VISUAL IMAGES AS HOOKS FOR PROBLEM-BASED LEARNING

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ABSTRACT

In problem-based learning students are presented with a problem as the motivation for group research. The presentation of the problem attempts to address the issue of ownership of content by both providing a context for knowledge acquisition and requiring a transformation of material to address the problem. The transformational aspect in principle provides the opportunity for creativity. We present two case studies, with different outcomes, and the results of a workshop, in which visual imagery was used as the hook for a PBL problem with a view to encouraging creativity in the responses.

1. INTRODUCTION

Science education begins with an emphasis on discovery. Very soon however we realize that no normal pupil is going to discover Newtonian mechanics without some help. And then we discover that there isn't time for discovery, so we just provide the answers. But scientific research isn't really about answers except in as much as these raise further questions. So there is a long period of learning during which students are required to suspend judgment on the usefulness of what they are learning until, finally, they become research students and at last they are doing science again. This is a very long period of suspension and not to everyone's taste.

Problem-based learning (PBL) is an attempt to address his situation by providing a starting point in which a question generates the need-to-know in the form of a research issue. In tackling the problem students are guided to the acquisition of new knowledge in a meaningful context (e.g. Raine & Symons, 2005 and references therein). The essential motivation is that PBL requires a transformation of material that captures the need for ownership in a way that the student essay does not.

However, even within PBL in a science programme there is a tension between the need to cover curriculum content and the freedom to foster creativity. Very often the desire on the part of students to demonstrate creativity is focused on the medium and not the science content. Thus, we get lovingly produced powerpoint presentations, videos, reports, but with superficial subject matter. The conference workshop provided an opportunity to explore PBL with a particular focus on the creative transformation of the problem material. We provide two contrasting case studies from undergraduate courses and discuss the results of the workshop exercise.

The two case studies and the workshop focus on using visual material as the hook for a PBL problem. In these cases the problem is usually one of decoding of the visual image and has a correct answer. In our cases we wanted to provide a visual stimulus to creativity while at the same time maintaining a set of learning objectives.

2. Case study 1

We presented students with a set of images representing the passage of a light beam from the Sun to Mars and thence to the eye at the eyepiece of a telescope. The images of Mars were altered to represent various defects of vision, the intention being that these should prompt students to consider the way images are processed in the eye. It was made clear, or so we thought, that the solution of the problem posed by the images was an account of the fundamental science of optics and the eye. The creative aspect of the problem was to figure out a consistent story. This should have required a detailed knowledge of the nature of light and visual processing in the retina. However, it is easier to "google" the medical aspects of defects of vision, which were not part of the learning objectives. The background information provided to facilitators proved inadequate to deflect students from addressing mainly the medical aspects. Consequently the student effort focused on treating each individual picture as a medical case, thinking they had solved "the problem" once they had identified the nature of the defect and pasted a description from the internet. There was no significant transformation of the material.

3. Case study 2

We presented students with the following problem statement:

> A for Andromeda was a made-for-TV Science Fiction serial broadcast in 1961. The basic plot is the discovery of a radio message received from a distant civilisation with coded instructions on how to make a living being. Unfortunately the tapes of all but one of the episodes have been wiped so the coded message has been lost. In order to advertise their remake of the series **TV Remakes Unlimited** have decided to publicise the supposed discovery of a "real" coded message received by Jodrell Bank in 1987 which it claimed had been hushed up by the military and government. The code in the original broadcast production was alpha-numeric but it was decided to give the supposedly newly discovered one a glyphic form to make the deciphering more interesting. You must decide what each glyph symbolises and therefore in which order the "message" should be assembled in order to create the life form.

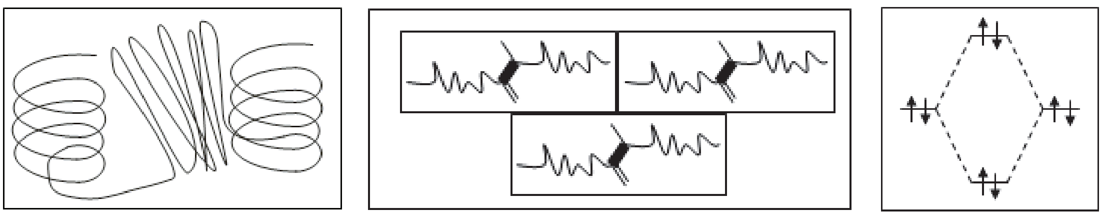

Figure 1: Some of the glyphs for case study 2.

Some of the glyphs are shown in figure 1. The aspect of creativity here is to understand the science well enough to argue for a logical ordering of the pictures. This allows many answers while requiring students to explain the science behind each picture. Some examples of learning objectives were: to describe the origin of molecular bonding, to discuss the structure and role of amino acids and proteins and of the shapes of molecules.

The feedback from the problem was positive. Students attempted to master the learning objectives at an appropriate level, while the proposed ordering of the glyphs varied between groups. Some of the weaker groups gave an order without an argument, as if this were self evident from their descriptions of the pictures.

4. RESULTS FROM THE WORKSHOP

The PBL questions posed in the workshop were somewhat ambitions. We presented each group of participants with a choice of three specially painted pictures (figure 2) as their PBL hook.

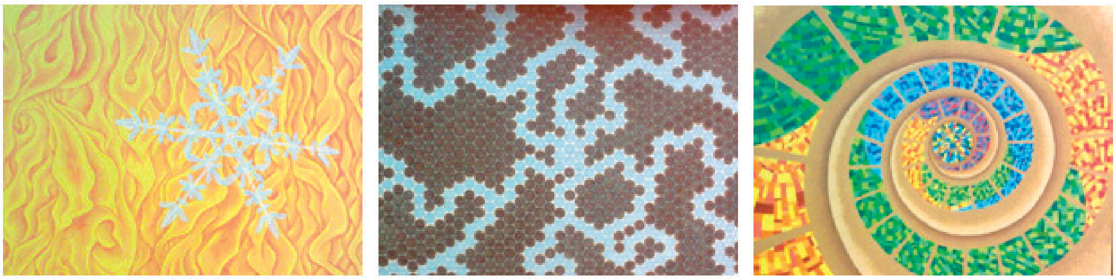

Figure 2: The images used in the conference workshop.

Of course, we had some idea of what we would like, having specified a physics context: from left to right we thought of the problems as fire and ice, electrical breakdown and Archimedean spirals or, more physically, light transmission through a glass window. The groups chose the first and last of the pictures. The first produced an interesting discussion of how an ice crystal could survive in the vicinity of a flame, for long enough to be visible. (Not all flames are hot, although that is perhaps chemistry rather than physics.) On the other hand the third picture produced a discussion on material heating up as it accretes into a black hole. Of course, this is a creative connection, but not one on the intended outcomes. It is also inconsistent with the colouring.

5. CONCLUSIONS

Scientific discovery depends on making creative connections that transform content. In the context of PBL such transformations develop ownership of the material and hence promote deep learning. Visual prompts can be used to promote the type of creative imagination without the unrealistic expectation that students can make scientific discoveries. Such problems need careful preparation and close facilitation. However, there is an ever-present danger that the results are superficial repetition of existing knowledge and do not promote new learning. Hooks of this type may be more appropriate in contexts where there are no specific scientific learning objectives, but are simply triggers for a piece of in-depth research chosen by the students. Alternatively, in a defined context, such as the second case study, one can think of these hooks as prompting a mind-mapping of content knowledge. In this context they have the advantage over traditional mind-maps of providing both the constraints and the freedom necessary for true creativity.

References

Raine, D.J. & Symons, S. (eds.) (2005) PossiBiLities: A Practice Guide to Problem-based Learning In Physics and Astronomy. Hull, UK: The Higher Education Academy Physical Sciences Centre.