
Preparing to Be a Doctor in High School: A Study of Underrepresented Pre-Medical Students' Gains from Advanced Placement (AP) Courses

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Introduction

Nelson Mandela once stated, "Education is the most powerful weapon which you can use to change the world." As a future physician and scientist who wishes to leave a long lasting impact in our society through medical research, I strongly value and appreciate education. I believe it is a key that opens doors to success. My journey these past few years has been filled with role models and mentors who have guided me along the path I go on today. To give back to my community, I volunteer as a peer mentor for high school students motivated and passionate about joining me in the pre-medical track and one day becoming a physician.

My research is inspired by these students, and my personal interest in being able to provide them with the most accurate advice on how it is best to prepare for college. My research addresses whether Advanced Placement courses, specifically Biology and Chemistry, have prepared underrepresented pre-medical track students to be successful in similar science-related college courses. Furthermore, I wanted to understand whether these courses provided students retainable knowledge that they brought to college, and what are some of the benefits the students gained to increase their success in college from enrolling in AP courses. Lastly, I wanted to address the correlation between student performance in AP Biology and AP Chemistry courses with AP exams to students' success in college and whether support or discouragement played an additional role.¹

In high school, AP Biology and AP Chemistry are some of the most challenging courses offered (Hammond). To achieve success in either of these courses, it requires students to take a new approach different from what worked in their other high school courses. It is during this time that students have the chance to begin exploring new ways of studying and how to do so effectively to gain the most understanding. AP exams test students on the type of critical and analytical thinking used in college. Unfortunately, many students do not reach that level of cognitive thinking at such a young age as their brains are still developing ("All about Advanced Placement"). This is another reason why my research question came about; if students do not have the skill set to fully

¹ As an underrepresented student myself, my research stems from my genuine interest to gain knowledge on how AP science courses are providing students benefits in the form of college success and preparedness.

understand some of the topics taught to them in high school, then what is it that the students are feeling they gain from these courses when they enter college science courses?²

From my own experience, I feel that, even though I may not have performed well on all of my Advanced Placement exams, I did learn essential study habits and time management skills that have played a significant role in my success in college science courses. I feel as if I had seen a “sneak preview” of what it was like to cover large amounts of complex material in a short amount of time and be tested on it through very difficult exams. College science courses became less terrifying and much more approachable than they probably would have been to an incoming freshman without exposure to college-level courses.

The academic research that has been conducted on student success in college after enrolling in AP courses is not very extensive (Hammond; “Does AP”; Bressoud). Research suggests that AP involvement does not necessarily point to students being more likely to have higher grade point averages in college and being more successful. There are a few studies that specifically focus on the correlation between AP exam scores and college success, and they did find a positive correlation. Research studies testing this correlation in underrepresented groups are lacking (Marwick; Moore and Slate). Additionally, there has not been research conducted discussing students’ gains from AP courses. I find this highly interesting as many students share that they feel they gained a lot from AP courses. Well, what are they actually gaining if it is not necessarily shown through their grade point average (GPA) and/or college performance?³

Advanced Placement courses were initially developed to engage the minds of very smart, bored high school students during the 1970s. Since then the reason students are enrolling in AP courses has become more of a combination of a desire to entertain themselves with more challenging academic courses and the benefit of making themselves more competitive during the college application process. Additionally, AP courses were only offered and accessible to students of higher income and social status, but through time they have been offered in just about all schools—this is a trend that is slow, but changing as well (Katula; Marwick). Few studies have tracked student success from high school to college, but many have looked instead at the probability of student success according to the student’s AP examination score (Hammond; “Does AP”; Bressoud).

Many argue that AP courses are a benefit to students as they serve as college preparation and they may increase their chances of college success (Scott, Tolson, and Lee). Others argue that the quality of AP courses is not at the adequate college level⁴ and that students should not be exempted from these courses, especially when they are part of their field of study. This idea may be gaining momentum as private schools and some of the best high schools in the United States have recently begun the abolition of all AP courses in their programs. They are now offering more critically and analytically focused high school courses. Universities do not have a problem with this as they can see students are gaining the skill set that they look for specifically in high AP exam scores (“Starting Small”).

Are high AP scores indicative of a student who has developed analytical and critical thinking skills on the subject of their AP course and will that demonstrate their success in college science courses? A student from Cornell University would strongly disagree as he obtained 5s on all of his AP exams, and still found himself having to withdraw from Biology II in college (Oxtoby). However, Bridgman and Lewis would agree because of their extensive research study of looking at the correlation between essays and multiple-choice scores of AP exams with freshman grades at 32

² Early on in this research paper I wanted to get the reader thinking about what possible benefits students may be gaining other than grades and a passing AP exam score that will provide them college credit.

³ I continued to hint at the significance of student gains in AP courses. This is a topic mentioned frequently in the field, but has not yet been studied.

⁴ By appropriate college level, authors within the field and myself refer to critical thinking and analytical skills gained on the subject of the AP course.

colleges⁵. One of their focuses was on AP Biology and they found that the multiple-choice scores highly correlated with freshman grade point averages. Even though the student from Cornell and these authors seem to contradict each other, they are actually demonstrating the fact that students are gaining something other than the thorough understanding in their classes to help them achieve “successful” GPAs in college. There is a research gap addressing this correlation; no study before has attempted to look for the specific factors that provide the benefits students feel they gain in AP courses.⁵

Society is putting an immense pressure in students to be a part of Advanced Placement courses in order to be considered for college. In many cases, the students are not gaining college credit or the knowledge from the classes to allow them to successfully move on to more advanced college courses right after high school, such as Biology II after gaining AP Biology credit (Bressoud). However, students feel more prepared for college even if that means taking those same subject AP courses again⁶. Professors and college students have shared their experiences of how faulty the AP Examination scores may be in representing student success in the same topic college course (Oxtoby). A new focus and approach to AP courses should be taken once we understand what are the benefits that are truly helping underrepresented students succeed in college.

My research will be focused on underrepresented pre-medical students in college and how their AP courses, more specifically AP Biology and Chemistry, have helped them achieve “success” in college. By success I am referring to an academic level at which the student is competent. I will specifically try to look at the factors such as study skills/habits, knowledge, or experience that AP courses provided these students to make them feel like they had benefited from the courses. Additionally, I will focus on how and why they got involved in AP courses, whether they were discouraged in enrollment of AP courses, and how their success in high school compares with their current college experiences.⁷

Methods

A questionnaire was designed through Survey Monkey to collect demographic and academic data about seventy pre-medical college students who enrolled in Advanced Placement courses in high school. A message briefly explaining my research, asking for pre-medical student responses, and greatly appreciating students for their time was sent to a large population of students through the web. First, the survey was posted in the discussion sections on Webcourses of my Physics II, Physiology, and Principles of Infectious Disease courses. Second, this survey was sent through email to a group of pre-medical students whom I mentor under the Learning Environment and Academic Research Network at the University of Central Florida. Lastly, it was posted on Facebook several times to my friends, many of whom are in the pre-medical track, and was re-posted in pre-medical clubs such as Multicultural Association for Pre-Health Students and American Medical Student Association at both the University of Central Florida and the University of Florida.⁸

⁵ I used the example of the student from Cornell University so readers could relate to the student experience.

⁶ Once again I am hinting at the fact that the students feel more prepared for college, even if they have to retake the course of their AP class from high school. The reader may be really thinking now, “Well, how in the world is this possible?” This hopefully makes them want to read even more about why and how this is happening.

⁷ This may seem like a lot of different topics I am trying to address, but with my methodology I knew I would be able to at least focus in in several students and understand their experiences in depth.

⁸ When I first sent out the survey I only got about eight responses in a week. I felt very discouraged, but decided to repost it again. This time I got so many more responses. I continued to repost my survey link in all of the different sites. When I realized that people using these social media sites log on at different points in time and therefore see different posts, I was on a mission to get as many responses as possible. This may be a simple idea, but I think it is definitely one that students creating surveys should keep in mind.

Students were required to be eighteen years of age or older. The ten question survey asked about the following variables: age; gender; ethnicity; whether student enrolled in AP Biology, Chemistry, or both; course grades; and AP examination scores for both AP Biology and Chemistry. Lastly, they had a short free response question to write about other AP courses they took outside of AP Biology and AP Chemistry that they found beneficial to their academic success as pre-medical students in college and why.

Survey Questions:

1. What is your age?⁹
2. What is your gender?
3. What is your race?
4. How many Advanced Placement courses did you enroll in during your high school career?
5. Did you specifically enroll in AP Biology, AP Chemistry, or both?
6. What grade did you receive in your AP Biology course?¹⁰
7. What was your AP examination score for AP Biology?
8. What grade did you earn in your AP Chemistry course?
9. What was your AP examination score for AP Chemistry?
10. What other AP courses did you take in high school that you found were beneficial with a pre-medical major and why?¹¹

Eight students were asked to participate in the cases series, but only four students filled out the follow-up survey questionnaire and were able to make it to the focus group discussion¹². Case studies were conducted to further understand the survey results and student standpoints on various issues. These students belong to underrepresented groups in the enrollment of AP courses and in science careers. They were elected after they took the survey and randomly chosen from a pool of eight pre-medical students from the Learning Academic and Research Network. A list of twelve questions requiring short response was given to the students to answer before meeting as a group for discussion. The students did not fill it out prior to our focus group discussion as planned so I decided to give them a twenty minute brainstorming time to jot down all of their main ideas before we jumped into discussion.¹³

The questions in the follow-up survey questionnaire asked students about the kinds of experiences that were most rewarding and beneficial during their AP courses that they have

⁹ When I first designed this survey, I felt there was a strong value in understanding the demographics of pre-medical students enrolling in AP courses. I was very interested in seeing whether the gap between underrepresented and white students could be seen in a school as diverse as UCF.

¹⁰ Another focus of my survey was to determine student success in AP courses. I was interested in seeing if there would also be gap between the underrepresented students compared to the white students in academic performance. This data would be beneficial to show the students who participated in the focus group and ask them to share reasons why they thought the results came out the way they did.

¹¹ Looking back, and now being aware of how short the time period was to conduct this research, I would have immediately asked students through the survey about some of the benefits they found in the AP courses as they continued as pre-medical majors in college. I wanted to focus more on this in the focus group, but I think it would have been interesting to see the results from a larger sample size.

¹² I had planned to have a minimum of five students to do the focus group, but unfortunately several students did not show up. Scheduling a group of students to meet at the same time is difficult. I wish I would have done at least several smaller group discussions instead.

¹³ As I waited for students to respond to my twelve question survey, after fifteen minutes they kept counting how many they had left. I decided that instead of being so detailed with their responses, they could brainstorm instead and write down their main thoughts on each subject. Through the discussion they would each share their experiences at length. This was definitely an effective change in my method because students were able to agree with each other and come up with new points of view they had not thought about.

applied or continued to use in college. Another focus of these questions was to learn reasons behind enrollment in AP courses and whether as minorities they were ever discouraged in participating in AP courses. A focus group was held to discuss their personal experiences and how it compared to that of other students. During the discussion, I did not follow the questionnaire in order. I guided the conversation as it took different paths with student responses. I was attentive to when it would be the most appropriate time to ask each question. Additionally, follow-up questions were asked to get more information about why the students thought the way they did.

Follow-Up Survey Questions:

1. Do you feel like you learned to critically think and engage with the topics learned in your AP courses? If not, do you think there was anything within the course that helped you develop these skills in your college science courses?¹⁴
2. What were some factors of your AP courses that helped you be more prepared, confident, and successful in college? (i.e. time management, ability to handle a lot of difficult material at once, knowledge on topics, etc.)
3. What are some factors or things you wish you would have been taught or exposed to during your AP courses that would have helped you be more prepared for college courses?
4. Did you retain a lot of the information from your AP courses? If not, did it help you retain it better in college? Do you think it helped you understand the material even better?
5. Do you think that AP science courses should definitely serve as replacement to science courses in college if the students passed their AP examinations? In other words, do you think AP courses are equivalent to the level of learning and understanding of that is required in a college course, and should allow students to skip that course?
6. As a student who belongs to an underrepresented group in the enrollment of AP courses nationally, were you ever told you shouldn't take AP courses or did you ever feel discouraged? If so, explain why.
7. Why did you enroll in AP courses, and not just continue with regular high school courses?
8. Why do you think that students in underrepresented groups are not enrolling in AP courses as often?
9. How would you compare your success in college to students who may not have taken AP courses?
10. Do you think you gained something from AP courses? If so, what was the most beneficial aspect?¹⁵
11. If during the survey you mentioned you took other AP courses other than Biology and Chemistry, which ones did you find were also beneficial to your preparation and success as a student in college taking science courses?
12. Do you think AP examination scores are representative of student success in college?

Results

A total of seventy students responded to the survey. Within the sample group, 64% of them were between the ages of twenty and twenty one. About 67% of respondents were females. The race of the students was predominately White (60%), but there were also African-American (9%),

¹⁴ When the students read this question they were confused. I had to explain to them what I was trying to ask them. It was interesting because I had two friends read over the questions previously and they knew what I was trying to say. I am glad I was there to clear up the confusion.

¹⁵ I worded the same question differently at the beginning (question two) and towards the end of the survey (question ten) to try to get newer thoughts or ideas from the students as they shared more of their experiences and were able to recall more information.

Asian (14%), and other (23%) races students within the study considered themselves to be. Within the academic questions of the survey, 24% of students had taken more than seven AP courses. Taking three and five AP courses was also common with each respectively about 20%. AP Biology (48%) was a much more popular course taken compared to AP Chemistry (16%), but many students also took both (36%). Approximately, 78% of students scored at least a B or above in their AP Biology and AP Chemistry courses. Additionally, only 30% of them had a three or above on their AP examination scores.¹⁶

In the free response question of the survey, students had the chance to write about other AP courses that benefited them the most in addition to(or instead) of AP Biology and AP Chemistry. More than half of the students left this question blank.¹⁷ Of those who responded, most of them answered AP English Language, AP Calculus, and/or AP Physics. They additionally restated that AP Biology and Chemistry were the most helpful AP courses since “the material directly overlapped to their science courses in college.” Students agreed that AP Calculus and AP Physics taught them different techniques to approach difficult concepts and begin learning to think more critically. AP English Language was a “great course to learn basic academic writing” which is often used in laboratory reports for many college courses.¹⁸ Graphs of data are in the following page.¹⁹

The four students who filled out the follow-up survey questionnaire and participated in the focus group had all very interesting point of views. Overall, they agreed that balancing a heavy workload and other activities was a major factor that has aided them through the college experience. Additionally, they believed that they did not retain most of the information, except one student, but being able to see it again for a second time made learning in science courses much easier. Another factor that has helped them continue their pre-medical track was experiencing failure in at least one of the exams in their AP science courses. One of the students stated, “I am glad I lived in a supportive environment when I began getting grades below Cs in my AP Biology course. Once I got to college I avoided a mental breakdown and already knew to push through difficult times.”

Three out of the four students felt that they began to experience critical and analytical skills as part of their AP courses. Two of the four students were discouraged by a counselor to enroll in these more advanced classes. The focus group students did very well in their AP courses by earning Bs or above, as well as in their science courses in college where they also earned at least Bs. They agreed this is not the case for most underrepresented students. Collectively, they said that their main reasons for enrolling in AP courses was because they wanted to learn and engage with the information at a more challenging academic level. Additionally, it also made them more competitive applicants for college. One student frankly stated, “I wanted to have fun in high school and engage with new knowledge. I loved it so much I ended up majoring in AP Biology.”

When they were asked the reason why other underrepresented students are not enrolling in AP courses as often and the numbers are not increasing annually per year, only two students had a response. They thought many underrepresented students might be scared of failing, may not want

¹⁶ Out of the seventy students who responded to my survey, many skipped the questions of the grades they received in the AP course, and their AP examination score. I understand this is confidential information, but in the future I would try to make it a requirement within the survey to answer all questions and leave students to make the decision whether to take the survey as a whole or not.

¹⁷ In the future, I would make all questions required before the survey could be submitted. The only issue is that I had some students put a smiley face or symbols, which the program will most likely read as a response.

¹⁸ Not all students answered this question. Some did not take any other AP courses. In the future I would make this question multiple choice when used in a survey to try to get as much data as possible on this topic.

¹⁹ For some reason the graphs kept moving to the next page leaving this page more than half way blank. In the future I would have liked to create graphs on the benefits students found in AP courses, but due to sample size of four students in the focus group who shared these experiences it would not have been as statistically accurate.

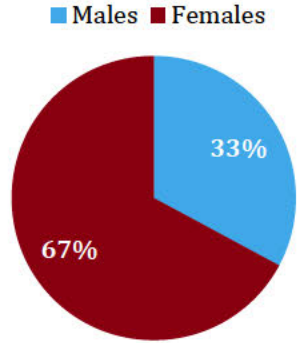


Figure 1: Gender of student participants in the survey demonstrated women were much more involved in AP courses.

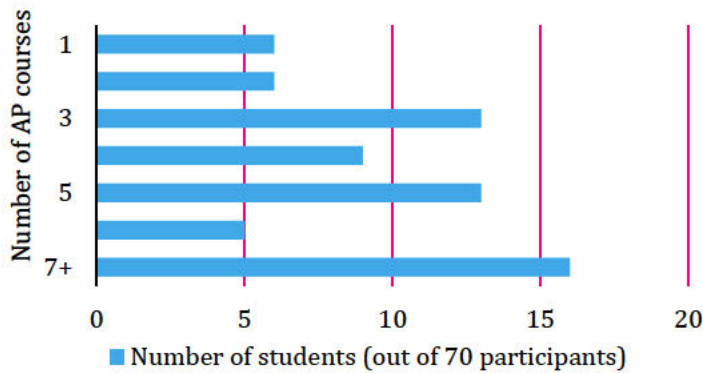


Table 1: Number of AP courses taken by student participants during their high school career

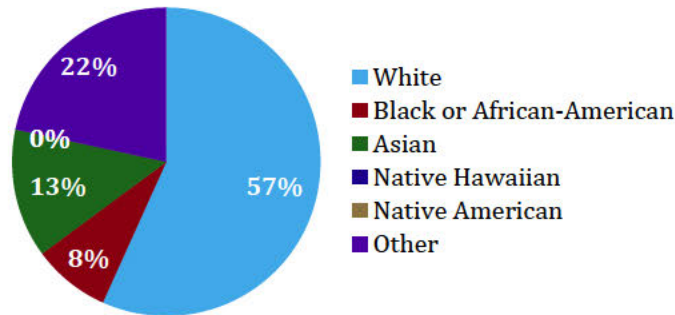


Figure 2: Race of student participants in the survey. More than half of the students identified as White. “Other” was used by students who considered themselves Hispanic.

to do all the work it took to do well in the course, and most likely did not have a strong support system.

The last point discussed in the focus group was whether AP success dictates student success in college. Students all agreed that this was the case. However, after I asked them to give me

reasons why they thought this and if they knew of anyone who did not fall under this generalization they were able to come to an agreement.²⁰

Discussion (Analysis and Arguments)

Demographic data collected in the survey bolstered the gap of white student enrollment predominating over that of minority students in AP courses. This is quite interesting because I posted the survey in a pre-medical club that is only for minority students, posted it on my Facebook in which most of my friends are Hispanic, and sent it to the minority students in the LEARN program, and there was still a significant difference in participation. Additionally, according to my data more females than males are participating in AP courses. This is something that has been occurring during the last few decades as women are given the same opportunities as men. Another way this occurrence is happening is through medical school classes in which women are becoming the majority ("Women in Medicine").

During the focus group, only two out of the four students were able to speak about the reason why underrepresented students are less involved in AP courses. These same two students had been discouraged to participate in these courses. The reason for these varied responses is probably due to the different situations that these students experienced during their high school AP course curriculum. Amanda, one of the students who was not able to discuss this topic, grew up in Miami where white students were actually the minority in her AP courses. She had the opposite experience as most underrepresented students face across the United States. Her environment was actually overwhelmingly supportive and encouraging. Amanda confessed she was unaware of the low percentage of underrepresented students enrolling in AP courses.

Unlike Amanda, Kathryn was a minority in her AP courses. She had been part of advanced classes since she was a little girl and her enrollment in AP courses just seemed like the expected step to for her take. Nobody questioned her actions and she felt like she was where she was supposed to be. Kathryn did not know why other underrepresented students were not enrolling in AP courses. She mentioned that she did it and was unsure why others did not do so as well. However, what she did not consider was the fact that she continuously mentioned how supportive her family was throughout the entire process. Additionally, not all underrepresented students are part of advanced classes all their lives. Some may not even get the opportunity to take any at all; this lack of experience provides guidance counselors reasons to doubt underrepresented student success in college-level courses.²¹

Luis and Nhatvy both were underrepresented students in their AP courses. Unlike Kathryn, even though they were also part of advanced classes previously and part of other prestigious programs in their high school, they were still discouraged by at least one person. Having the experience of being discouraged has most likely given these students the ability to ponder and attempt to answer why there is a low number of underrepresent students in AP courses nationally. Both Luis and Nhatvy agreed that one of the main reasons may be lack of a strong support system from their family and friends as that is something that just about all AP students have. Additionally, they may lack the motivation and eagerness to learn which seems to be the main driving force for student enrollment in AP courses. This aligns well with why the students in the focus group decided to enroll in AP courses in the first place. They genuinely wanted to feel academically challenged, learn complex material, gain as much knowledge out of the class as they could, and appear as more

²⁰ As I asked questions to the students they were very quick to give me answers. I asked them more questions on the topic and made them give me reasons for why they thought they way the did to dig deeper into their reasoning. The students changed their opinions at least a little most of the time after they had more time to reflect on it.

²¹ As I asked questions during the focus group, I was able to not only hear their opinions but also understand them at a larger scale and what they really meant to the field of study.

competitive applicants for college. Previous research has demonstrated that many underrepresented students do not share this mindset (Marwick). This might be because they were not brought up to think this way. Or they may lack the motivation and desire to pursue very difficult and time consuming classes, or it could be due to personal reasons they have to deal with at home. This is a very interesting area of research that needs to be explored in the near future.²²

Students in the survey who took one AP course ended up taking more than three (85%). Approximately, 78% of them scored at least a B or higher in their AP Biology and AP Chemistry courses. However, only 30% of them had received a three and above on their AP exam score. What this data represents is that many students took several AP classes during their high school career and did well in the classes by earning good grades, but still failed most of their AP exams. These students are very likely to be demonstrating talents to handle the workload, stress, pressure, and ability to learn the material throughout the course. Unfortunately, they seem to be lacking the ability to critically think and analyze the material at a college-level which is the skill AP exams specifically test. So where and how are these students gaining and developing the skill to critically think and analyze? I sought to answer this question by asking students in the focus group the gains they felt of AP courses for achieving success in college as a pre-medical student, and if they felt they gained some of these skills in other AP courses to state them.

The gains these students felt they were getting from AP courses were collectively stated during the focus group to be time management, ability to handle a heavy load of material, and exposure to content of the material. Additionally, they felt dealing with frustration and failure early on made them stronger and more confident to deal with those similar situations in college. After hearing the experiences of these students it seems that the ability to deal with stress, failure, and a million things to do sometimes gets overlooked to be a one of the great benefits of AP courses. Being proficient at these skills may serve as the tool to reduce the number of students who give up and change their pre-medical majors when they struggle with Biology or Chemistry during their freshman year.²³

When students in both the survey and focus group were asked to mention which AP courses were the most beneficial to prepare for a pre-medical major, they stated that AP Biology and AP Chemistry were definitely the most beneficial. The reason students elected these two courses were because the material directly pertained to the classes they have to take as part of their pre-medical major. It allowed them to bring with them very basic prior knowledge, if any remembered at all. Most of the students agreed that it was seeing the material a second time that helped them learn it with less of a struggle and the ability to even understand it at a deeper level. When they used the word struggle it makes it seem like the material in AP courses is much more difficult since it's the first time students are exposed to it. By the time they get to college they feel more comfortable and can remember bits and pieces of what they learned previously. They can now ask questions to deepen their understanding of the material. The outlier of my data was Amanda, one of the students in the focus group. She said she retained all her knowledge from her AP science classes and did not have to study much during her science courses freshman year. This once again goes back to the circumstances in which she learned the material. The students and teachers were all very engaging,

It seems that the ability to deal with stress, failure, and a million things to do sometimes gets overlooked to be a one of the great benefits

²² Data collected in my study has made me very interested in exploring in all the possible reasons of the low number of enrollment. There seems to be a lot of factors causing this occurrence. I was so excited to have such excited participants who were willing to share so much of their thoughts and experiences with me.

²³ These beneficial factors that had not been given the importance before should be considered as more significant now to help retain students in the pre-medical majors. This will be specifically for those who may not have the experience and confuse lack of talent for the field with still learning how to handle college courses.

helpful, and allowed enough time for students to ask questions on the material as needed. One might ask, “Well, don’t the other students have time to engage with the material and ask questions?” In most circumstances, the students do not actually get this opportunity as the professor has to cover so much material during the short class time.

Other AP courses that students also found benefits in were AP Physics and AP Calculus because these are both required in the pre-medical majors and have a strong focus on analytical thinking. These classes required students to think beyond any other class in high school. College courses are more about understanding the concepts than the regular memorization used in just about every other high school course. It gets pretty close to what students quickly found was a necessary skill to have in college courses. AP English Language was also found to be very beneficial in learning how to write academic papers and analyze different pieces of literature²⁴. This skill can be utilized in various ways in college through writing lab reports in science courses and in essays assigned in the Humanities courses. The professors expect students to know the material and therefore test students on their ability to apply it to different circumstances.

The last topic discussed during the focus group was whether AP course and examination success—in other words scoring a 3 or above—dictated student success as a pre-medical student in college. I was interested in learning whether underrepresented students who did well, or struggled, in AP science courses continued on that same path in college. Previous studies have looked at the AP examination scores providing this correlation, but never at the combination with the AP course. When I asked the four students, they all confidently replied that the correlation was definitely there. Three of the four students that did well in AP science courses have continued to do well in their science courses in college even though they did not pass their AP exams. However, Kathryn was the only one who explicitly stated she struggled in AP Biology. She always tried her best, but never got the results she wanted. Even in college she had to work twice as hard as the other students to get the grades she wanted. Her support system and peers encouraged her to keep trying which is one of the reasons she majored in Biology. She did well in Biology I but continued to struggle in her Biology II course. She confessed that she recently came to the realization that she is not meant to pursue a field in the sciences and was going to change her major.²⁵

I believe that passion and motivation to learn continue to be key in the success of students, especially underrepresented students.

For the underrepresented students that took part in my study, getting a very high or a passing AP examination score was not the only predicting factor of their success in college science courses. Their ability to do well in their AP science courses happened to be the first sign of success. Struggling in AP courses is normal as they are challenging compared to other high school classes. Struggling in college-level science courses is also normal, and students who are not exposed to AP classes may take it as if they are not good enough to pursue a major within that field. Students with AP science experience may struggle less, and are more likely to overcome their struggles and failures to reach success as demonstrated with the students in my focus group. Other students like Kathryn may realize after all that they are more proficient at other fields like the humanities. No matter how often struggles are overcome success might not always be the end product in science classes per se, but success can be achieved in another field of study.

²⁴ This knowledge is very important. Understanding that taking AP science classes along is not enough to be fully prepared for a pre-medical major is significant information to know that needs to be shared with students. Many students and even teachers do not realize the skills learned in these other AP courses and how they can benefit from them in the long run.

²⁵ When Kathryn shared this information, I was very shocked. I think these results truly help explain underrepresented student success.

I believe that passion and motivation to learn continue to be key in the success of students, especially underrepresented students. If these were the underlying reasons that students in my focus group chose to join AP courses then they must also be significant as they take college-level science classes. Through this research I also learned a lot about my own experience and success in college after taking AP science courses. As the students in the focus group asked me my thoughts and opinions on some of these topics, we came to a conclusion. There is a general trend in which students who do not succeed in AP science courses are very unlikely to pursue those fields later on; however, there are also a select few who get even more motivated rather than discouraged. They keep working hard and end up succeeding like the others who initially did well in the courses.

Before I conducted this study, I believed that all students who were motivated enough could accomplish anything they wanted, but now I understand that this is a much more complex issue than initially perceived.²⁶ To achieve success as a pre-medical major in science classes, there are many factors to consider. Some of these are eagerness to learn, motivation to succeed, experience with failure and stress, support systems, academic history, AP course curriculum, location of high school, and many more unknown factors that attribute to an underrepresented student success in college.

The major limitation in this study was a small sample size in both the focus group and in the survey. With a very short amount of time to conduct this research, the survey could have been utilized to balance a focus on both the benefits of AP courses in addition to the demographics and the grades students obtained²⁷. It will be very interesting to see the responses of a large audience when asked if they learned to balance time effectively, handle stress, work under pressure, retain knowledge, and think critically during their AP courses. Another topic of interest to study further is the reasons behind underrepresented students' low number of enrollment in college-level courses. Is it based on family issues, personal motivation, or peers who convince them they might not be cut out to be part of those courses?²⁸ Due to my small sample size we cannot make generalizations about all students, but we can gain a clear understanding of the situations that these different students experienced and how it has affected their success in college.

The knowledge gained in this study can be used for students in high school who are hoping to become pre-medical majors, as well as professors and teachers, who can focus even more on the aspects that make these students more prepared for college. I will use this new knowledge when I advise my mentees and other students on how to approach AP science courses to their benefit. Additionally, this information could be used by guidance counselors in both high school and college to understand these students and guide them along the right path. Hopefully, this will help encourage and maintain as many students in their pre-medical majors to stay motivated and one day achieve their goal of becoming a physician.

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²⁶ This research has opened my eyes to a new perspective on mentoring. As I conducted this study I tried not to think about my own experiences, but that was made impossible when the students themselves asked me about them. This will help me understand students better and allow me to provide the best advice according to each student's situation.

²⁷ With more time I could have collected more data that could have been more representative, but I am very excited to have found new knowledge on this topic and frankly interested in learning more about it.

²⁸ Not a lot of research has been done in this study population; therefore, there are so many different areas of research still to pursue. But before jumping into all of them, I think it is imperative to learn the specific reasons for underrepresented students' low numbers of enrollment in AP courses.

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