

Katy Jain
July 21, 2011

Mini Research Project #1 – Report #1

For this mini research project, I was a member of the High School and College Age group. The group was comprised of 18 members interviewing students ranging from 9th grade of high school to college age students. Collectively, as a group, we interviewed ten college students, ten 12th graders, seven 11th graders, three 10th graders, and two 9th graders. The group of students who were interviewed were made up of fourteen males and eighteen females. Two group members did not post enough data to contribute to the results. Their data will not be considered for this report.

Section 1: Interview

The interviews for this research project were very interesting. Each member created their own interview questions and revised them using feedback from other group members. All group members asked their subjects about the seasons. I chose a semi-structured interview, as did most other group members.

My own interviews went very smoothly. My female subject was a 12th grade student. She clearly understood what caused the seasons. My last question asked for her to draw a diagram and use it to explain the seasons. Her diagram looked as if it could have come from a textbook and she accurately expressed how the tilt of the earth causes the seasons. My male subject was an 11th grade student. He held the classic misconception that the earth's elliptical orbit caused the seasons, explaining that winter was caused when the earth was at its farthest point away from the sun. I found it very interesting, however, that when I asked him to draw a picture of the earth and the sun to explain the cause of the seasons, he drew a circular orbit with four versions of the earth around the sun, equally spaced out. The picture depicting the earth during summer was slightly closer to the sun than the picture of the earth doing winter. I was expecting a more exaggerated picture showing the earth during the winter months much further away.

When you look at the interview videos, listen to the audio from other videos, and read the interview transcripts, it is clear that many students at this age level have a lot of misconceptions about the cause of the seasons. The most common misconception was that the distance of the earth from the sun is what causes the seasons. This was a misconception held by both male and female, and at every grade level. In fact it was a misconception that eighteen of the thirty-two students surveyed held as either the sole cause of the seasons or at least a partial cause of the seasons.

There were also a wide variety of other misconceptions throughout the sample of students besides the most common one described above. For example, an eleventh grade male student believed Florida has summer when Michigan has winter. Another example is a young man who will be entering college this fall who believed "Mother Nature" caused the seasons and that the sun orbits around the earth. Another student about to enter college, this time female, stated that she thought seasons were a "balance" on earth so that no place on earth became too hot. This

student also believed that the spin of the earth caused the change from one season to another. Other misconceptions included:

- Belief that the earth's orbit was shaped like a circle
- The moon influenced the seasons
- Indirect rays were rays that are blocked by clouds
- Belief that all areas along the same longitudinal plane are experience the same season, at the same time, regardless of hemisphere
- Belief that San Diego does not have four seasons
- Belief that thought that tilt of the earth determined wind temperature
- Belief that the moon pulled on the axis of the earth to change the angle of its tilt
- Belief that indirect rays are reflected off another object

As you can tell from the long list of misconceptions, many students did not have true understanding of what causes seasons. From the interviews, only eight students did not have any apparent misconceptions and were able to correctly explain the seasons. It should be noted that of those eight, all were twelfth grade or higher with the exception of one tenth grader. Of those eight, five of the students were female but I feel that is probably attributed to the fact that our group interviewed more females than males overall. In fact, when one looks at the responses overall, there were no notable differences between the responses of males and those of the females.

When you look at responses by grade levels, there are two notable patterns that I noticed. First of all, amongst 12th graders, all students except one either had a correct understanding of the seasons or held the common misconception that earth's elliptical orbit causes the seasons. Secondly, in grades nine, ten, and eleven, students seemed prone to the widest range of misconceptions. Often they held the common misconception (season's caused by the elliptical orbit) and a second or third misconception as well.

Section 2: Test scores

As directed, our group administered a five question multiple choice test to our interview subjects. Two of the questions were given to us and those we the two questions we reported on for our frequency distribution chart. Below is my original frequency distribution chart, Figure 1. I also created a frequency distribution chart that compared male scores to female score, Figure 2. Finally, you will also find below a chart that compares test scores by grade level, Figure 3. In Figure 3, it should be noted that scores were grouped into three grade levels: ninth and tenth graders, eleventh and twelfth graders, and college level.

From these graphs you can see that the majority of students scored two out of two. The average score was 1.625 out of 2. The majority of the scores were high, as twenty-three participants scored two out of two. Eight students scored one out of two. Only two students incorrectly answered both questions. My own participants did fairly well, with my 12th grade female scoring a two 2 and my 11th grade male scoring a one. Overall, the scores were high as is evident in the frequency distribution graph. The graph does not have a bell shape as a result.

These high scores are surprising when you consider how few students correctly understood the cause of the seasons. But if you compare the two questions to the types of misconceptions you

will notice that the majority of the misconceptions were related to the cause of the seasons and very few misconceptions were related to the comparison of the northern hemisphere to the southern hemisphere. In fact, when you look at the other three questions administered, there were no questions that directly asked about the cause of the seasons. So in essence, our students' misconceptions did not necessarily skew their understanding of the differences in seasons between the northern and southern hemispheres.

When you look at Figure 2 and compare the test scores of males and females, you can see that there is not a huge difference between their scores. The same number of males and females scored a zero. The same is true for a score of one. More females scored a two than males, but again, it should be noted that we interviewed more females than males.

When you look at Figure 3, which compares scores by grade levels, you can see that again, most participants scored a two. Ninth and tenth graders were the only group that did not have any participants score a zero. All college students except one scored a two on the multiple choice test. College age participants scored better than the high school aged participants.

Figure 1

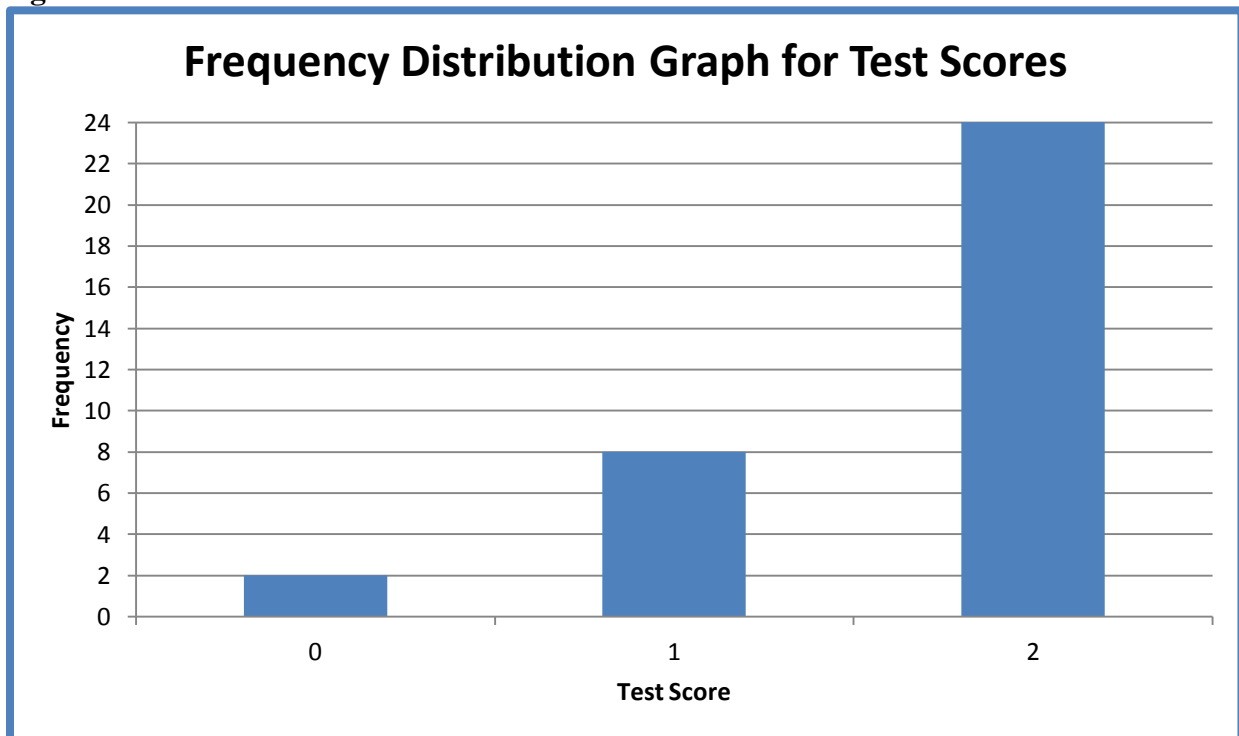


Figure 2

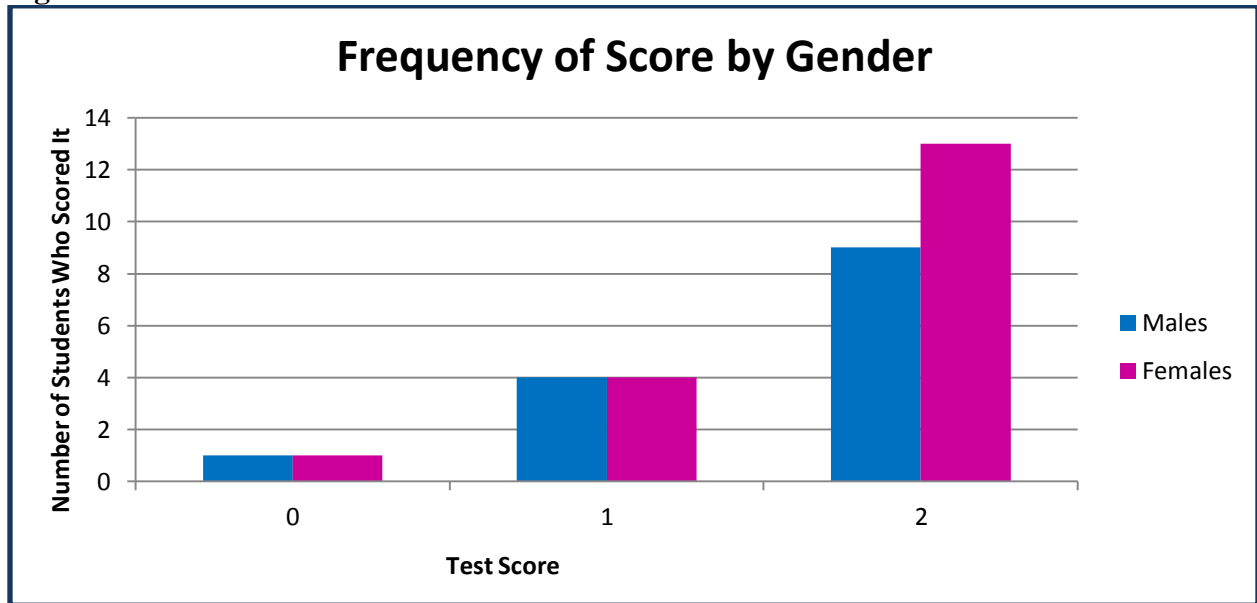
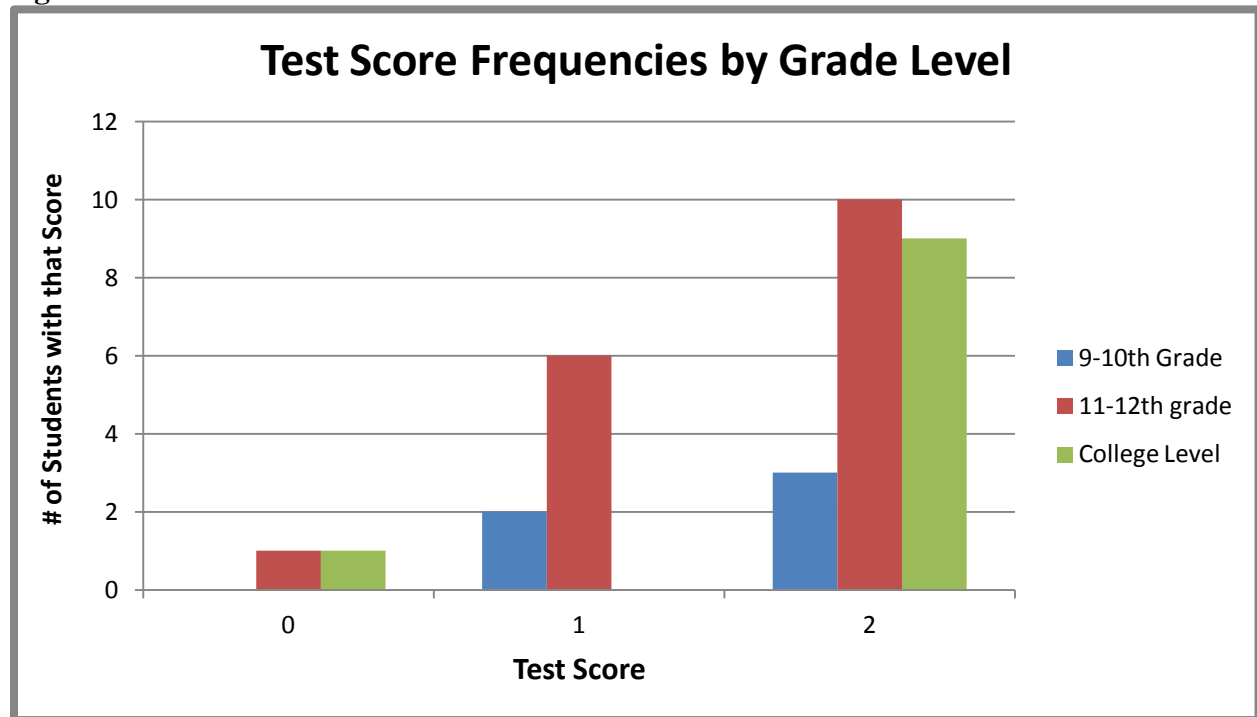


Figure 3



Section 3: Synopsis

As noted before, there were eight subjects who did not have misconceptions concerning what causes the seasons. Those eight participants also scored high (two out of two) on the test. However it is important to reiterate that a large number (23) students scored high on the multiple choice test even though 26 of the 34 held at least one misconception about a concept related to the seasons.

I believe there are a few possible explanations for the large number of high scores despite an even larger number of misconceptions. First of all, the multiple choice questions dealt with understanding the difference in which season it is depending on which hemisphere you are in. Most misconceptions were related to the cause of the seasons. Our group did not have one multiple choice question about the cause of the seasons. In hindsight that was a huge mistake.

Another explanation for the inconsistencies between the interview and the test might be that the misconceptions that students held about the cause of the seasons did not affect their knowledge that the seasons in the northern and southern hemisphere are opposite. Interview questions indicate that students understood they were opposite due to the tilt of the earth and which hemisphere was tilted towards or away from the sun at a particular time of year. It seemed that many students saw this simply as an explanation for that phenomenon and had nothing to do with the cause of the seasons itself. Perhaps student view the two as having separate causes. Perhaps not enough follow-up questions were asked in the interview to help students connect the dots.

Finally, another explanation for inconsistencies between the interview and the test is the varied length of time between the interview and the test. Some group members conducted their interviews almost a week before the multiple choice test was finished. Students would have had ample time to research more information on the seasons. Two students expressed their desire to learn more about the seasons because they felt they should have known the answers to the questions in their interview. Students were not given any instructions not to research the topic on their own, and many may have done just that, causing the high test results.