

## Design and implementation of problem-solving framework to enhance creativity and innovation in undergraduate science students: the ability to ‘think differently’

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### The aim

Problem-solving and creativity are two of the most important employability skills identified by employers. Our aim was to develop to develop a framework of problem solving, and enhance both formative and summative assessment practice, embedding use of innovative approaches and technologies to enhance problem-solving and creativity skills.



### Benefits

- To engage students in co-design and creation of a curriculum embedding problem-solving and creativity
- To provide a toolkit to teaching staff to enhance problem-solving and creativity
- To foster problem-solving and creativity in students

### The approach

We developed the principles of a problem-solving framework, within a broader framework of skills and attributes, and applied these to teaching and learning practices across three undergraduate degrees: Biomedical Science, Forensic Science and Crime and Investigative Studies. We want to foster in students the ability to define and clarify the nature of a problem, and identify a solution.

**Survey and focus group:** We surveyed students anonymously to determine their understanding of employability skills, how they identified these skills within themselves, and how well they perceived these were being taught on the courses they were undertaking. Finally, we asked students their preferred teaching approaches when being taught these employability skills. Surveys utilised ranking questions and Likert scales to elicit responses, and were conducted online (Jisc surveys) and on paper, to ensure we obtained as many responses as possible. A total of 74 students from across the three courses participated. Surveys were conducted with full ethical approval, and participants signed informed consent forms.

Students who participated in the survey were invited to participate in small focus groups to discuss these aspects in more detail, focussing on general employability skills, but with an emphasis on problem-solving. Eleven students from across the three courses participated in two focus groups. Both focus groups were asked the same set of open-ended questions which had been previously prepared. Questions were based around three aspects: development of transferable skills, knowledge retention and the role of the tutor in facilitating the teaching of employability skills. The sessions were audio recorded and transcribed verbatim. Using NVivo 11.0 (QSR International), coding of text fragments on content was done manually and illustrative quotations selected. The students identified time-management, teamwork and communication as being strongly facilitated in their courses, but felt

business and commercial awareness was the least facilitated. Problem-based learning was welcomed, with a preference for these skills to be developed in practicals, tutorials and workshops. A report of the outcomes of the survey and focus groups was produced and used to inform curriculum development.

**Problem-solving framework:** We pulled together various problem-solving strategies used in business and other areas, and provided worked examples of how to teach these in class. These included, among others: 5 Why's approach; the Six Thinking Hats; Failure Mode and Effects Analysis; Boundary Examination; and Creative Problem Solving. Models utilising a number of different approaches were developed.

**Innovative approaches and gamification:** We developed a range of 'games' that can be used to teach problem-solving in class, but also to demonstrate that using problem-solving can be a means of enhancing engagement, improving the relationship between teaching staff and students, and embedding deep learning. A constructivist approach was taken, and a set of problem-based learning sessions were developed.

**Embedding in the classroom:** Tutorials were developed for level 4 students, and delivered in small group and large cohort sessions in each semester. A problem-based learning approach was used in the development of case studies.

### The outcome(s)

Survey and focus group: Guidance has been provided to teaching staff on how to conduct problem-based sessions.

Problem-solving: A report on different problem-solving strategies is available, with exemplars of how these can be embedded in teaching.

Innovative approaches: A repository of games to engage students is available to be used in teaching sessions.

### Profile

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### Future Development

- Problem-based learning will be more widely utilised across all courses in the School of Life Sciences
- Problem-solving and gamification approaches will be embedded to engender a greater sense of community, and engage students more actively in their learning
- Group work will be developed along the lines of the problem-solving principles developed

### Recommendations

- Development of toolkits is essential to assist staff in formulating lessons, providing them with specific guidance on how to teach skills, rather than purely theoretical approaches
- Involving students as co-creators has been transformative in terms of curriculum design and innovation
- Working with student interns has been a thoroughly enjoyable experience, and is highly recommended.