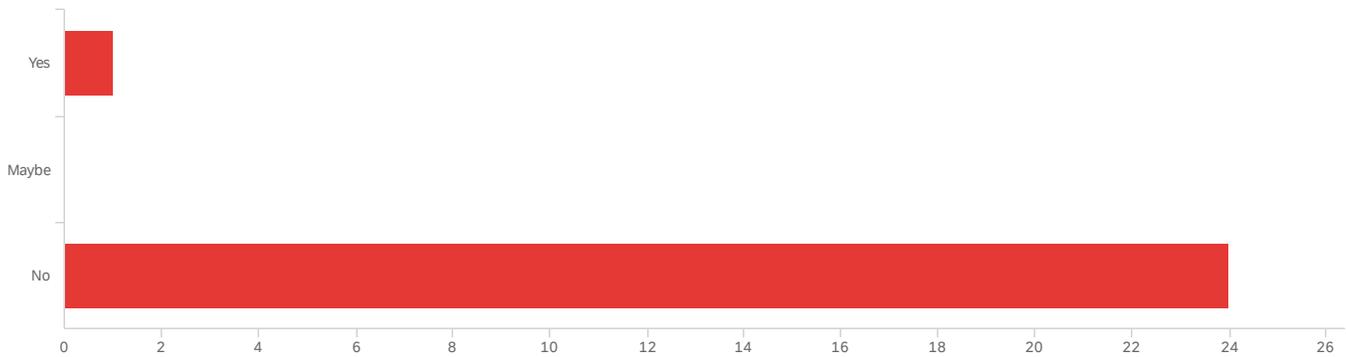


# Appendix B

## Virtual Chirality

Q2 - Did you experience any barriers that kept you from being able to complete the virtual reality experience?



#	Field	Choice Count
1	Yes	4.00% 1
2	Maybe	0.00% 0
3	No	96.00% 24
		25

Q2a - In your own words, describe the barriers you experienced. NOTE: You are not required to share any information related to a disability, neurodiversity, or other personal information. If you choose to share that information, keep in mind this survey is anonymous.

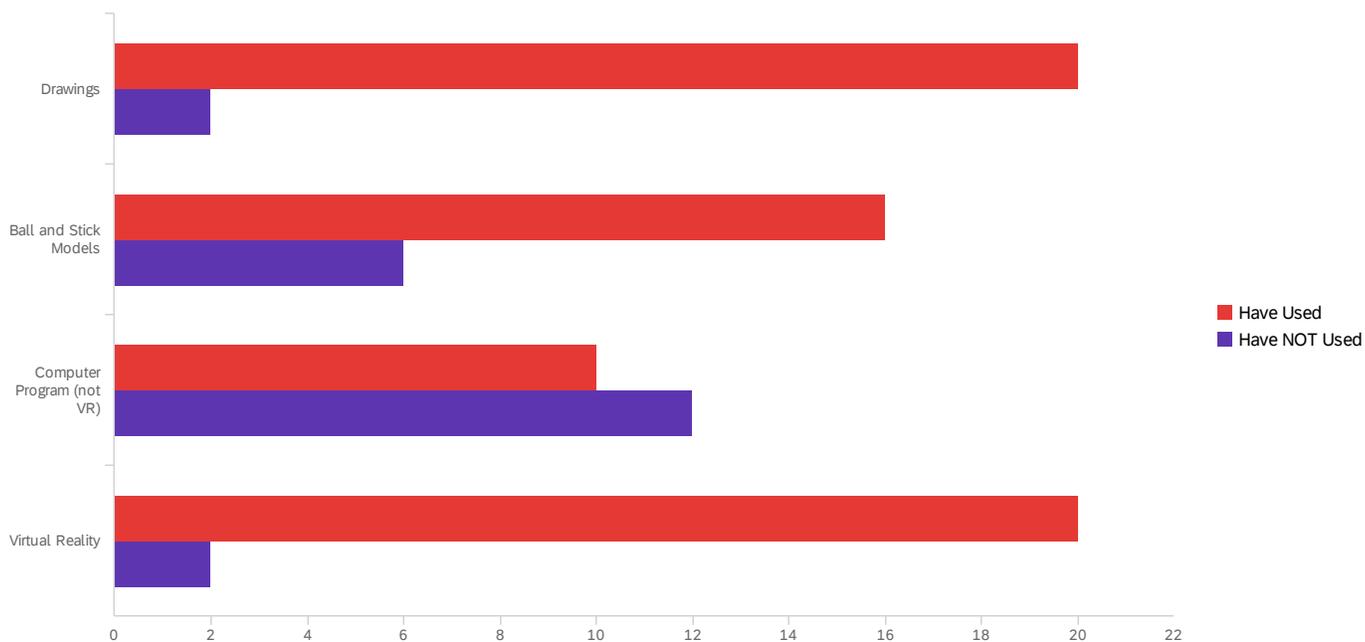
In your own words, describe the barriers you experienced.

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N/A

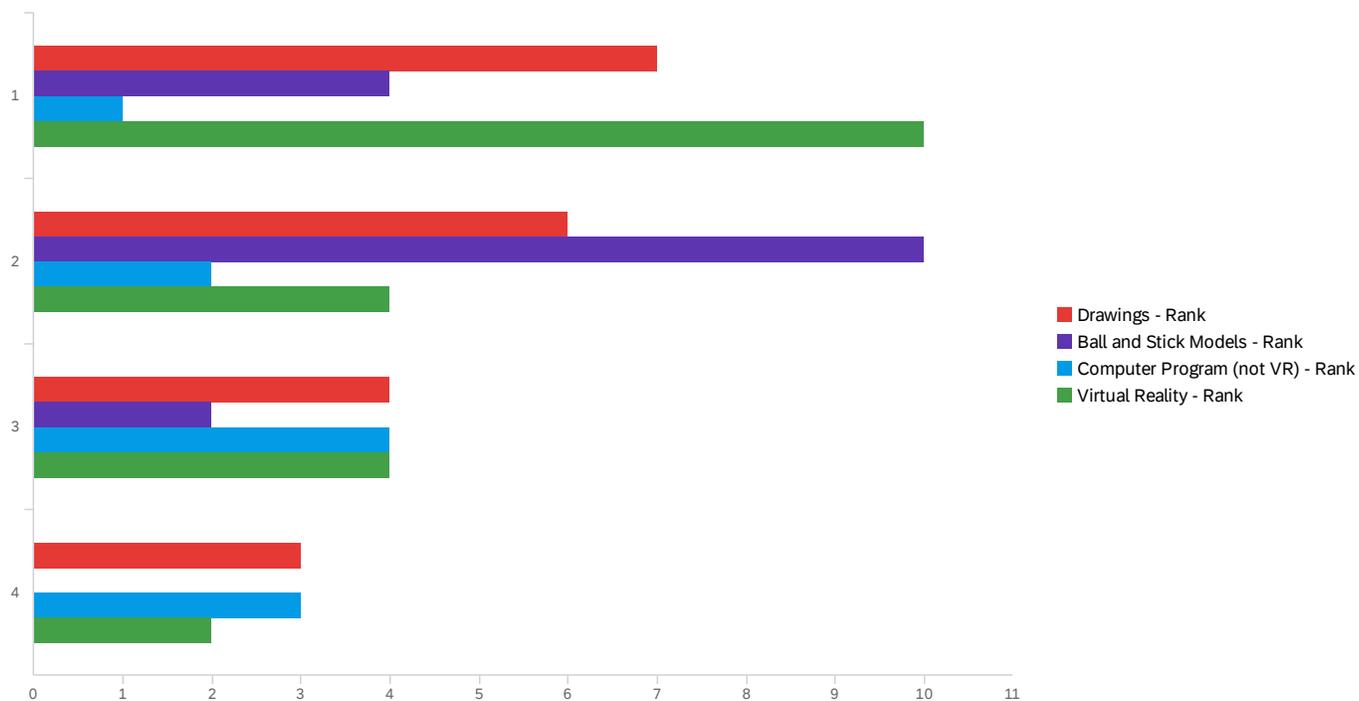
Q3 - This question has two (2) parts: 1. Which of these visualization tools have you used while studying chemistry? Move each option into the corresponding box. 2. Once each item has been placed in the corresponding box, Rank the tools you have used in order of most valuable to least valuable in understanding chirality.

1. Which of these visualization tools have you used while studying chemistry?



#	Field	Drawings	Ball and Stick Models	Computer Program (not VR)	Virtual Reality	Total
1	Have Used	30.30% 20	24.24% 16	15.15% 10	30.30% 20	66
2	Have NOT Used	9.09% 2	27.27% 6	54.55% 12	9.09% 2	22

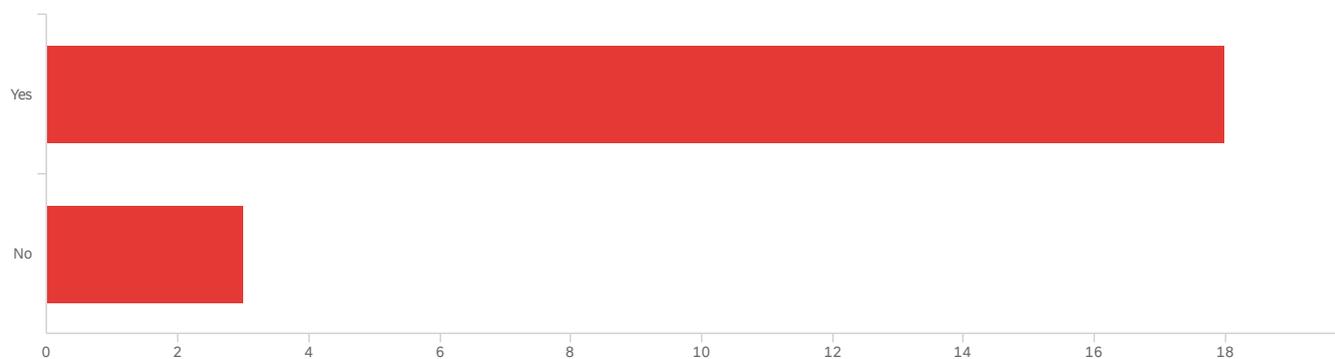
2. Once each item has been placed in the corresponding box, Rank the tools you have used in order of most valuable to least valuable in understanding chirality.



Visualizations Students have used, ranked:

#	Field	1	2	3	4	Total
1	Drawings - Rank	35.00% 7	30.00% 6	20.00% 4	15.00% 3	20
2	Ball and Stick Models - Rank	25.00% 4	62.50% 10	12.50% 2	0.00% 0	16
3	Computer Program (not VR) - Rank	10.00% 1	20.00% 2	40.00% 4	30.00% 3	10
4	Virtual Reality - Rank	50.00% 10	20.00% 4	20.00% 4	10.00% 2	20

Q6 - Do you believe that manipulating the molecules in the virtual reality experience improved your ability to make R/S assignments?



#	Field	Choice Count
1	Yes	85.71% 18
2	No	14.29% 3

21

## Q10 - Please explain your answer.

Please explain your answer.

Ball and stick models do the same without all the fancy equipment.

It was helpful to see the models in 3D and move them around in VR.

It made it easier to visualize how the molecules are oriented in space

I had a very good understanding of R/S assignments prior to this

Being able to see which molecules were behind and in front of the plane helped to make the R/S assignments.

The rotations are more obvious

It was very interesting to see this and be able to "touch" the molecule

The ability to see the molecules in 3D made the concept of R/S assignments clearer and allowed me to better visualize drawn molecules in a 3D format after the VR session.

It is much easier to see how the molecules are oriented when they can be rotated in 3d.

It helped me visualise the tetrahedral geometry of chiral centres so as to make the *r/s* distinction.

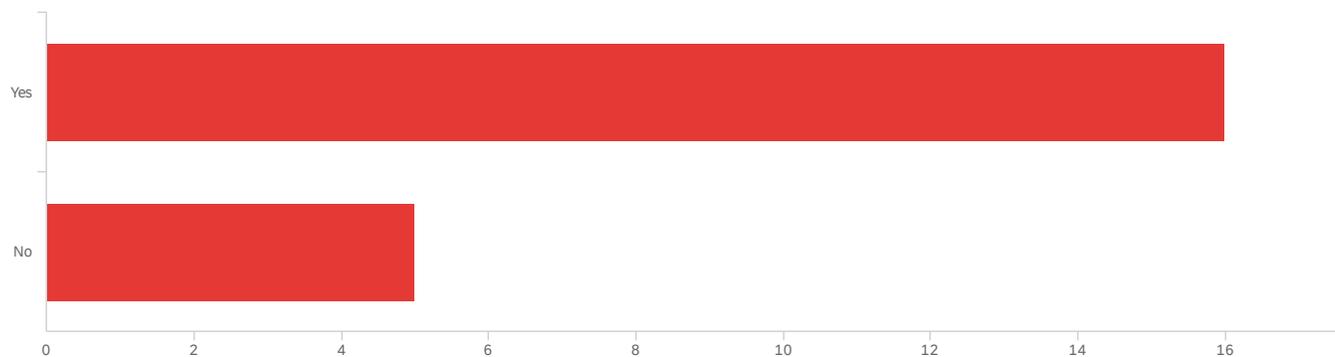
I may have different answers than the rest of the study, but I am not very technologically-inclined, so a ball-and-stick model is much more effective to me than VR.

It allowed me to manipulate them in 3 dimensions rather than having to read off Natta projections.

It was easier to understand how the molecules were supposed to be oriented based on the natta projections we did in class.

It was nice being able to visualize it. I have already learned how to determine R/S configurations and found it easier to understand by drawings on paper since that is how we will be tested.

Q8 - Do you believe that manipulating the molecules in the virtual reality experience improved your understanding of the non-superimposibility of enantiomers?



#	Field	Choice Count
1	Yes	76.19% 16
2	No	23.81% 5

21

Showing rows 1 - 3 of 3

## Q11 - Please explain your answer.

Please explain your answer.

Again, even though it was cool, it wasn't that revolutionary or offered something so new that I'd choose it over traditional means of learning chirality.

It was helpful to see the models in 3D and move them around in VR.

Same as Q10

Sometimes drawing the chiral molecules on paper makes it hard to see how simply flipping the molecules wouldn't give you the same compound but being able to manipulate them and see them really helped me

Being able to place and hold molecules next to and on top of each other helped to understand the non-superimposibility of enantiomers.

You can 'physically' try to superimpose the molecules

Touching them made it easy to manipulate.

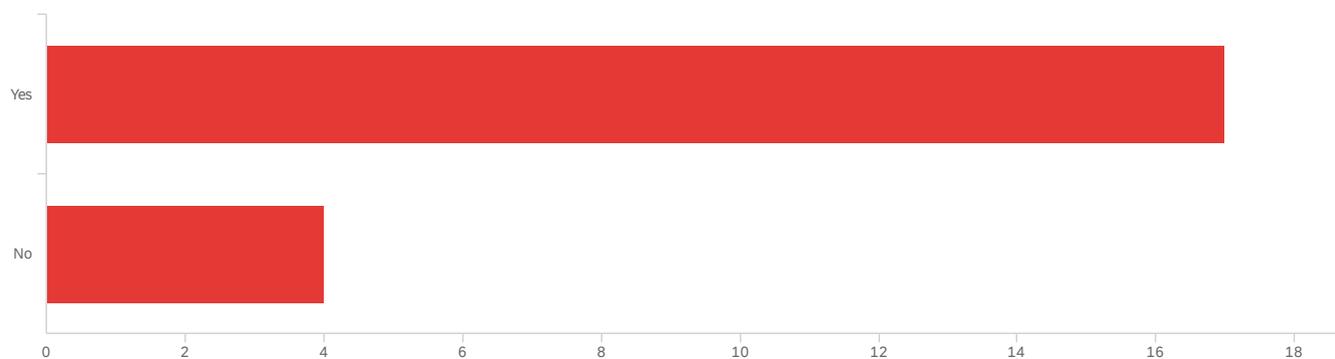
The VR experience helped me better understand the 3D nature of organic molecules and the concept of chirality.

The concept of nonsuperimposibility was pretty clear to me prior to the VR experience.

Same as before. VR is just a worse ball-and-stick, though it is very cool.

It was more difficult to visualize the super-imposibility of the molecules in VR.

Q9 - Do you believe that manipulating the molecules in the virtual reality experience improved your ability to mentally visualize molecules?



#	Field	Choice Count
1	Yes	80.95% 17
2	No	19.05% 4

21

Showing rows 1 - 3 of 3

## Q12 - Please explain your answer.

Please explain your answer.

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It was helpful to see the models in 3D and move them around in VR.

Same as Q10

it was an incredibly helpful experience for someone like me that isn't the best at spatial configurations and is trying to get better

Yes I can still visualize how the molecules looked in the virtual reality experience and it has helped me to visualize molecules in my head by being able to relate to the molecules I saw in the virtual reality experience.

I can see them

Seeing the connections helped me

It helped being able to see all aspects of a molecule from different perspectives and has enhanced my ability to apply this to drawn molecules.

While I was able to visualize the molecules before, having a model to go off of from the VR experience is helpful.

Same as before.

**End of Report**