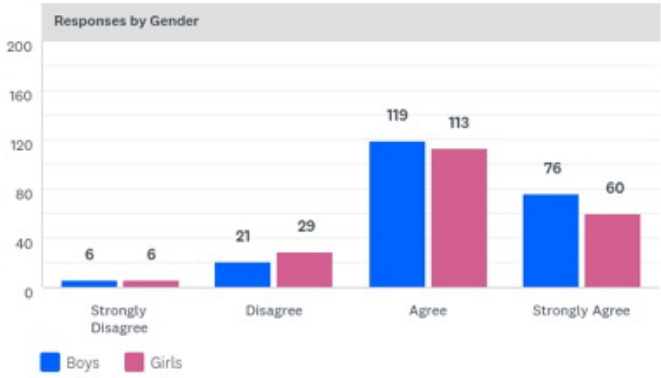
15. This video made me want to try my own science activities.

Answered: 431



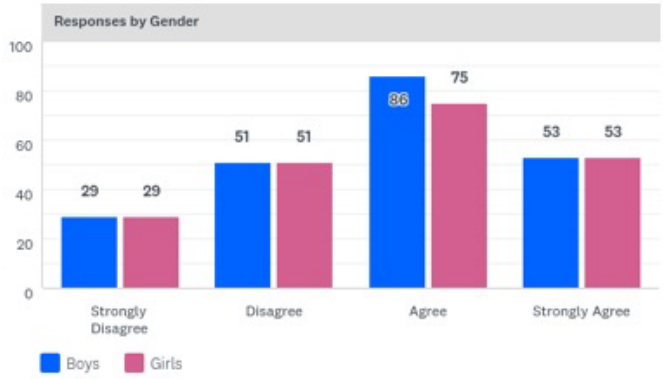
16. This video made me think that it is important to learn science.

Answered: 430



17. I would watch this video for fun on the weekend.

Answered: 427



18. My favorite character was:

Answered: 425