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My honors thesis involved surveying college students in introductory level classes and an informational pamphlet created using responses from the survey. I faced many unexpected challenges while working on my thesis, such as IRB approval and using Microsoft.

Initial Ideas and Proposal

When thinking about topics to focus on for my thesis, I knew I wanted to do something regarding microbiology. I had heard of a student creating a children's book for their thesis and it gave me the idea of focusing on education in a younger demographic. When I was younger, I wanted to be a teacher because I enjoy teaching others. I wanted to incorporate teaching into my thesis.

I remembered my first semester at Colorado State University (CSU), especially VMBS100. I was surrounded by people who had done incredible things with a variety of certifications. I quickly learned that there were people in my classes that had a much more in-depth background than I did about the medical field and microbiology. For example, it felt like most people in VMBS knew that viruses are significantly smaller than bacteria. I did not know the size comparison and I would have guessed that they were around the same size. This showed me how diverse people are in terms of the knowledge they have of microbiology even though most of the people in my classes were around the same age. Most students in the class had recently graduated from high school, but students were not all on the same level in terms of knowledge of microbiology.

The Covid-19 pandemic was another indication of people's lack of microbiology knowledge. There was a lot of confusion and misinformation circulating during the pandemic that could have been reduced by basic knowledge of microbiology. Although we are not currently at the height of the pandemic, we continue to face consequences.

I wanted my honors thesis to address some of these challenges and lessen some of the consequences of the pandemic, even if it is on a small scale. In my proposal, I proposed sending a survey to students to discover where the differences were in knowledge. Using the information I gathered, I could create something to help students learn basic microbiology and there would not be as large of a difference in knowledge between students. This includes information I believe people should know about microbiology.

The survey is also intended to gather information about students' interests in microbiology. What do they want to know? This serves several purposes such as providing answers to questions students have, supporting their scientific curiosity, and keeping their interest while providing information they should know. Increasing knowledge through education is important, even when the specific information may not be as critical. Scientific curiosity plays a large role in science and is an important trait to have. Answering questions people have about microbiology will encourage students to support their scientific curiosity. On the other hand, there will be information that students do not care to learn. Integrating information they want to know with information they should know and do not care to learn may allow students to learn the "boring" information they otherwise would not.

I originally planned to send the survey to high school students before they were in college classes. I wanted to learn about what people without any college education knew because college classes are more centered around the student's interests rather than providing information about the population as a whole. I was going to survey high school students at ThunderRidge High School because I am familiar with their curriculum from attending the school. When I went to ThunderRidge, they taught basic cell biology, but not beyond. They did not teach about bacteria viruses, or the immune system. I also knew a few teachers that I could ask about sending the survey to their students. However, I ran into some issues with my original plan.

Institutional Review Board

When planning my thesis, I discovered that sending a survey to students is considered human research. To send my survey, I needed to get approval from the Institutional Review Board (IRB). I was lost on how to begin the process and I was worried about the timeline of my project. I was not sure how long the process would take, but I knew that my project was going to have more steps and take longer than I originally planned.

An email from Ms. Kathy Kioussopoulos, director of Human Research Protection Program, included the investigator manual that had 46 pages describing the approval process. After reading the manual, I had a variety of questions. There were several terms in the manual I did not understand, including some basic level information and terms used throughout the manual. However, reading through the manual did answer some of my questions, such as the potential for my thesis to be considered exempt. I was grateful when I discovered a significant portion of the manual did not apply to me. My project does not involve prisoners, collecting personal information, or patient samples. However, using high school students would be more complicated because the heavy majority of high school students are under 18 years old and are minors. The manual made it clear that the process would be more complicated, but I was not sure how much more complicated it would be.

After reading through the manual, I met with Ms. Cami Lind, an IRB coordinator. She was very helpful and walked me through the IRB application process. The approval process was simpler than I was expecting but would still be very complicated and time consuming. She provided several tips for the application that were helpful. For example, she said that a problem she sees is students adding information about themselves but not the PI. I would not have thought of the complication, but it helped me later when making the application. I also learned that if I surveyed high school students, my project would not be exempt. This caused me to survey college students early in their college careers instead of high school students because most college students are not minors.

I was not worried about the CITI training until I began the process. I was confused on how to access the training because there were several questions I was not sure how to answer and how to access the training for my specific project. Eventually, I was able to find the training for my specific project. Quickly, I discovered the training would not be as fast as I would have liked. Especially in the beginning, I was frustrated because the modules were extensive and included information that did not apply to my project. I understood that there is importance in learning about different concerns the researcher might not have thought of, such as some forms of coercion. However, there were also pieces that I felt were not relevant to me, such as what is expected of an IRB coordinator.

After gaining more information about the application process from Dr. Kelp, I began putting the application together. Some of the questions on the application were easy to answer, such as if I was using minors in my study. I used a different strategy to work through the application questions than I normally do for large assignments. I jumped around the application and answered questions out of order. I answered the questions I was confident of first and then moved to longer questions, such as background research. I then jumped around more, answering questions in order of how unsure I was of the answer. I left some questions blank when I did not know any answer. I then finalized the attachments, such as the survey, consent form, and drafts of emails to professors. It felt really rewarding to complete the “first draft” of the application even if there were several questions that I was unsure of. It had felt like I wasn’t moving forward with my project until this point. I think it was because much of the work I had been doing up to this point was helpful tips that I needed to incorporate, but I did not have solid evidence of the work I was doing. Looking back, I needed to do those steps in order to complete the application, even if it was frustrating that it felt like I was not making progress.

There were some areas that I thought would be simple, such as asking if professors wanted to provide extra credit. However, this proved to be more complicated than I thought originally. I was not collecting personal information, so how would I inform the professors of which students to give extra credit?

I met with Ms. Lind again to discuss the remaining questions I had about the application. She provided a solution to the extra credit dilemma: create another survey. I learned that it can be helpful to just ask rather than trying to struggle and piece everything together myself. She pointed out more aspects of the application that I changed, such as including a range for the number of people approached and a specific number of people recruited. She advised choosing a high number of people recruited, but I was still not sure what specific number to choose. What is a number that was high enough not to be a concern but low enough that they would accept? I learned through this process that there are times when I must go with something even if I have little confidence in it. There are times when I have done the most that I can, and I must continue with the decisions I have made.

I was relieved when I received IRB approval of my project. I was very concerned about the timeline, and I was limited in what I could do without approval. Upon receiving approval, I immediately continued my project by sending emails to professors.

Sending the Survey to Students

I needed to decide who I was sending the survey to. On the application, I stated that I would approach 900-1,000 students and recruit 800 students. My goal was to send the survey to a variety of students in introductory level classes. I began by looking at the CSU catalog and finding the introductory classes to different majors, such as biomedical sciences and political sciences. I then went to RamWeb registration for fall of 2024, the current semester. I looked at the classes I chose and found specific classes that added to a total number of students between 900-1,000. I enjoyed working through the small details, such as verifying that the professor I chose only taught one section of the class. It made me feel like I was making progress on my project when I had not been able to before.

Before beginning this project, I had a lot of anxiety about sending emails, especially to people that I did not know. My project has forced me to send many emails, causing my anxiety

to lessen. I was able to email the professors, most of which I had never met, without too much anxiety. The urgency of time was likely also a factor.

I received emails from two of the five professors less than 24 hours after my initial email. I responded to both quickly. Professor Mikkelsen did not want to provide extra credit, which made me realize that the survey I provided the link to had information about extra credit. I quickly created a copy of the survey without information about extra credit. Professor Jeckel also opted not to provide extra credit. I met with her to explain my project and discuss speaking in front of her class. I had some anxiety about meeting with a professor I did not know, but Professor Jeckel was incredibly nice and accommodating. She eased some of my anxiety about meeting with people I have not met before. She was very supportive of me talking in front of the class, which I appreciated. I also have anxiety talking in front of people. I hate it, but I can speak in front of people when I need to. Professor Jeckel supported me, making it easier to talk in front of over 200 people. It was surprisingly easy to talk in front of the class because I had never talked in front of so many people.

I sent out another email to professors that did not respond to my initial email and two more professors sent out the survey and chose not to provide extra credit. I also had anxiety about sending another email because although it was only two emails days apart, I felt rude and pushy. In the first response back, the professor commented on my initiative, which eased some of my anxiety because she appreciated my second email instead of my fear of being annoyed.

Microsoft Issues

I faced my challenges through my project, but the problems I had with Microsoft were some of the most frustrating. I originally created my survey on Google Forms, before I discovered I needed IRB approval. However, I learned that Google Forms was not secure enough to store responses from students. The OneDrive with a CSU account is secure enough for my project because I am not collecting identifiable information. This caused me to use the Microsoft equivalent of Google Forms, Microsoft Forms.

I was frustrated when the “import” document did not work. I had to figure out the differences in design between Google Forms and Microsoft Forms while typing the full survey again manually. Although frustrating, the largest problem this created was time consumption. I could face this problem head on without too many issues. There were larger problems that I faced with Microsoft.

After filling in the consent form template, I wanted to add it into the beginning of the survey for students to respond to before completing the survey and without collecting their information. I struggled to add the consent form to the beginning of the survey. I learned that if I added the consent form to the introduction, it would be cut off and students could not see most of the form. I changed the design style of the introduction, but Microsoft Forms continued to cut off the form. I then tried to copy and paste the form, but Microsoft Forms would not paste. I tried to copy smaller sections, which failed to work as well. I then started typing the form manually. It worked at first, but then Microsoft Forms would not allow me to finish typing the form. I believe there was a character limit. I repeated typing the form manually into a “question,” but faced a character limit again. I tried uploading a file, which also failed because I had shared the survey. I tried manually adding the form into both the introduction and question sections, which seemed to work. The formatting was slightly off, but the important pieces were included. Struggling with

Microsoft Forms taught me patience and to try a variety of solutions. Eventually, I was able to find a solution to my problem.

I wanted my survey to be anonymous and not to collect personal information. Through chance, I discovered the default for Microsoft Forms is verify that responses are from CSU students and faculty. This makes people sign-in using their CSU account, defeating the purpose of not collecting information. I was able to change the settings to anonymous, anyone with the link can answer, before sending the survey to students. This helped me look at details of my project before distributing the survey.

I created a copy of the original survey for professors that did not want to include extra credit quickly in order to give it to the professor. In my hastiness, I forgot to rename the survey. At first, I did not believe this was an issue, until I realized that once I sent the survey out and people responded, I could not change the title of the survey. It was then difficult for me to know which survey had and did not have information about extra credit. I was able to “favorite” the survey without the extra credit because it was the survey professors were distributing. However, this did not change how the survey appears when I open Microsoft Forms. Eventually, the problem was resolved because I can easily see which survey has more responses. The survey with the most responses is the survey without extra credit.

Responses and Results

I started to slowly get responses once the professors sent out the email. None of them offered extra credit, so I was worried how many responses I would get because there was no incentive for people to respond. I tried to think of ways to encourage people to respond, but I felt restricted in what I could do because I did not want to have problems with the IRB and I could not collect any identifiable information to reward students. However, going to Professor Jeckel’s Life102 class and speaking at the beginning of class encouraged more people to respond. Later that day and the following day, I received more responses. I doubled the number of responses that I had. I do not think all the responses were from the class I spoke in, but I believe a large percentage of the responses were from the class.

There was a single early response that I could not use. They stated that they did not want to participate in the consent form. This meant that I could not use their responses to the questions. This was a larger concern when I saw the response because very few people had completed the survey at that point. Only three people had responded prior to the response denying consent. Although they did not provide consent, they completed the survey, but it was one less response I could use. This caused me to wonder if I should have changed the wording from the consent form template. The template had the options “I agree to be in this study” and “I don’t want to be in this study.” There were people who did not have an interest in microbiology and likely did not care to take the survey, but they would allow me to use their responses. They might not have wanted to, but they did anyway to help in my research. Luckily, the other responses all gave consent to participate in my research.

Early in looking at responses, I realized there were things I wanted to know, and I might have changed some of the questions and formatting. I asked about interest in microbiology early in the survey and I gave examples that people might know about cell biology in high school. I wonder if this gave people a false sense that microbiology was only cell biology, causing them to say they had a smaller interest in microbiology. My intent with the question was to gauge if

students had an interest in science in general because I contacted different types of majors. Someone going into the medical field might have an interest in bacteria and viruses, but not cell biology. In the future, I might change the question, so it asks about science or biology in general. I could also ask the question again at the end of the survey after asking about bacteria, viruses, vaccines, etc. Asking at the end of the survey might give students a more accurate sense of microbiology. I could have also removed the examples relating to cell biology and allowed people to say without knowledge that they likely know some microbiology. There were other questions that I would have worded differently such as horizontal gene transfer (HGT). There were not as many people as I expected that had an interest in HGT. I wonder if it was how I explained it. I think more people would be interested if they had an idea that bacteria could obtain DNA from other bacteria and the DNA be expressed. It is different from our systems, and I think more people would be interested if I was able to convey that better. I also think more people would have had an interest in why people believe vaccines cause autism. Although it still may not be as highly ranked as other topics, I think more people would be interested in how the myth started. However, in the survey I worded it like a question if vaccines cause autism. I think most people believe that vaccines do not cause autism and do not have an interest in me confirming their beliefs. The people that had an interest in vaccines and autism might have been curious if vaccines could cause autism in very rare cases or they might have been interested in why it is a myth. I didn't know their thought processes and it could be frustrating. If I could have understood why they did not have an interest, such as they did not understand the concept, I could have made a more effective survey. I could have explained things in a different way that drew their attention rather than them assuming they did not have an interest in something they did not know anything about or thought they already knew.

As I read through the responses, there were some additional questions that I would have liked to know. I really would have liked to know people's interest in each category, such as bacteria, viruses, etc. I asked about the general interest in microbiology and specific topics of each category, but not the general interest of the category. There were some responses that I got a good idea if they were interested, such as checking every box of specific topics or checking none of them. But the majority of responses had some boxes checked while others were left unchecked in specific topics. I would have also asked why or what part interested them in the different topics. Some of the topics were very broad, such as how bacteria affect people, that answering them is difficult. I regret having some of the categories because they are very wide open. Two people could both be interested, but one person wants to know what the clinical signs of a bacterial infection are, whereas the other person wants to know how the bacteria cause the clinical signs.

There were some questions that I liked, and I would likely not change. I really liked the responses to what question(s) would you ask a bacteriologist, virologist, etc. The responses were really interesting. People thought of things that I did not think of that they had at least a mild interest in. I think it also gave me an idea of how much they knew about the category because the level of depth of the questions varied. Some people asked questions about what microorganisms do, whereas others asked more specific questions. Sometimes it also gave insight into how interested someone was in that category. There were a couple responses where people had an answer for one category but not another.

I liked the specific topics question where students selected the topics they were interested in for each category. Although there were flaws to the question, I think it got some people thinking about the category. I wonder if some of the topics sparked people's interest when they

were not expecting to be interested in anything. There were multiple people who responded they had no interest in microbiology in the beginning, but selected topics later in the survey. Although some topics were chosen because people should know about them, there were some topics that had the purpose of trying to draw people's interest, such as vaccines and autism. I believe most college students do not believe that vaccines cause autism. The goal of adding the topic was not to inform people of something they need to know because I think they already knew it. The purpose of adding the topic was to grab people's interest by making them laugh or get people to ask why vaccines causing autism is a belief. It was interesting that some of the topics that I thought might be interesting to people did not have as many responses. The horizontal gene transfer and autism topics only had 10 and 7 responses respectively. The other topics in their respective categories generated significantly more responses. For example, how bacteria affect the environment and how they affect people both received 20 responses. In the vaccines category, the next most popular topic after autism, the different types of vaccines, had 15 responses. There was a lot of interest in each category as a whole, but there was less interest in some of topics such as horizontal gene transfer and autism.

I found the question about their understanding of each category interesting. Some of the responses were what I expected, and some were not. I thought it was interesting that the general trend for all categories was "some understanding" had the most responses and "excellent understanding" had the least with "not at all" being a close second to last or tied with "excellent understanding". For example, 60% of people responded "some understanding" and 12% of people responded "excellent understanding" in reference to immunology. This was the trend for all the categories except vaccines. In every question except for vaccines "some understanding" held at least 50% of the responses. Although "some understanding" had the most responses in the vaccines category, it was only the majority by one response. Significantly more people answered "good understanding" about vaccines. 11 (46%) people responded "some understanding" and 10 (42%) people responded "good understanding." I wonder if people know more about vaccines because they are discussed more and spoken of very generally in how they work, especially after the pandemic and the controversy of vaccines that increased. People have heard of bacteria and viruses, but bacteria and viruses are often discussed as a part of life. The discussion surrounding them is focused on how to prevent infection rather than what they are or how they function. The mechanism of vaccines on the other hand, is taken about more, possibly because it was something people created, and scientists want to eliminate some of the fear surrounding them.

Some of the responses surprised me with how much people knew, especially without knowing the significance of their statements. The open-ended questions about immunology especially had responses where students mentioned a term but expressed uncertainty about it. For example, students would say "not much" or "something" before or after saying a term like white blood cells or antibodies. "not much" was used 10 times between 7 people, which is a significant proportion for a specific phrase with 25 responses, making a total of 28% of people using the phrase. Especially in regard to the pandemic, I think scientific terms were used and people learned them without knowing the meaning of the terms. Several people mentioned white blood cells, but very few could explain what they did or why they are important. There were a few people that were able to explain them, surprising me, but the majority of people could not explain the terms they said. Between all the categories, students seemed to have a vague idea of several concepts, but I believe there is space to learn basic microbiology.

Pamphlet

I realized early into making the pamphlet that I could not add a lot of information. I had originally planned to include both basic information as well as some answers to questions people had. I added very simplified information into the survey itself and answered questions in a separate document. However, there was still some information I could not include in the pamphlet about basic information. Luckily, some of the questions people asked allowed me to fill in some of the blanks I could not add to the pamphlet.

I kept switching back and forth between the pamphlet and additional questions, which I did not like. It felt like I was disorganized and did not have a clear direction. However, I moved through the different sections of the survey and pamphlet. I got into a rhythm later by making a list of the topics from the survey that were mentioned several times and moving through the topics.

Conclusion

Overall, I really enjoyed reading the responses from students, but there was a lot of frustration leading up to the responses. I think the most frustrating part was the IRB process because it was something that I had never done before. I was confused and lost throughout the process, and it felt like I was moving incredibly slowly. I recognize that a large reason why this process took me so long was because I had never done anything like it before. However, that did not make it less frustrating. I was very concerned about the timeline and if I could finish by the end of the semester. In the end, I am glad that I was able to get through the IRB application process. In the future, I will have more confidence going through the process and it will not take as long as this project took. I am more familiar with the process, which plays a large role in science research.

My frustration became anxiety when I was trying to send emails to professors for multiple situations. However, this project provided me with opportunities that decreased my anxiety for activities I will do in the future. I will need to send emails to people I do not know and speak in front of people.

The responses were interesting to read through. It was informative to read what people did and did not know because there were some surprises and some things I predicted. It is good information to have so I do not assume that people know information they don't when trying to explain different concepts.

I am grateful that I did this project even though it became more complicated than I originally thought. Adjusting to problems and solving them is a trait that I can always develop further. There were challenges that I could not predict, but there was a reward in the end. The responses that I got and my accomplishments felt very rewarding.