Mathematics as a Profession: A Letter to Students

Hassan Azad

(*This letter was written originally to raise mathematics awareness among students of the King Fahd University. I believe that the conceptions regarding mathematics are common to many other professional institutions.)*

Most of you have joined the university with clear ideas about a profession in engineering or business. I have been teaching mathematics here since 1996 and have experienced that in a class of forty, there is at least one student who has obvious mathematical talents. For such students, adopting mathematics as a profession would be more rewarding than a career in engineering or business.

After talking with such students, I found that the reasons why such mathematically talented students do not opt for mathematics are based basically on two gross misconceptions about mathematics. Namely, that there is nothing new to be discovered in mathematics and the only job opportunities that mathematics provides are in teaching. Nothing could be further from the truth. While teaching is an essential and a very rewarding profession for a large majority, there are many other avenues open to mathematicians: I will return to this later.

I can very well see why you think mathematics is a dead subject. Every year, Nobel prizes are given in chemistry, physics etc for progress in these fields and the Nobel laureates are very much visible to you through newspapers and television. The absence of a Nobel Prize for mathematics no doubt reinforces in your minds the impression that, perhaps, mathematics is after all a second rate subject. Why there is no Nobel Prize in mathematics is a very good question and you will find detailed discussions and answers on the Internet. It seems that Alfred Nobel had more or less the same ideas about the importance of mathematics as you do, just as Thomas Alva Edison had a low opinion about theoretical aspects of basic sciences .The good news for mathematics is that in the very near future a yearly prize - the Abel Prize- named after the famed Norwegian mathematician Niels Henrik Abel, will be given for discoveries in Mathematics and it will be as prestigious, rewarding and visible as the Nobel prize. Thus a gross injustice to the visibility of mathematics in the public domain would soon be undone. However, there are many prizes that treat mathematics at par with the highest achievements in other disciplines. Some of these are the Balzan Prize, the Wolf Prize and the King Faisal Prize, which carry enormous prestige and rewards. So you see that new discoveries are constantly being made in mathematics and they are also amply rewarded.

While you may have a clear idea of what a physicist or a chemist does- because you see them working in their laboratories- you may not have a very clear picture of what a professional mathematician does to discover something new. Well, the laboratory of a mathematician is the laboratory of ideas which are handed down through generations of mathematicians. The usual task of the mathematician is to combine these ideas to form new ideas, to link hitherto unrelated mathematical ideas and to have, of course, original ideas. All of this demands extreme hard work and patience but if you are mathematically talented, you will certainly have a couple of good original ideas and these ideas would be enough to earn you a respectable place in the comity of mathematicians.

Just as most of you learn to appreciate language and can recognise beautiful phrases and ideas, a trained mathematician also learns to recognise beauty in mathematics and to sift good ideas and is guided in researches by such largely aesthetic criteria. The joy of discovering a truly fruitful idea is something that can only be experienced; it cannot be described in words.

Now I want to give you some examples of what professional mathematicians consider to be good questions and fruitful ideas. You may have noticed floor tilings in the shapes of squares, equilateral triangles or regular hexagons. If you ask yourself the question-What are the possible ways of covering a floor by regular polygons and are there other ways to tile a floor than the ways just mentioned – then you are asking a good question – and the idea you will need here, for example, of looking at the number of polygons of a given shape meeting at a vertex of one fixed such polygon – would be an example of a fruitful idea. Why?
Because this question leads to an obvious similar question about polyhedrons and contains in it the germs of a very important theory which, incidentally, also leads to higher conservation laws in physics.

Other good ideas are those relating to the meaning of the words dimension and infinity, algorithms for dividing one number by another and for solving systems of linear equations. These are exceedingly good ideas because they have proven to be profoundly fruitful and provide the foundation for much of mathematics and computer science. Your original idea could simply be a new definition, an algorithm or a novel way of linking two different ideas and it need not be as powerful as the ideas I just mentioned. And in all this, you will be motivated by your intense desire to understand and master mathematical ideas.

For historical reasons, mathematics underwent a period of intense introspection, from which it is only now emerging. So, for mathematicians of my generation, it was not absolutely essential to know about other disciplines in any great depth. But for you, it would be good to know about other subjects, for example

biology, in some depth, because the demand of the times is inter-disciplinary research. A hundred years ago, almost all mathematicians investigated both pure and inter-disciplinary matters, for that was the spirit of the times then.

As a professional mathematician, you will get to travel extensively to new places and meet many new people who share your interests and this will give you immense emotional satisfaction. You will form friendships with such people and may work jointly with them or perhaps even compete with them! In all this, you will not spend a penny from your own pocket and your currency will just be your intellect.

Mathematicians, by training and inclination, are always toying with ideas and are great problem solvers. They are also trained to absorb, condense and present logically vast amounts of information. For this reason, it is no surprise that they are in great demand in a surprisingly wide range of jobs- in development, designing and research wings of aircraft and automobile industries, as software developers for major computer companies, in financial institutions, in insurance companies and even in law firms- apart from their traditional employment in research institutes devoted to mathematics and physics. You can get a first-hand account of all these professions by visiting the site MAA Online and searching for career profiles. The Microsoft Corporation is so impressed with mathematicians and their way of thinking that it has established its very own research institute for mathematics.

As regards the relevance to everyday life of what you will study in advanced mathematics, the truth is that mathematics is ahead of applications by about a hundred years- sometimes much more- as in the case of study of conic sections by Greeks and their applications to the motion of planets and satellites almost two thousand years later. However, this gap seems to be rapidly decreasing now- as in the case of fractals and wavelets. Two sites which I recommend whole heartedly to you are MathForum@Drexel and the Millenium Mathematics Project. These sites will help you in every aspect of your studies and will answer all your questions relating to mathematics in everyday life, job opportunities and much, much more. Explore these marvellous sites at the first opportunity!

I hope that these lines have helped to correct your impressions about mathematics and that they will help you in making informed decisions about your careers.