Case Study K: An Integrative and Creative Approach in Science Education: Working in Small Groups to Research and Present on a Scientific Breakthrough

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This case study focuses on a creative approach to assessment with a class of 30 first year undergraduate students of functional biology and of plant science at Trinity College Dublin, all taking the Workshops, Tutorials and Seminars module. The module involved two two-hour sessions, two weeks apart. The first session took place in a flat seminar room while the second session, consisting of presentations, took place in the old-style botany lecture theatre.

The first session incorporated an exploration of the role of problem solving and creativity in science, exploring different types of approaches to problem solving through a self-assessment questionnaire. There was also a discussion about the pros and cons of working in groups and group working styles.

Using a mixture of lecturing and activities, creativity in science was explored regarding the scientific method, reflecting on quotes from science students and scientists, definitions of creativity, and philosophical considerations; i.e. the universe as intrinsically creative versus the universe as a mechanism. The session finished with a whole-group creative problem solving activity consisting of a card puzzle.

Students were provided with a list of potential assessment topics, but it was also made clear that they could pick their own topics. Suggested topics included:

- Barbara McClintock and transposable elements;
- Nikolai Vavilov: Crop genetic resources and seed banks;
- Melvin Calvin, Andrew Benson and James Bassham: Photosynthesis (Calvin cycle);
- Kerry Mullis and PCR;
- John Sulston: Programmed cell death;
- Alexander Fleming: Insulin; and
- August Kekule: Structure of benzene.

One month after the second session, the students handed in a short (800-word) summary of their topic and a short reflection on the group process and their own problem solving abilities and creativity (200 words). In their groups, the students presented their topic in a creative way (more details below). I filled in a feedback sheet, which was returned to the students with their marks (which also incorporated marks regarding their presentations).

The project also involved peer assessment. Before the presentations, students were engaged in a discussion about the grading criteria (which I provided) and what makes a good creative presentation. An example of a movie made in a previous year was shown to the students. The grading criteria

consisted of the following categories: clarity of scientific content, quality of presentation, and creative expression. Students were asked to incorporate anything else that they thought to be important into the grading criteria. Each group was graded by each student and by myself on a 5-point scale, with a score of 5 being excellent. The final mark for each group was the mean score from each student for each category combined equally (50:50) with my mark for that group.

The composition of the groups was chosen by the students - plant science and functional biology students worked together. The students were told that they had to work in groups to research their topic and produce a 10-minute creative presentation. A list of URLs of 'resources for presenting creatively' was provided. Some suggestions were given about the method of presentation, e.g., writing a poem or song, making a movie, performing a play, producing a quiz show, talk show interview or producing a puppet show.

The students were asked to consider the following questions related to the scientific process when working on their project: what was the story behind the science and the scientists involved? What motivated them? How did they come to recognise the problem? How did they develop the solution? How/why did they make the creative leaps that they made? What was the fundamental creative insight that changed the way they looked at the problem and led to the new insight/solution?

Feedback from students was overwhelmingly positive; e.g.:

"This exercise was honestly one of my favourite assignments I have completed in college. I found since studying science that we may have lost our sense of creativity somewhere along the way but this assignment has shown me that science can actually be creative and enjoyable."

"Science and art are at a first glance totally different fields. We are made to believe so by years of education, where our minds are squeezed into tight fitting boxes of lay-outs, marking schemes and past exam papers. After years of following sheepishly what I have been told, I can honestly say I feel less clever, and certainly less creative than before."

"I noticed a change in the spirit of the group. People have an interesting response to being creative or 'playing'. I think it is very healthy and it has opened my eyes to the fact that not all of the best work is done staring at a computer screen. I particularly enjoyed how Watson and Crick were using cardboard cut outs of nucleotides to attempt to identify the way they're assembled. The fact that a method like that can win a Nobel prize assures me that there's hope for us all."

Some challenges, enablers and suggestions

Although many science educators feel that creativity should be a central focus of science education, they are often restrained by pragmatic issues relating to their own internalised norms and values as well as institutional cultures and structures. The tacit assumption is that purveying scientific knowledge is sufficient. Science education still suffers from 'the tyranny of content'. There are 'things' that the students must know and therefore there are 'things' that we must teach them. However, students are very capable of a creative exploration through virtual information space. Enabling and empowering students to find out information for themselves is advantageous. It instils in them a sense of what the research process is all about. Research and learning go together because they are complementary to each other: research is learning, learning is research. Both are creative explorations.

Individual science lecturers can certainly make a difference when it comes to encouraging creative thinking in their students by using creative approaches in their teaching like that presented here. But the lecturer's themselves will have to overcome some of their own inhibitions related to trying out such approaches, particularly handing over some power to the students and letting go of control of the situation (Wride, 2015). Creating a group dynamic for teaching and learning that instils confidence in students is important for overcoming fear of failure or of being creative, students can also self-assess and then peer-assess each other's work. In the process students learn about science communication through using the language of science. Allowing for and enabling reflection is also important.

Overall, both my students and myself found this an overwhelmingly satisfying experience and I continue to use this approach. It could be easily adapted for any subject area.

References

Wride, M.A. (2015). Science play time. Creative Academic Magazine 2b, 19-21. https://www.academia.edu/11508366/MEd_Dissertation_Re-Creating_Science_in_Higher_Education_Exploring_a_Creativity_Philosophy

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