Internet access constrains science development and training at South African universities

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How to cite this article:
Slippers B, Majozi T, Nelwamondo FV, Steenkamp CM, Van Heerden E, Wright CY. Internet access constrains science development and training at South African universities. S Afr J Sci. 2011;107(9/10), Art. #685, 1 page. doi:10.4102/sajs.v107i9/10.685

As a group of young scientists whose future careers depend increasingly on access to Internet resources, we are extremely concerned by the apparent lack of understanding of the stranglehold that current approaches to Internet pricing are placing on the development of science in South Africa.

A recent issue of *Science*[1] contained a special section dealing with a common problem facing scientists today – too much data. The issue is well captured by the question in one of the titles: 'Will computers crash genomics?'[1] What Pennisi[1] refers to is that a single sequencer can now produce the same amount of data in a single run as that produced by the Human Genome Project in 10 years. With thousands of these machines operating worldwide, scientists are battling to deal with the storage and analysis of this data deluge. Genomics is only one of the many fields bending under the load of data emerging from technological advances that are driving scientific progress. For example, the Large Hadron Collider at the European Organization for Nuclear Research (CERN) in Switzerland produced 13 petabytes (13 million gigabytes) of data in 2010.[2]

The current answer to dealing with these issues is to utilise the resources available over the Internet: clouds of computers and armies of people all over the world are collaborating and analysing data simultaneously.[1,2] This approach is seen as the only option to deal with the vast amounts of sequencing data.[3] Also, the data produced by CERN is immediately spread to 200 000 processing cores in 34 countries around the world.[2] As another example of spreading the load of analysis, one ongoing project has thus far enlisted 395 000 people to help analyse astronomical masses of data using a web-based system (www.zooniverse.org/home).

Apart from dealing with data and analyses, the Internet is transforming the way in which scientists engage with information and each other, more rapidly than ever before.[4] The vast array of free analysis programs, high-quality podcasts and webinars from leading publishers and scholars, online conferences, online teaching, and web-based discussions of critical advances or new papers are changing the way research is conducted and evaluated.

The single most important requirement to access this exciting new world is affordable and rapid Internet access. Yet students and staff at South African universities and research institutions are faced with high costs for Internet access and strategies that appear to discourage them from using the Internet, rather than promote its use. For example, we estimate that single access to the free content available weekly on the websites of leading science journals such as *Science* and *Nature* (including sections on news and comments, careers, weekly summaries on podcasts, videos and many open access papers) could require more than 25% of the yearly allowance of subsidised Internet usage of a PhD student at one of the major research universities in South Africa. At another research institution, staff members are required to get permission from their departmental head to download more than 0.5 GB per month. Faced with large monthly bills for downloading data at work, some university scientists are now downloading the majority of their data at home at night, where rates are as much as 15 times lower than those charged by some universities in South Africa. It is evident that the current situation, where off-site access is cheaper and more readily available than at research institutions, poses a serious impediment to research development in South Africa. While a government initiative (i.e. South African National Research Network) is promising to increase the speed of Internet connection to South African universities, administrators will determine the price structures for researchers and students for its use. If a model is maintained that adds to the costs of Internet access at the current levels and passes these on to research budgets of individual research groups, then there is little hope of keeping up with research development internationally. A re-evaluation of costs for effective Internet access at academic institutions is urgently required.

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