

Brighter future in mind for science education in Australia

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Paper

Introduction

There have been a number of revolutions in human endeavour in the last few centuries. The most recent and current revolution is in the area of biotechnology, particularly in relation to DNA technology. This revolution has now been in progress some 20 or so years. Such revolutions are based upon cutting-edge science that in turn requires a substantial number of imaginative and creative scientists. Also required is a depth and breadth of scholarship in our educational institutions.

It is interesting, and indeed of concern, that concomitant with this revolution there has been an obvious rejection of science as a pursuit at both secondary and tertiary level education. Of most concern is that our brightest and highest achieving students, the ones upon whom the revolution depends, are the ones leading the move to abandon science as a career.

As governments around the world are jostling to position their electorates to capitalise on this revolution there is growing awareness that a problem is emerging. If fewer students are doing science, who is going to fill our biotechnology research institutions? Who is going to fill the numerous jobs in biotechnology manufacturing? Who is going to make the next series of breakthrough discoveries that will underpin our economic development?

But the problem is bigger than this. If fewer students are taking science at secondary and tertiary level, will there be a scientifically literate community prepared to support the development of such industries? Or will the possible economic advantages that could spring from this revolution land in a quagmire of ignorance, apathy and resistance.

The Bright MindsTM project is an initiative of The University of Queensland. Its mission is to increase the retention rates of students studying science as they progress through secondary school and into tertiary education. Philanthropic funding has been provided to give the project a three-year kick start. Bright MindsTM has multiple target audiences including school students from Year 6 to 12, tertiary students of science at first-year level, parents of all those students, teachers and school guidance officers.

Why are students turning away from science?

In order to understand the problem and develop a strategy to achieve its mission, Bright MindsTM commissioned a report on the problem. The full report (Mattick, 2002) can be found at www.brightminds.uq.edu.au/thesource/resources/products/mattick_report.pdf. In summary, the problem is complex. Students appear to turn away from science at a number of levels in the education system and for different reason at different levels. Important at all levels is that the curriculum is failing to capture the interest of our students.

At primary school level it appears the problem is teacher-related. Most children appear to be innately interested in the world around them. They want to observe and question. They appear to be able to design and carry out experiments that are a reasonable facsimile of the accepted scientific process. And yet in Queensland primary schools our best guess suggests that students in upper primary (Years 6-7) receive no more than one hour per week on average of science.

Why is it that teachers are opting out of delivering to students a subject in which the students display so much interest? We believe that the teacher is not comfortable with the subject. They

mistakenly believe that science is about content and because they do not know the content they do not know science and therefore cannot teach it.

The move from primary to secondary school appears to be the most critical time for students developing an attitude about science. It coincides with the onset of significant physiological, emotional and social change for the student – a time when formal education reduces in importance from the student's perspective. The student still, however, moves into secondary school with great enthusiasm for science and yet within a year this enthusiasm is largely lost. What messages are being conveyed to the student and by what communication process that result in this negative response to science?

It would appear that the student expects a process-based subject steeped in exciting hands-on activities. Instead they are delivered a content-based, teacher-directed subject comprising copying copious quantities of notes from the board and watching activities done for them rather than involving them. In addition, there is an expectation that the content be learned by rote. This leads to a mistaken belief by the students that science is too demanding compared to other subjects and as choice in subject selection becomes available to them, science is dropped.

Compounding on this is the comparative antiquity in the content presented. As teachers find a spare moment harder to capture and employer approved professional development more difficult to access, the content taught is little more than that taught in years gone by. The student is accessing content of their own from outside sources such as TV, internet or their peers. This information is highly diluted by content from other interests such as sport and TV soapies and it is becoming increasingly apparent that the content delivered in schools is not the cutting-edge, exciting scientific advances presented on television. They conclude that science as presented in schools is not relevant to them.

The move into upper secondary school presents another range of problems for science. Over the last two decades in Queensland there has been the removal of compulsion for students to study science and at the same time there has been a proliferation of other subject offerings. The now range of science subjects are seen to be relevant only to those seeking tertiary education. The subjects presented have a heavy emphasis on assessment of content and are seen by students as difficult even though they are judged as high in status.

The decision-making process for the student is complicated by outside advice. Peer pressure paints a picture of nerds in white coats standing all day at benches (and other communication the students receives, including from scientists themselves, does little to dispel this image). Parents who have gone through the same education system and have been turned off science do not see science as relevant to their children. Teachers and guidance officers have been shown to provide inaccurate and negative information concerning science as a career.

Bright Minds™ response to those problems

The problems presented are serious and systemic. How does a small project operating outside of the formal education system expect to bring about significant change? The answer lies wholly within our planning and communication processes.

As the problems defined above cross a range of potential audience groups, the Bright Minds™ project has 14 different products each designed to overcome identified problems with specific audience groups. The team running Bright Minds™ has recognised that multiple communication channels are required to orchestrate an effective communication process with its various audiences. Each of these products is being presented to its audience group via one of four communication channels.

The first of these channels is direct to the individual student. We recognise that students do receive the majority of their scientific information from sources other than school. In addition, we

recognise that effective education takes place when students control their own curriculum, when peer teaching is involved and, most importantly, when the student is actively involved and enjoying the educative process. The Bright Minds™ web site is one of the products using this channel and will be discussed in detail shortly.

The second channel uses the student peer group within the school to get information to the student. We recognise that peer teaching is an effective education strategy and that students often place more importance on both attitudes and content information they receive from their peers than they do from their teachers. The UQ Science Ambassador program uses this channel and it too will be discussed shortly.

The third channel uses the formal education system. Both the content and modes of delivery need to be addressed through this channel. Getting information to students via this channel presumes that it goes through the teacher and so communication directly with the teacher that has been sanctioned by the formal curriculum system is critical. While a number of Bright Minds™ products have been designed to utilise this channel, the Scientist-in-Residence program will be used as an example shortly.

The last channel is the informal education system. This channel gets information to the student through the school but not through the classroom teacher. An example is careers information moving via the school guidance officer. The emphasis of the Bright Minds™ careers programs is to interest students in the study of science rather than concentrate on the career itself. We believe it is just as important to have scientifically educated lawyers, politicians, business leaders etc to act as advocates in their field as it is important for us to have practicing research scientists.

The Bright Minds™ web site

The Bright Minds™ web site www.brightminds.uq.edu.au, is the vanguard product of the project. It utilises that channel direct to the individual student.

In the development of its web site, Bright Minds™ has recognised the importance of innovation and quality in an effective communication process. The web site has been constructed to emphasise those aspects of the educative process known to be important. Students can control their own curriculum using a number of different pathways within the Bright Minds™ web site architecture. A chatterbot known as 'Ask Susie' can be engaged in general conversation, of which knowledge of the new biologies is a feature.

Students can seek information they consider important. The information is supplied by leading scientists at The University of Queensland – it is cutting-edge information and accurate. In addition, there are a number of bulletin boards where students, teachers and parents can ask questions of each other, or be involved in answering questions from other students. Along with this is a supervised and password controlled, real-time chat room where students can converse with scientists as well as their peers.

Students can challenge themselves in games involving questions and answers on biology-related topics. These games can be attempted individually or in groups, with participants challenging the computer or each other. The use of games has proven valuable through all levels. A game currently under development is designed for researchers wanting to improve their skills in writing successful research grant applications.

The web site has been developed to appeal to students of a variety of ages. To ensure this occurs, student representatives of each of the main audience groups were surveyed. Sites, and features within those sites, were developed around the responses given.

Some of those features were technological in nature. Students wanted their opinions heard. We responded with an opinion poll with online voting and the introduction of bulletin boards and a chat room. Students wanted two-way interaction. We responded with a chatterbot and a 'Contact Us' button enabling users to get feedback on anything of interest. Students wanted to be entertained. We responded with a series of online games.

The chatterbot is one of the web site's key innovative technological features. 'Ask Susie' has been programmed with a series of biology-related questions and answers. The accompanying Susie character was designed by a high school student and refined and programmed by local database developers. At this point in the site's development Susie is limited in her content knowledge. Plans are underway to link her to a series of databases after which she should be both conversational and encyclopaedic.

Mechanisms have been designed to ensure user interaction and feedback. The 'Contact Us' button automatically logs the page the user was on when they submitted an enquiry (no other site does this). All transactions are logged and analysed. The information is used to refine the web site.

The Bright Minds™ web site has been developed on best practice principles. It operates on multiple platforms, including PCs, MACs and Unix, and on multiple browsers (Netscape and Internet Explorer, both current and older versions). Metadata used is based on Dublin Core standards. It also conforms to accessibility guidelines of the World Wide Web Consortium that allows users with computer-based disability to use the site. As a result the web site should be equally accessible to all students with internet access.

We attempted to ensure that quality of content and technology was integral to the web site design by including in the development team specialists with expertise in information architecture, web development, database design, graphic design, web usability, scientists, educators and communicators. At a number of predetermined points in the development process, user testing was carried out with both students and science teachers. Feedback was incorporated into web site refinements.

UQ Science Ambassador program

We frequently underestimate the willingness of students to listen too and believe information and attitudes they receive from their peers. The UQ Science Ambassador program captures and utilises this process as a means of enhancing our communication with students.

The program identifies a single Year 11 student in each school and appoints them as Ambassador. This student has indicated an enhanced level of interest in science and a willingness to act as the conduit of information from the University to their peer group. Close relationships are developed between the Ambassadors and the University and between individual Ambassadors. Frequent competitions and annual awards reward the students for their efforts.

Currently we have about 240 Ambassadors operating in about 220 schools in south-eastern Queensland and northern New South Wales. Schools are generally chosen with some emphasis on geographic proximity to the University as the Ambassadors are frequently involved in face-to-face activities. The main target audience of the program is the upper secondary group with a significant flow-on to both the lower secondary and teacher audiences.

Each month a package of material spanning all of the sciences is posted to the Ambassador. That material, or the information contained within, is distributed through the school via the peer group network. Material also moves upward to the teachers. As the Ambassadors are in control of both the information and its flow they appear to take great personal pride and responsibility in its distribution.

Regular email contact is maintained with each Ambassador and contact between the Ambassadors is encouraged. The Bright Minds™ web site has a secured real-time chat room restricted in use to the Ambassador program. This is opened at predetermined times and monitored from the University. It has been used on a number of occasions to develop interaction between one or more scientists and the Ambassador network to explore cutting-edge science along with its social ramifications.

Scientist-in-Residence program

Having recognised that the lack of science presented in the curriculum at primary level is largely the result of lack of confidence and interest by the teacher, Bright Minds™ has developed a scientist-in-residence program to address this issue. The audience group is a combination of the primary teachers and their students. The communication channel is through the formal education system.

A scientist from the University (a carefully selected undergraduate in science) is partnered with a single teacher of upper primary and their class for a period of ten weeks. During that time the scientist works in concert with the teacher to develop a plan for weekly involvement with the class over the ten weeks. How that plan develops will depend on the needs and wishes of the teacher. It will likely involve the scientist presenting to the class a series of lessons including the preparation and coordination of practical classes. It may also involve simply providing the teacher with both content knowledge and an understanding of scientific processes in order for the teacher to better teach the class themselves.

The scientist is not 'thrown in the deep end' so to speak. Prior to their contact with the school they undertake an intensive course to provide them with an understanding of the environment in which they will be operating, the issues they will need to address and the skills to handle themselves appropriately. They are not trained as teachers as at all times the teacher remains with the class and is responsible for the students.

This program will operate for the first time in 2003. We anticipate that it will give the teacher the confidence to continue with an enhanced level of science teaching after the scientist has gone. While in-residence, the scientist is expected to orchestrate positive experiences in science with the students as well as providing a role model for them. Combined, these may equip the student enough to withstand the potentially lower standard of science delivery they may get at lower secondary level. It may convince them that poor teaching and not science itself is the problem and may entice them to demand better – as is their right.

Conclusions

The program is ambitious. While we do not anticipate changing the world overnight we do expect to have a significant impact on science education in Queensland and beyond. The key to this success is embedded in a clear identification and understanding of our various audiences combined with a strategic approach to communicating with those audiences.

A backdrop to our Bright Minds™ project is a communication strategy pitched at decision makers and influencers in the education system to ensure Bright Minds™ has the formal support. As with all audiences, communicating in a way they understand and welcome is critical.