POLICY FORUM: EDUCATION

# Science and the Student Entrepreneur

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The economic metrics based on land, labor, and capital are increasingly being subjugated by new dynamics, in which intellectual assets and attributes such as creativity, innovation, and inventiveness have become the new mantra for energizing the economy. Traditional vocations are starting to become less important or even dysfunctional. These patterns of change affect employment; they therefore have an impact on the educational arena, which is the holding area for the future workforce.

To address the oncoming challenges, Singapore is adopting a multipronged approach to promote a culture of creativity, innovation, and entrepreneurism as the new way for creating jobs and wealth. Significant emphasis is placed on developing these attributes in students. The shift in government policy has led to the incorporation of an additional goal in the desired outcomes of education: Infusing an enterprising spirit into student endeavors (*1*). Structural reforms in the education system have been made that give greater weight to problem-solving skills, creative thinking, and independent learning, for example, a 20% reduction in syllabus content; a 30% emphasis on information technology across the revised curriculum; a new examination format, which emphasizes thinking skills for the Cambridge A-level examinations from 2002; and project work. Student projects have been made compulsory in schools since 1999, to count as criteria toward university admission from 2005. Although it is difficult to quantify the apportionment of the educational budget for these initiatives, we estimate that it is more than 10%.

Project-based investigations in up to 12 disciplines are afforded by the Young Scientist Badge scheme, which was initiated in 1981 for primary school students (grades 1 to 6). The success of this initiative, as reflected in the increasing number of schools and students taking part, as well as the number of coveted "I Am a Young Scientist" badges awarded annually, has led to the introduction in 1988 of the Questa Club scheme for secondary school students (grades 7 to 10). Currently, more than 60,000 Young Scientist badges and 9000 Questa Club badges are awarded annually to students. At the junior college level (grades 11 and 12), the Science Research Programme and the Technology, Engineering, and Research Programme of the two premier universities allow internship opportunities for students with top scientists. About 200 students, constituting less than 1% of the junior college cohort, participate in this scheme annually. The scheme does not entail any extra funding for the universities, as the students provide valuable manpower (assisting the scientists) while immersed in the research tradition.

Inventive skills are also being promoted, as ingenuity is a natural corollary for entrepreneurial initiatives. The Tan Kah Kee Young Inventor's Award was instituted in 1986 to inspire young students to take up the challenge of inventions and to experience the joy of developing innovative products. It has become an annual showcase of inventions in various categories, mainly creative solutions to practical problems in everyday life. Some recent entries include a handy knotter that makes the tying of balloons easier, a simple trap to capture annoying insects that fly into the living room on rainy days, a floor trap oil filter for preventing oil from seeping into and choking drain pipes, and a "crab assassinator" for humanely dispatching crabs for the dinner table. Another initiative is the Sony Creative Science Award, which was established in 1998 and offers primary school students a platform to invent toys, based on scientific principles, from commonly available materials. A recent entry was an intricate roller coaster to show the dynamics of motion of a marble. In particular, this competition exposes students to awareness of the mass marketing opportunities for children's products. The invention initiatives are proving to be effective mechanisms to ferret out ideas buzzing in the minds of students, as well as fostering practices long considered the bastion of the adult and business world. Many of the winners have been inducted as junior members of the Innovator's Club, set up by the Agency for Science, Technology, and Research, the national funding agency for R&D, as a mark of appreciation.

An impetus introduced in 2000 to promote "technopreneurship" among students is the orchid hybridization program. It trains teachers in genetic engineering techniques for the creation of new strains of orchids, so that they can then set up orchid corners in schools and pass on the skills to students. In this way, students get opportunities to create new strains of orchids by hybridizing genes from orchids with different characteristics. Rewards are available for those who succeed: They can register the orchid hybrid with the Royal Horticultural Society in London; they can sell it to orchid nurseries or to the public; they can name it after themselves; they can sell it at an Internet auction site to individuals or corporations wishing to christen it after themselves; or they can use it to raise funds for their schools.

"Dotcom-ing" the student community is an integral aspect of the technopreneurship drive, and the metaphor of the Internet leveling the playing field for all is frequently invoked. Recent media reports have featured a student who makes S$12,000 a month from his dating Web site and another two students who each make S$3000 from their Web page design business. Information and communication technologies currently contribute 20% of Singapore's GDP.

Recognizing the importance of the life sciences in the new economy, some secondary schools and junior colleges have set up research centers to provide students opportunities to be involved in projects such as cloning flowers, altering the gene that affects fluorescence intensity in jellyfish, extracting DNA from genetically modified food, and creating genetically modified bacteria. Such work is traditionally done in universities. A group of students has recently developed a DNA extraction kit that costs S$30 and has an extraction time of 30 min; similar kits on the market cost S$200 to S$500, with an extraction time of 1 to 4 hours.

We envision that further funding is necessary to institutionalize the various initiatives through the establishment of business societies, invention clubs, and entrepreneurship laboratories in schools and to provide entrepreneurship electives. A significant challenge is to change the mind-set of students who have been brought up in the belief that risk-avoidance leads to good grades, which are a passport to a comfortable job. We also need to address the low tolerance in society for failure, which makes people hesitant to strike out on their own. There must be room for bohemianism, often considered a harbinger of creativity, but frowned upon in Singapore. Failure has to be treated as a learning experience—hence, the focus on students, whose minds have not yet been set in a rigid mold!

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**References and Notes**

1. *Learning to Think, Thinking to Learn: Towards Thinking Schools, Learning Nation* (Ministry of Education, Singapore, 1998).