[O19] Creativity and research-led teaching

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Keywords: creativity, problem-solving, research-led, website

Introduction

Currently, full and demanding curricula for science subjects, in schools and universities, leave little space for the development of creativity in individuals. The Creativity and Research-led Teaching website (**http://www.fbs.leeds.ac.uk/creativity**) addresses this issue by promoting creative approaches to problem-solving in students working in isolation or in groups. The website incorporates a research-led approach by featuring short films of leading researchers describing their projects and problems/issues associated with their work. Students are asked to think of creative solutions to these problems. Alternatively, students may address other pressing problems in the biosciences. Participation by all students is encouraged from the outset as they engage with a range of exercises designed to promote creativity in individuals. This is a crucial element of the approach adopted with this website: it ensures that the more reticent students who may lack confidence are helped to reach their creative potential.

Students are placed in groups and as they develop their own ideas they may communicate these to other members of the group using the website's 'Group Chat' facility. The importance of a period for incubation of ideas is emphasized and, when students feel comfortable with their ideas and suggestions, they can submit these for more formal consideration by the group. The initial communication and submission of ideas can occur with group members geographically isolated from one another and this approach helps to ensure that the ideas of all of the group members are given a fair hearing.

Finally, students participate in formal and traditional round-table group sessions. Like the creativity exercises for individuals, these sessions are intended to promote participation by all students and are structured to ensure fruitful discussions with minimal conflict between participants.

Inspirational researchers

Students may access a number of short films that feature leading researchers discussing topics as diverse as GM bananas, tissue engineering and biosensors (**Figure 1**). They may choose to pursue problems suggested by the lead researchers. Alternatively they are free to address essentially any problem within the biosciences that they find interesting and challenging. Individuals are helped to generate ideas using a range of techniques.

Figure 1: Students may choose from a number of short films recorded by leading researchers

Promotion of creativity in individuals

Several textbooks together describe a large number of techniques designed to promote creativity in individuals working alone or in groups. The website features a number of approaches that prove useful when working with scientists. Here are a few examples.

Curiosity

Isaac Asimov said ‘The most exciting phrase to hear in science, the one that heralds new discoveries, is not “Eureka” but “That’s funny. . . .”.’ Scientists should be curious about the unusual and they should welcome the unexpected. The examples of Kevlar and Viagra are used to illustrate these points. The Du Pont scientist Stephanie Kwolek’s curiosity regarding an atypical and apparently contaminated polymer preparation led to the development of the super-strong, lightweight fibre Kevlar. The Kevlar of body armour is thought to have saved thousands of lives worldwide. Similarly, the curiosity of clinical investigators at Pfizer, concerning a minor side-effect associated with a drug undergoing trials for treatment of high blood pressure and angina, led to the development of the highly successful drug Viagra. Students are advised that, from time to time during their scientific careers, they will encounter unusual and unexpected results. They are urged to pursue these observations and make the most of them.

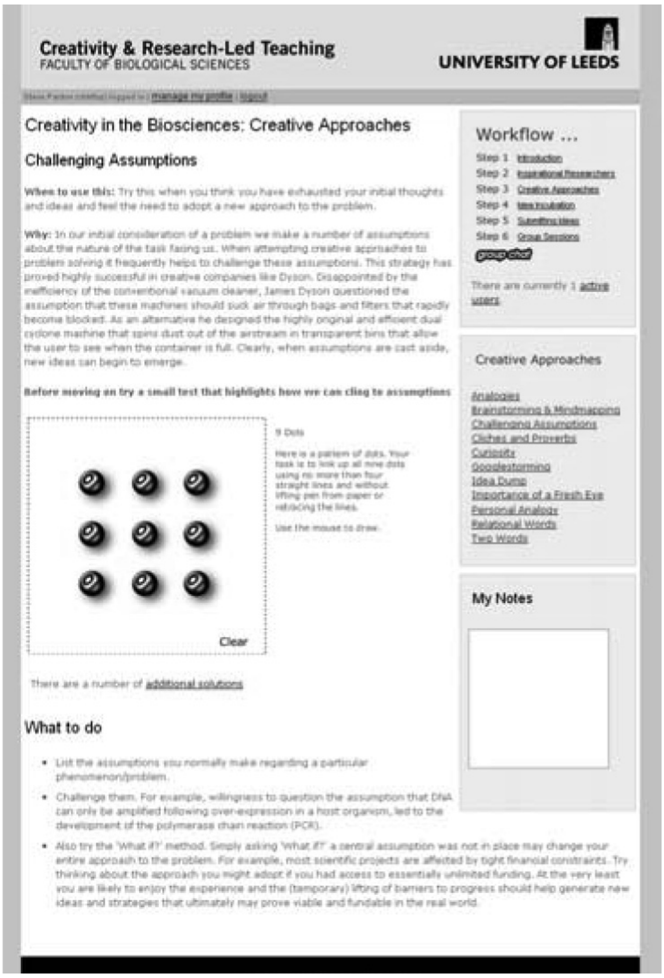

Figure 2: Students are encouraged to challenge assumptions

Challenging assumptions

During the early years of education in school, children are happy to question and challenge well-established ideas. However, as they mature, students are less inclined to ask questions and are often content with the status quo. Creative individuals are far less inclined to accept things as they stand and will consider alternative approaches and solutions to problems. We use a simple exercise to demonstrate how most of us cling to assumptions (**Figure 2**; see also **http://www.mycoted.com/Nine_Dots**). We then illustrate the importance of challenging assumptions in commerce, using the example of the Dyson suction cleaner, and in science using the example of the polymerase chain reaction (PCR). For the former, James Dyson questioned the assumption that vacuum cleaners must rather inefficiently suck air through filters that rapidly become blocked and designed the highly original and efficient dual cyclone machine that spins dust out of the airstream. For the latter, Kary Mullis and collaborators challenged the assumption that significant quantities of DNA fragments could be produced *in vitro* only following cloning and over-expression of the fragments in host organisms.

Students are asked to list the assumptions they normally make regarding a particular issue or problem. They are then asked to challenge the assumptions and to ask the question ‘What if?’. Simply asking ‘What if?’ a central assumption was not in place can change the entire approach to a problem. For example, most scientific projects are affected by tight financial constraints. Students are asked to consider how they might approach a problem with unlimited financial backing. The temporary lifting of barriers to progress can sometimes help suggest ideas and strategies that ultimately may prove viable and fundable in the real world.

Analogy

In an analogy two things that are essentially different, but which nonetheless have some similarities, are compared. There are many impressive examples of the creative use of analogy in the biosciences and elsewhere. In particular, a number of innovative inventions stem from the identification of an analogy between a problem and a natural phenomenon. For example, a team of designers was given the task of devising improved motorcycle crash helmets and a member of the team asked whether there were any examples in nature of animals receiving serious blows to the head without suffering brain damage. A colleague suggested the analogy of the woodpecker whose beak has a spongy base that absorbs most of the impact from continual pecking. This observation led to a fundamental change in the way helmets are designed. Instead of constructing helmets from hard, impenetrable steel they were instead designed to harmlessly deform on impact, thus preventing the energy of impact from reaching the wearer's head.

Students are asked to define a problem then to try to generate an analogy, perhaps by looking to nature for inspiration. They then use the analogy to apply knowledge or technology from its source to their problem with the aim of bringing a new insight or perspective. The idea is that the analogy will help suggest an entirely novel solution to the problem.

Personal analogy

In this approach the person constructing the analogy places himself at the centre of a problem to gain a new perspective and kick start the generation of ideas. As a teenager, Albert Einstein asked himself 'how would the world appear if I were to travel on a beam of light?' He persisted with this approach and it eventually helped lead him to his special theory of relativity. Students are encouraged to look for novel insights and solutions by imagining themselves part of the problem under consideration.

Importance of a fresh eye

Many scientific breakthroughs stemmed from inter-disciplinary collaborations. For example, the fruitful partnership between Robert Bunsen, a chemist, and Gustav Kirchoff, a physicist, led not only to the creation of the spectroscope but also to major developments in the science of cosmology. Students are advised to network and collaborate with people from a range of backgrounds. They are told that by sharing problems with colleagues working in related disciplines, in industry or even with friends and family members, they may gain a valuable new perspective from the 'fresh eye' that each of these individuals will bring to the problem.

The website contains a further six methods designed to promote creativity in individuals. Students are advised to try as many techniques as possible as certain approaches will work better for some individuals than for others.

Group chat, idea incubation and submission

People are often at their most creative during periods of ‘relaxed attention’. Students are therefore asked to incubate their ideas for a few days and to think about them when they are feeling relaxed, for example, when taking a shower or during sports or other recreational activities. They are also encouraged to exchange ideas with other members of their group using the website’s Group Chat facility, although they may submit ideas anonymously if they wish. Electronic submission of ideas is straightforward and group members may use a ‘fridge magnet’ facility to compare and relate all of the submitted ideas as they move them around the screen on ‘magnets’. This approach is intended to encourage new thoughts and developments based on the original ideas submitted by members of the team. The team should now have a list of ideas that can be taken forward for more formal consideration during group sessions.

Group sessions

Each group member will have had the opportunity to generate, develop and submit ideas for consideration by the group. Structured group sessions build on these ideas using one of three creativity techniques for groups: Brainstorming; Lotus Blossom, described originally by Yasuo Matsumura; and Edward de Bono’s Six Thinking Hats (several books describe a wide range of creativity techniques for groups – see Further Reading). The sessions are designed to facilitate both detailed consideration of ideas submitted by individuals and the generation and development of new ideas during group discussions. As new ideas emerge, groups are encouraged to allow a further period for incubation before identifying and refining the idea(s) favoured by the majority.

Preliminary observations and conclusions

The website has been trialled with a class containing four groups of five Level III Bioscience students at the University of Leeds. It proved difficult to persuade students to engage fully with the techniques designed to promote creativity in individuals and it seems clear that the use of this facility must be more closely supervised in future years. However, the groups made many useful and creative suggestions during problem-solving. Some of the problems they addressed were based on the films featuring the lead researchers although the students were given the freedom to consider other pressing issues in the biosciences. Assessment of the activities involved oral, written and poster communications. For future academic sessions, a ‘Dragon’s Den’ style of presentation, during which the group attempts to persuade a panel of ‘experts’ of the viability of their proposals and ideas, may be used as part of assessment procedures.

The Creativity and Research-led Teaching website may prove most useful in promoting creativity and innovation in more senior scientists; currently we are investigating the efficacy of our approach with postgraduate students and postdoctoral researchers. Indeed the overall approach adopted in the design of the website should have considerable potential in a wide range of settings and disciplines both in higher education and industry. The website will also support and encourage inter-disciplinary cross-talk and collaboration as colleagues from different backgrounds and disciplines work together on idea generation and exploitation.

References/Further reading

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