bioscience education

Research Article

Raising Awareness of Individual Creative Potential in Bioscientists Using a Web-site Based Approach

David J. Adams[1], Siobhan Hugh-Jones[2] and Ed Sutherland[2]

[1]UK Centre for Bioscience, Higher Education Academy, and Faculty of Biological Sciences, University of Leeds; [2]Institute of Psychological Sciences, University of Leeds.

Date received: 13/05/2010 *Date accepted: 25/06/2010*

Abstract

We report the preliminary results of work with a unique, web-site-based approach designed to help individual bioscientists identify and develop their individual creative capacity. The site includes a number of features that encourage individuals to interact with creativity techniques, communicate with colleagues remotely using an electronic notice board, then participate in group sessions. A total of 19 postgraduate students engaged with the web site during two structured sessions, two weeks apart, and were encouraged to communicate with one another during the intervening period. Quantitative and qualitative measures were used to assess individual creativity, and attitudes to creativity and the approach in general, before and after interaction with the web site. Participants were overwhelmingly positive about the site indicating that it helped them see themselves as creative people and offered new ways to generate ideas and/or solve problems. Perhaps not surprisingly, we noted no marked increase in individual creativity during this short study. However, the preliminary data and students' responses warrant further investigation involving larger numbers of participants using the web site over much longer periods.

Keywords: individual creativity, confidence, idea generation

Introduction

Creativity is a difficult concept to define but the generally accepted view in Psychology is that it is the production of ideas that are novel, influential or useful (e.g. (Paulus and Nijstad (2003). It is therefore not surprising that Manolache and Basu (2010) stressed recently that creativity is essential in our rapidly changing world. The importance of creativity in science was emphasized by Loehle (1990) who noted that scientists who are creative are held in especially high regard by others.

Psychologists have long discussed the notion of creativity in relation to whether it is a 'static trait' (e.g. Birdi, 2005; Azadegan *et al*., 2008) or an attribute that can be taught and learned. There is now a large and convincing body of evidence that the latter is the case, suggesting scope for educational programmes to address the development of creative thinking (e.g. Torrance, 1993; Sternberg, 2003; Makel, 2009). Unfortunately, many currently available university programmes in the sciences are designed primarily for the development and assessment of knowledge, technical and other skills and place very little emphasis on creativity. Indeed, it was demonstrated recently that students of the biosciences are rarely given the opportunity to develop their true creative potential (Adams *et al*., 2009).

The *Creativity in the Biosciences* web site was designed to address the above issues (Adams *et al*., 2006, 2007; Adams and Grimshaw, 2008). A considerable body of evidence indicates that individuals working alone produce more and better ideas than they do when working in

groups (Mullen *et al*., 1991). Furthermore, idea generation can be enhanced if group members, working in isolation, are given remote access to the thoughts and ideas of other members of their group via computers (Valacich *et al*., 1994). These results informed the design of the web site which promotes creative problem solving in individuals working in isolation but also provides Chat Room and 'Fridge Magnet' (electronic noticeboard) facilities that enable participants to communicate with their peers who are trying to find creative solutions to the same problem. These facilities are intended to promote participation by all members of the group with the ultimate aim of building confidence in individuals so that they are prepared to explore their own creativity prior to structured group sessions. Here we provide a preliminary report of student interaction with the web site and its effect on how they perceive their own creative potential.

Methods

Questionnaire and Unusual Uses Methodology

Participants

There were 19 participants, 9 males and 10 females. They were an opportunity sample from a relevant cohort of Bioscience postgraduate (taught MSc) students from the University of Leeds. All of the students were volunteers who were paid for their participation. The mean age of participants was 23 years (standard deviation 2 years 10 months).

Design and Materials

This was a repeated measures design employing a questionnaire designed to assess participants' views on creativity as well as their performance in a creative task: Torrance's Unusual Uses Task (Torrance, 1974) which is designed to assess divergent thinking, a form of thinking that is widely considered to be the basis of creativity (e.g. Runco, 2007). A copy of the questionnaire, with a summary of student responses following its completion at the end of the second session, is included in Appendix 1. Note that the objects used for the second Unusual Uses Task (brick, blanket, newspaper) differed from those used for the first task (barrel, paper clip, tin of boot polish).

Procedure

Prior to any exposure to, or knowledge of, the Creativity in the Biosciences web site participants were required to complete the questionnaire and the first Unusual Uses Task. Five days later they were presented with information about the Creativity in the Biosciences web site.

Participants were introduced to the 'Creativity in the Biosciences' web site (Adams *et al*., 2006) and were asked to view a film on 'Biosensors', presented by a leading researcher; at the end of the film the researcher asked them to think of novel applications for biosensors.

The participants were then introduced to the section of the web site that contains a series of approaches designed to promote individual creativity. During this first supervised session they were asked to try at least three of these approaches as they tried to identify novel applications for biosensors. They were also encouraged to try other approaches, in their own time, between this first session and the second supervised session that followed two weeks later.

During the first supervised session, students were informed they had been placed in groups of four or five and were encouraged to communicate with the other members of their group using the web site's Chat Room facility. They were also introduced to the 'Submitting Ideas' section of the web site incorporating the 'Fridge Magnets' page (see Fig 1). The latter is, essentially,

an electronic 'Post-it Notes' facility that enables participants to submit their own ideas and consider, rearrange and respond to ideas submitted by other members of the group. Crucially, the emphasis here is on participation by all members of the team. There is little scope for any one individual to dominate proceedings as each student has every opportunity to submit ideas for consideration by all group members.

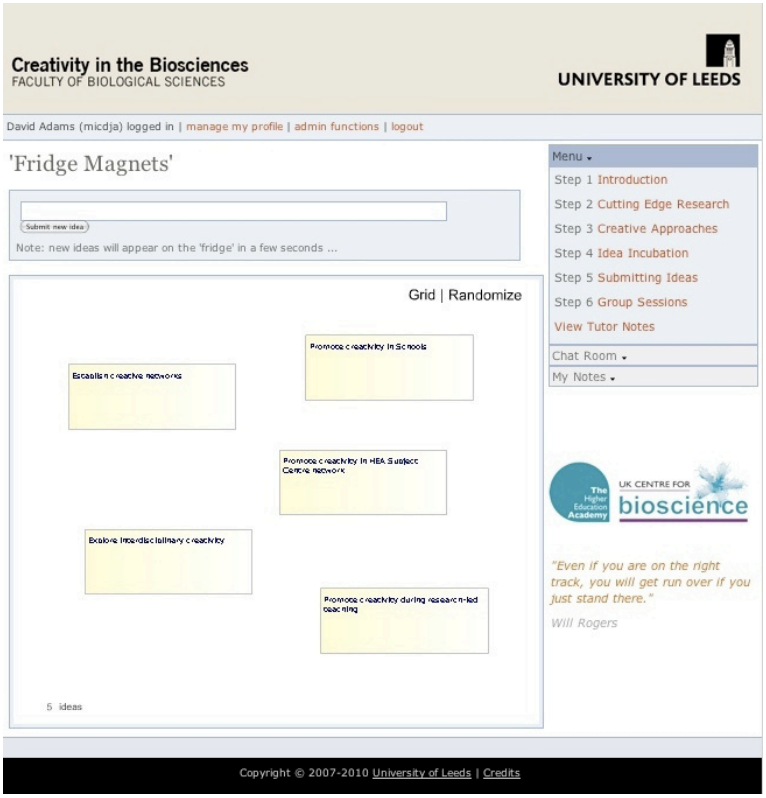

Figure 1 *'Fridge magnets' — A mechanism for submitting ideas for consideration, rearrangement and response*

Between the first and second supervised sessions the students had unlimited access to the web site. They were encouraged to 'incubate' their ideas (see Sio and Ormerod, 2009) and communicate with other group members (using Chat Room or Fridge Magnets) at any time, on or off campus. The second session involved groups meeting in the same room to consider the ideas submitted by each group member. They identified the novel application for biosensors that they, as a group, wished to propose in a structured group session based on Edward de Bono's Six Thinking Hats technique (de Bono, 2000).

At the end of the second supervised session, students completed an Unusual Uses Task and the questionnaire for a second time. They were then asked the open-ended question: 'Did the Creativity in the Biosciences web site affect how you feel about your own individual creative potential? Please comment.'

Results

Analysis of results involved a comparison of the number of unusual uses generated by participants at the beginning and end of the study (Table 1), as well as collation and examination of the comments made about creativity generally and the Creativity in the Biosciences web site specifically.

Unusual Uses Tasks

Table 1 *Mean number of uses (and standard deviations) for items used in the Unusual Uses Tasks at the beginning and end of the study*

Tasks at the beginning of the study

Item	Mean number of uses	Standard Deviation
Barrel	5.84	3.20
Paper clip	5.00	2.92
Tin of boot polish	3.84	2.57
TOTAL	14.68	8.01

Tasks at the end of the study

Item	Mean number of uses	Standard deviation
Brick	4.63	2.27
Blanket	5.47	2.72
Newspaper	6.47	3.12
TOTAL	16.58	6.96

The mean scores reveal a similar level of performance for all items. Standard deviations were also similar indicating that no one item was associated with a particularly large number of uses. The data also suggest that there was an improvement in performance over time period with an increase in mean number of uses of 1.9. However, inferential analysis of the data using a paired samples t-test revealed that this increase was not statistically significant ($t = 1.348$, $df = 18$, $p = 0.194$) suggesting there was no overall improvement in creativity at the end of the study compared to the beginning.

Questionnaires

Participants completed the same questionnaire before the first, and immediately after the second, session with the Creativity in the Biosciences web site. Unless indicated otherwise, below, for most participants and most questions responses were consistent between questionnaires. In defining creativity, most students shared similar views indicating that creativity involves thinking and acting in ways that differ from the thoughts and actions of others, being open minded and even being prepared to have crazy ideas. Most also agreed that creativity could involve criticism of other people's ideas and could be a strategy for solving problems: the most popular response regarding proof of creativity was that an individual had been creative if he or she solved a problem in a way that was different to how others had solved it.

Interestingly, the views of a number of the participants, on whether creativity can be learned, changed during the course of the study. Prior to the study less than half (9 students) believed this to be the case. However, after interacting with the web site almost all of the participants (16) felt individuals could learn to be more creative. Participants also appreciated the importance of creativity with the vast majority agreeing they must be creative if they are to be successful students of the biosciences.

Students indicated strongly that they wished to be more creative. They felt that, in general, they were already creative individuals but for a number of students this did not extend to their academic work. They provided a wide range of explanations and two particularly interesting comments were 'My study assignments and research requires lots of reading and writing with less focus on how to develop things' and 'Creativity not always pays in academic work so I try to follow stereotypes'.

Table 2 *Respondents' positive comments about the Creativity Web site*

Comment	Actual number who commented
Site was generally very useful	11
Helped me to develop new ways to solve problems	11
Increased my confidence in being creative	5
Found the variety of approaches to support creative thinking useful	7
Helped me to see that I am more creative than I thought	5
Inspired me to be more creative	2
Helped me to focus on the problem	1
Helped me to maximise my already strong creativity	2
Promoted the view that anyone can be creative	1
Liked the group aspect (as it promoted view that creativity does not have to happen in isolation)	2
Liked the mind mapping in particular	2
Liked the fridge magnets in particular	2
Liked Googlestorming in particular	1

After completion of the second questionnaire, participants were asked, specifically, the open-ended question: 'Did the Creativity in the Biosciences web site affect how you feel about your own individual creative potential? Please comment.' All 19 students responded and the data were subjected to a basic content analysis. Respondents were overwhelmingly positive about the usefulness of the site, although some mentioned particular features which they felt needed to be improved. The positive comments are detailed in Table 2 and the negative comments, or suggestions for improvement, are presented in Table 3.

In the main, positive comments pertained to the usefulness of the site in offering new ways to solve problems and / or generate ideas, as well as the capacity of the site to help participants see themselves as creative people. Negative comments were offered by a small minority of participants and these were concerned with site-specific features, although one participant seemed unclear about the overall purpose of the site.

Table 3 *Respondents' negative comments about the Creativity Web site*

Comment	Actual number who commented
Unsure whether the site helped me as I am already creative	1
Fridge magnets had limited word count / masked one another	2
Did not understand how the site was meant to support creativity	1
Did not like the group elements	2
Site needs to be more secure to promote sharing of ideas	1
Site needs to be more versatile	1
Site only useful as general encouragement	1
Methods too time consuming to use all of the time	1
Site does not necessarily promote habitual creative thinking	1
Study was too short to comment on real effects of the site	1

Discussion

The major aim of this study was to explore how students interact with the Creativity in the Biosciences web site and to determine whether the web site-based approach raises awareness of their own creative potential. The students interacted with the web site for a very short period of only two weeks and we did not anticipate that this interaction would lead to an immediate enhancement of their creativity. We were therefore not surprised to note that students exhibited

similar creative problem solving abilities before and after use of the web site facilities. In future work, participants should have access to the web site for much longer periods. In addition, future studies should focus on the recruitment of larger samples to determine whether the small increase in standard of performance, noted in the unusual uses tasks after use of the web site, occurs as a statistically significant increase when much larger numbers of participants are involved. It is also worth noting that in this preliminary study, following a call for volunteers, the sample of students involved was self-selecting. Eradication of any bias from self-selecting samples in future studies will be achieved most readily in a situation where use of the web site is a compulsory component of a degree programme.

Participants were asked to define creativity at the beginning and end of the study and it was reassuring to note that their definitions were consistent, broadly similar and generally in-keeping with those found in the relevant psychological literature. The students were therefore well-placed to respond to questions relating to: the importance of creativity; whether or not creativity is a skill that can be taught; and their own creative potential. Following interaction with the web site it was plain that students had an increased appreciation of the importance of creativity in the biosciences. They were also generally more convinced that creativity is a skill that can be acquired: prior to interaction with the web site only 47% of the participants believed that creativity could be taught and learned but this increased to 84% of the students at the time of completion of the second questionnaire. This increased awareness of the scope to enhance individual creativity should help ensure that students interact more effectively with the web site or other creative approaches in future.

The Creativity in the Biosciences web site had the very positive effects of building confidence in students and raising awareness of their capacity for divergent thought and creative problem solving. There were a number of specific comments in support of this conclusion: ‘This study has made me aware of different types of thinking that has made me aware of things people can do to be more creative’; ‘This exercise has introduced me to ways of thinking creatively’; ‘With participation in this study, I think I am better able to think creative and become more confident’; ‘I am more aware about generating creative thought than I ever have been in my life. Creativity isn’t just a product but a process too!’ A further interesting and revelatory comment was: ‘Don’t get given enough freedom to demonstrate full creative potential due to financial/time constraints’. Similar feedback was obtained from other users of the web site including A-level students, Level 3 Bioscience undergraduates and participants in a university staff development workshop (data not shown). All of this indicates that students and other users of the web site felt they had the capacity to be very creative, they simply needed the time, space, guidance and confidence to develop their potential.

In the longer term it is to be hoped that raised awareness of creative potential will encourage individuals to engage more effectively with the Creative Approaches and other facilities available at the Creativity in the Biosciences web site. The web site is freely available to all and the approach could be used in a wide range of settings and disciplines. Indeed the web site could be used to foster interdisciplinary approaches to problem solving and we would welcome the opportunity to work with colleagues who may be interested in collaborative studies in this area.

Communicating author

David J. Adams, UK Centre for Bioscience, Room 9.15, Worsley Building, University of Leeds, Leeds LS2 9JT. Email: d.j.adams@leeds.ac.uk; Telephone: 0113 343 5602; Fax: 0113 343 5894.

References

Adams, D.J., Grimshaw, P. and Paxton, S. (2006) *Creativity in the Biosciences*. www.fbs.leeds.ac.uk/creativity (accessed 1 May 2010)

Adams, D.J., Grimshaw, P. and Paxton, S. (2007) Creativity and research-led teaching. In *Proceedings of the 2nd Science Learning and Teaching Conference, Higher Education Academy, 2007, University of Keele*, eds Chin, P., Clark, K., Doyle, S., Goodhew, P., Madden, T., Meskin, S., Overton, T. and Wilson, J., pp. 118–123

Adams, D.J. and Grimshaw, P. (2008) Creativity and innovation in the biosciences. In *Enterprise for Life Scientists: Developing Innovation and Entrepreneurship in the Biosciences*, eds Adams, D.J., and Sparrow, J.C., pp. 25–51. Oxfordshire, UK: Scion

Adams D.J., Beniston, L.J. and Childs, P.R.N. (2009) Promoting creativity and innovation in biotechnology. *Trends in Biotechnology* **27**, 445–447

Azadegan, A., Bush, D., and Dooley, K. J. (2008) Design creativity: static or dynamic capability? *International Journal of Operations and Production Management*, **28**, 636–662

Birdi, K. S. (2005) No idea? Evaluating the effectiveness of creativity training. *Journal of European Industrial Training* **29**, 102–112

de Bono, E. (2000) *Six Thinking Hats*. London: Penguin Books

Loehle, C. (1990) A guide to increased creativity in research – inspiration or perspiration? *Bioscience* **40**, 123–129

Makel, M. C. (2009) Help us creativity researchers, you're our only hope. *Psychology of Aesthetics, Creativity, and the Arts* **3**, 38–42

Manolache, V. and Basu, M. (2010) Creativity is the future. *Metalurgia International* **15**, 35–39.

Mullen, B., Johnson, C. and Salas, E. (1991) Production loss in brainstorming groups: a meta-analytic integration. *Basic and Applied Social Psychology* **12**, 3–23

Paulus, P.P. and Nijstad, B.A. (eds.) (2003) *Group Creativity.* New York: Oxford University Press

Runco, M. A. (2007) *Creativity: theories and themes, research, development and practice.* Amsterdam: Elsevier Academic Press

Sio, U.N. and Ormerod, T.C. (2009) Does incubation enhance problem solving? A meta-analytic review. *Psychological Bulletin* **135**, 94–120

Sternberg, R. J. (2003) Creative thinking in the classroom. *Scandinavian Journal of Educational Research* **47**, 325

Torrance, E. P. (1974) *Torrance Tests of Creative Thinking: norms and technical manual.* Bensenville, IL: Scholastic Testing Services.

Torrance, E. P. (1993). Understanding creativity: Where to start? *Psychological Inquiry* **4**, 232–234

Valacich, J., Dennis, A. and Connolly, T. (1994) Idea generation in computer-based groups: a new ending to an old story. *Organizational Behavior and Human Decision Processes* **57**, 448–467