Reflective Essay

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When I entered Ithaca College I never anticipated studying Mathematics. In my previous schooling experience, math had never been an issue for me. It was never exciting, nor something special, just an indistinct subject in school. Math was not a subject that I had to work at, so naturally I did not spend much time focusing on it. No one had ever mentioned the idea of studying math in college. Instead I was fed a stream of recommendations in physics, engineering, and architecture. Towards the end of high school I had a much greater interest in art, music, and French, three subjects that were both fun and challenging.

I entered Ithaca College as a Television and Radio student interested in music, music production, photography and French. I was a radio DJ, played in a band, made short films, and attended a weekly French social hour. Meanwhile I was starting to feel academically unfulfilled, and worried about potential post-college careers. During my sophomore year I became more interested in Finance and Economics, two subjects I previously thought to be for people with somewhat crooked interests. I picked up a Finance minor, and as a result had to take Calculus 1 as a requirement.

College level Calculus was unlike anything I had seen in high school. I entered into a world of proofs, theorems, and conjectures. Before taking Single Variable Calculus, I thought that I had adequate math knowledge, or at least enough to conquer any problem I would face in the future. Not only did the course reveal that I was wrong, it exposed the practical nature of mathematics, and it aligned so well with the way that I thought about everyday problems. I started to see math opening doors in my future. It is at that point that I realized I had to change my major and begin studying mathematics.

Switching my major to mathematics left me behind schedule with my coursework. To catch up I took Calculus II and Applied Linear Algebra at the University of

Hartford during the summer after my sophomore year, and during the summer after my junior year I took Complex Analysis and Abstract Algebra at Boston University. Before attending Ithaca College I had no previous exposure to what I would now call "true" mathematics. That being said, my current understanding of mathematics has been shaped entirely by my coursework at Ithaca, Boston University, and University of Hartford, as well as my interactions with my professors at each university. I have come a long way in a short two years studying math. I believe that I have learned more than I set out to learn, and have achieved more than is expected in the Mathematics Department. Most of all, what I have learned is invaluable.

While studying mathematics, I have developed and refined my problem solving ability. In single variable calculus I learned of the explicit connection between math and real world problems from understanding stock returns, to optimizing resources, to determining the cumulative effect of a changing variable. Math problems were no longer just mathematical manipulations and solutions, they were questions about the real world and how it is changing. I further developed my problem solving ability In Calculus II. I was intrigued when first learning how to reduce three dimensional volume calculations down to a single variable. Then I faced the puzzle of determining a formula for the terms of a sequence. Furthermore in Multivariable Calculus I was able to apply these problem solving skills to a broader landscape where new problems lived.

Heading into my Junior year I saw unfamiliar types of mathematics. I took linear algebra without having any previous knowledge of the subject. I had many formerly unanswered questions lingering from my middle and high school algebra courses. I was delighted to find that all these questions were addressed and answered in linear algebra. I left the course nevertheless asking more sizable questions. Next came my first experience with statistics. My course in mathematical statistics made me realize that I have always tried to be a probabilistic thinker, but never knew exactly how to do it. That course gave me a clear statistical thinking framework. I can now approach statistical numbers with the cover of mindful skepticism so that I may make inferences for myself. Statistical thinking is another problem solving tool that I have added to my belt while at Ithaca College.

A very distinct type of math, but very close to home, is discrete math. It employs the basics of logic, what is and is not, and varying types of arguments. I have always tried to engage in strict logical thought whenever possible, trying to be

mindful of the arguments that I can and cannot make. This course built a connection between the construction of rhetorical arguments that I had been familiar with, and the structure of mathematical arguments. Mathematical proofs must be not only rigorous and objective, but there must be a proper flow to form a clear and valid argument. I used to see proofs as just unclear evidence that one must take for granted. Now I can see why it is necessary to scrutinize every aspect of a proof. It is only after careful scrutiny that one can then prove to themselves the argument that the author is claiming to make. After reading and becoming familiar with many proofs throughout my mathematics coursework, I have come to understand proof writing as an art. It must be clear and clean. I see a proof very much like a play, with the exposition, rising action, climax, falling action, and finally the resolution. Additionally, a proof should only contain that which is minimally necessary for the argument. Famous playwright Anton Chekhov described this concept perfectly:

> Remove everything that has no relevance to the story. If you say in the first chapter that there is a rifle hanging on the wall, in the second or third chapter it absolutely must go off. If it's not going to be fired, it shouldn't be hanging there.[1]

Chekhov's insightful words further strengthen the parallel between play writing and proof writing.

As my growth in mathematics continued, I developed a comprehension for the general language of mathematics. I recall entering single variable calculus, opening up the course text, and being utterly baffled by the language therein. I found it hard to follow and did not comprehend the delivery. Since that time, I have read through many mathematical texts between courses, self exploration, and research and have gained a familiarity with the language of mathematics. This familiarity combined with what I have learned through course work, and my recurring exposure to mathematical proofs has given me the ability to open up a mathematical text and receive the message that is being delivered. Now that I have seen many different types of math from calculus and linear algebra, to discrete mathematics and set theory, to abstract algebra and statistics, I have gained familiarity with the language scattered across the broad field of mathematics. Of course there are still texts which contain types of advanced math that I have never seen before, and although I may not grasp the underlying math, I can call upon my undergraduate experience and

gain an understanding of the basic concepts. This is an ability that I am proud to have developed while working towards an undergraduate degree in mathematics.

Completing the standard undergraduate course work has taught me how to work through difficult multiple-step problems, exercise standard mathematical procedures, and think analytically. Apart from these basic abilities, our math curriculum introduces students to undergraduate research. I had limited exposure to research of any sort before coming to Ithaca College. Even then, I only had one mildly strenuous research paper before switching into the mathematics program. Then in my first semester, I took Math Experimentation which gave me my first real experience with any sort of research in math. Although we walked through guided exercises in the course, I was always interested in stepping beyond what was covered. My professor encouraged and assisted students to go beyond the course material and explore areas that we found fascinating. For a final project I looked extensively at the Collatz Conjecture, which I found highly intriguing. I continued exploring the topic into the next semester when I then had the opportunity to present some of my work on the subject at the Whalen Symposium. Presenting my own work was terrific experience that will benefit me for the remainder of my life. I anticipate having other opportunities in the future to improve upon my ability to deliver a meaningful presentation.

I have had the opportunity to deepen my research exposure by exploring the Thue-Morse sequence in both the Junior Seminar and Mathematics Capstone courses. In Junior Seminar, I explored some of the computational consequences of the sequence, and in my capstone work I looked at some of the deeper math that underlies the sequence and problems interconnected to the Thue-Morse sequence. Gaining exposure to undergraduate research taught me how to approach research questions and how to target the root of the underlying problems.

At Ithaca College I developed a mathematical skill set that I believe prepared me for a job in a field of my choice, whether it is finance, data science, or another related field. I have learned how to produce well crafted work. Moreover I have developed a new way of thinking about the world and its difficult problems. I think it is likely that at some point in the future I will pursue a graduate degree in math or a related field. I feel that my experience in the undergraduate mathematics program have equipped me to succeed in that academic environment.

References

[1] Valentine T. Bill. *Chekhov: The Silent Voice of Freedom.* Philosophical Library, 1987.