Is mathematics beautiful or useful? Why do people choose to do mathematics? How could Enrico Bombieri have been obsessed by the Riemann Hypothesis since the age of 15? How could Andrew Wiles have devoted 30 years of his life including 7 years of isolation just to solve Fermat’s Last Theorem? Indeed, mathematicians nowadays are still arguing about whether mathematics is or should be either beautiful or useful. Are those who do ‘useful’ research occasionally looked down upon by others who do more aesthetically pleasing ‘beautiful’ mathematics research?

Firstly, let’s look at what mathematics actually is. Mathematics is defined to be the study of quantity, structure, space and change. Mathematicians seek out patterns, formulate new conjectures and establish truth by rigorous deduction from appropriately chosen axioms and definitions. This somehow indicates that the importance of mathematics comes from the truths, the results that they prove, from the power to build the number systems, theorems, to seek patterns and predict. G.H. Hardy argues that because mathematics is based on proofs and logic, its reality is not shaped in one way or another by someone’s mind; it is simply built that way and is unchangeable. Languages can die, beliefs can change due to new discoveries but mathematics is immortal. It is what Alain Connes called ‘a raw and immutable mathematical reality’, ‘[that exists] independently of the human mind.’ [1]

Mathematics indeed has broad applications in many other disciplines: physics, chemistry, biology, engineering, computer science, medicine, architecture, astronomy, business, economics, actuarial science and many more. All children are taught numeracy from the age of 5. No matter whether a biologist likes mathematics or not, he/she still has to do some mathematics during his/her work. Some mathematical researchers are well rewarded for their efforts. However, is that the reason that motivates all these famous mathematicians? Is that all? Is it just because mathematics is ‘useful’ or it pays well? Is there anything more?

If it is about the money, many mathematicians do not earn much compared to other professions. If it is all about calculations and computations, what is going to happen to mathematicians as a consequence of the birth of computers and robots? No doubt, computers can out-count mathematicians in calculations; they can outstrip mathematicians in any finite computation. According to the recent discovery, Lipson and Schmidt have developed a powerful computer program which deduced the natural laws without a shred of knowledge about physics or geometry. It extrapolated the laws of motion from a pendulum’s swing in just over a day, a feat which took physicists centuries to accomplish. Creating rules from raw data has always been considered the province of human intuition, not machine intelligence. This program
has applications in many dynamical systems and areas such as biology, medicine etc. [3] A robotic system has also been developed to be able to carry out the entire scientific process on its own including formulating hypotheses, designing and running experiments, analysing data and deciding which experiments to run next. [4] We are certainly entering an age where technology and computers are advancing at such a pace. However, will this ‘artificial intelligence’ be able to replace mathematicians as well as many other scientists?

Henry Poincare, the French mathematician, once said ‘The scientist does not study Nature because it is useful, he studies it because he delights in it, and he delights in it because it is beautiful. If Nature were not beautiful, it would not be worth knowing and if Nature were not worth knowing, life would not be worth living.’ According to Henry Poincare, the reason why mathematicians are obsessed with mathematics is because of its beauty. The same view is held by Bertrand Russell ‘mathematics rightly viewed, possesses not only truth but supreme beauty. ’ [1] Indeed, many mathematicians devote their time to look for new elegant proofs even though there is already an existing proof. If it is only about the truth or application, there is no need to find new proofs for a theorem which has already been proven. But many mathematicians, like Enrico Bombieri, consider mathematics to be a creative art. Bombieri was obsessed with the Riemann Hypothesis. He loved working with prime numbers and called them ‘Nature’s gift to the mathematicians.’ [1]

Mathematicians also enjoy searching for deep results, and establishing new connections between areas which at first sight appear to be totally unrelated. Take the case of Andrew Wiles. After 30 years of working including seven years of total isolation, Andrew Wiles finally found the connection between Elliptic curves and Modular forms to prove Fermat’s Last Theorem fulfilling a passion held since he was a 10 year old boy. Another important point: mathematics is interesting also because of its deceptive simplicity. Many mathematical problems appear to be ridiculously simple to understand but can take years or centuries to solve or perhaps may never be solved. Let’s look at the example of Andrew Wiles again: ‘It looked so simple, and yet all the great mathematicians in history couldn’t solve it. Here was a problem that I, a ten-year-old, could understand and I knew from that moment that I would never let it go’ [2]. It was the challenge that fascinated and obsessed Andrew. Indeed, many mathematicians take delight in manipulating numbers and symbols which are challenging for many other people. This is demonstrated more clearly in Landon T. Clay’s concrete statement, ‘it’s the desire for truth and the response to the beauty and power and elegance of mathematics that drive mathematicians.’ [1]

I believe, for that reason, computers will never take the place of mathematicians. It is true that we are entering a new era, an era of collaboration between humans and machines. Technology and computers are advancing at such a pace that they are now able to find regularities, underlying principles in datasets that are too big for the human mind. But they still lack the ability to imagine, the ability to think, to reason, and the ability to have aesthetic pleasures which are, on the other hand, the strengths of mathematicians. Michael Atherton also believes that the program developed by Lipson and Schmidt could ‘help to generate perspectives that might not be intuitive;’ [3] however, ‘the creativity, expertise and recognition of importance are still dependent on human judgment.’ [3] Martha Pollack clearly points out that ‘the rules are mathematical formulae that capture regularities in the system.’ [3] Ross King predicts that ‘there may be teams of humans and machines’ where ‘robots will do more and more actual experimental work and simple cycles of hypothesis generation. Humans would migrate to more strategic and creative position.’ [4] In other words, machines still rely on humans to program them.

In conclusion, mathematics no doubt is ‘useful’ and is well valued by not just mathematicians but also many others. However, we cannot ever ignore the beauty of mathematics which captures and obsesses many mathematicians.

References

1. The music of the Primes, Marcus Du Sautoy, pp 2,5,6,7,14,17,209
2. Fermat’s last Theorem, Simon Singh, pp 6