Things I have learned so far[1]

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Admission into the University of the Philippines is a difficult task. For SY 2008-2009, 68,108 took the UPCAT and only 12,234 or 17.9% qualified for admission. In the College of Science, only 428 or 0.63% qualified for admission into its seven undergraduate degree programs. I give due recognition to their parents for making the vital sacrifices to ensure that their children would get the best education there is available. They have toiled because they believe, and rightly so, that a good education is the best legacy that parents can leave behind.

Let me share with you some observations that have become clearer to me as I get older. I have served the National Institute of Physics since June 1981. I am hoping that my insights will help the next generation of Filipino scientists and researchers to attain greater heights.

Initial conditions do not accurately determine what you will become later in life. I spent my childhood in Baclayon, Bohol, a coastal town that is known for its relatively old stone church. I attended a public elementary school in my town and graduated high school from a seminary that was located in nearby Tagbilaran City. I was considered a bright student but not because I was exceptional in the basic sciences and mathematics. I just had a good grade weighted average that was being pulled up by superior grades in the "soft" subjects. In UP, I had a Boholano batchmate who graduated from the Philippine Science High School in Quezon City. He was taking BS Chemical Engineering and was an NSDB scholar. He

successfully obtained his BS degree and now he is a practicing lawyer. There were only five of us who graduated BS Physics at what was then the Department of Physics - one eventually became a priest and is now a professor of theology in Rome. I was not ordained, perhaps disappointing my late grandmother, and I became a professor of physics.

Curiously, the elementary school and the high school department of the seminary where I was schooled, no longer exist today. The former was renamed to honor a local politician and the latter was closed - the Diocese of Tagbilaran came to the conclusion that the high school department did not really serve its intended purpose.

While I was an instructor in the 1980's, a professor of mine told me that I should specialize in experimental physics because I was not smart enough to become a theorist (like him). Later on when information about ISI publications became more accessible, I discovered to my amusement that he was also not smart enough to be a theorist. Human beings tend to regard themselves highly and get away with it for some time.

Scientists aim to develop a more accurate understanding of how Nature works and this objective is achieved through painstaking scientific research. New scientific knowledge is vital for the continued survival of the human species. It makes us understand ourselves better and allows us to overcome the paralyzing effects of ignorance and helplessness. Scientific knowledge is enabling – it empowers human societies to improve their quality of life and to withstand the intensifying pressures created by an increasing population, dwindling natural resources, natural and man-made disasters, and other calamities. Scientific knowledge is reliable and comprehensive because its accuracy and precision is constantly tested by experimentation.

A productive scientist is creative and imagination is the main ingredient of creativity. Just like the other kids in our old neighborhood, I did not have access to department stores that sold manufactured toys. We made our own toys from available bits and

pieces. We cut and molded empty tin cans into toy cars and crafted toy sailboats from coconut husks or old wood. I learned systems integration at an early stage in life. I distinctly remember a friend of mine who assembled a rudimentary microscope from old flashlight parts that enabled us to discover that ants have hairs on their bodies. Those were exciting times for all of us especially during summer vacation. Among my old friends though, I am the only one who became a professional scientist earning a living from designing laser microscopes.

Today, peoples of different nationalities and creed partake in an economy that is both global and knowledge-based. National economies do not function in isolation and they affect each other in complex ways. Economic growth is powered by technological innovation, particularly leapfrog technologies which are economically disruptive. Scientific research plays a vital and indispensable role because new scientific knowledge is the fuel that drives technological innovation. In 2005, the 30 OECD countries spent 2.25% of their combined GDP on R&D with the private sector accounting for 68% of this R&D expenditure. In the same year, the Philippines only spent about 0.1% of GDP on R&D.

The underperformance of the Philippines in scientific R&D could not be solely blamed on anemic government support. It is also caused by the low absorption capacity of our domestic science community. There is not enough PhDs in the basic and applied sciences, mathematics and engineering. The DOST counted a total of 1,374 PhDs in the Philippines in 2003. According to a 2004 Nature paper by Professor David King, there was 1 PhD for every 3,316 Germans, 1 PhD for every 11,621 Japanese and 1 PhD for every 6,533 Americans in the period 1998 to 2000. The estimated population of the Philippines was 76.4M in 2000, which is comparable with that of Germany. In 2000, there were already about 25,000 PhDs working in Germany.

Harvard, Stanford and Cambridge are recognized as among the best universities in the world because they get excellent scores in the various productivity measures of scientific R&D like number of Nobel Prize winners in the faculty and alumni and the number of