"DATA DUMPING, AFTER THE TEST YOU FORGET IT ALL": SEEKING DEEP APPROACHES TO SCIENCE LEARNING WITH SLOWMATION (STUDENT-GENERATED ANIMATIONS)

Garry Hoban (ghoban@uow.edu.au)

Faculty of Education, University of Wollongong, Wollongong NSW 2522, Australia

KEYWORDS: deep approaches, surface approaches, slowmation, animation

ABSTRACT
It is not uncommon for university students to rote learn facts and formulae to memorise information for a test. Unfortunately, these surface approaches to learning are encouraged by the complex teaching and learning system embedded in the context of university courses. Where possible, academics should encourage students to develop a deep approach to learning in their subjects. "Slowmation" (abbreviated from Slow Animation) is an innovative teaching strategy that encourages students to design and make their own narrated digital animation that is played slowly at 2 frames/second to explain a concept. It is a simplified way of making animations that has been developed over the last four years and is one way for students to engage deeply with science content. This strategy encourages such an approach because students design a sequence of five multimodal representations which involves them thinking about a concept in many different ways. These digital animations explaining science concepts can be shared and critiqued by other students or instructors.

Proceedings of the 16th UniServe Science Annual Conference, University of Sydney, Sept 29th to Oct 1st, 2010, pages 2-6, ISBN Number 978-0-9808597-1-3

INTRODUCTION
The science education literature has long been awash with concerns about the nature of learning of science in school and at university (Committee for the Review of Teaching and Teacher Education, 2003; Tytler, 2008). Despite some notable exemplars to the contrary, there is a persistent view that the teaching of science is more often about the delivery of content to students as propositional knowledge rather than encouraging deep conceptual learning by them (Davis, Petish, & Smithey, 2006; Goodrum, Hackling, & Rennie, 2001). Key to the type of learning in science courses is how and why students engage with content knowledge. Engagement in science learning is about the ways in which instructors are able to shape their practice in order to encourage students to take an interest in processing information, transforming their understanding and developing richer links between science concepts and their everyday experiences of the real world (Loughran, 2010).

There are, however, many influences that a university science lecturer needs to take into consideration that shape his/her practice. These influences are caused by the complex teaching and learning system impinging on the design of a university subject. For example, many science subjects have a large amount of content to cover which is strongly influenced by the knowledge requirements determined by the subsequent subjects. Hence the type of teaching and learning context in a university subject can be viewed as a "system" (Biggs, 2003) which is influenced by the teaching content, the type of student, the type of activities and the intended outcomes. This complex relationship is shown in Figure 1.

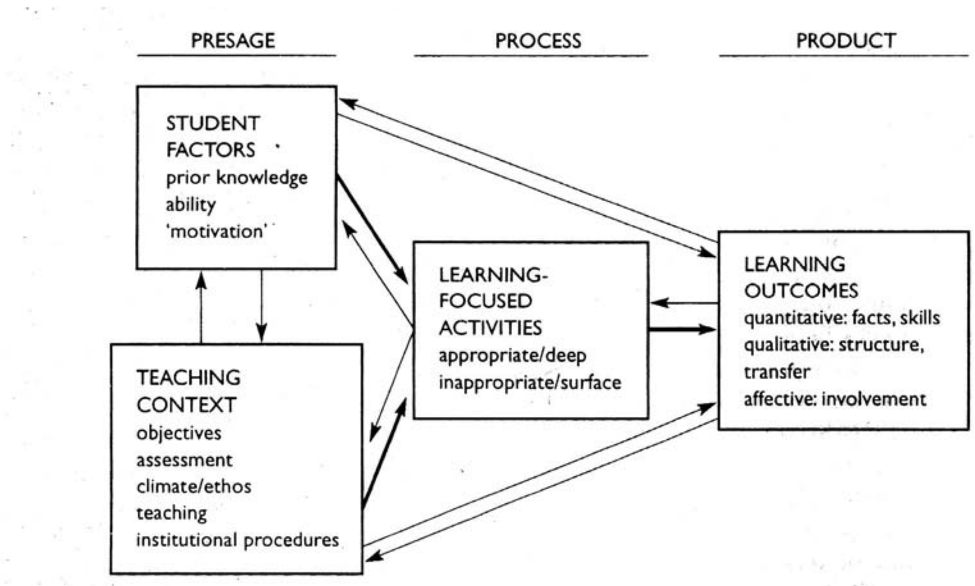


Figure 1: Biggs' 3Ps model representing the context of university teaching system

A body of literature has identified that the way university students engage with content is related to the nature of the task which can lead to students taking a "surface" or "deep" approach to learning (Marton & Saljo, 1976, 1984). According to Biggs (2003), a "surface approach arises from an intention to get the task out of the way with minimum trouble, while appearing to meet requirements. Low cognitive levels are used . . . . examples include rote learning selected content instead of understanding it, padding an essay, and listing points instead of understanding it" (p. 14). In contrast, a "deep approach arises from a felt need to engage the task appropriately and meaningfully . . . .when students feel this need-to-know, they try to focus on underlying meaning: on main ideas, themes, principles or successful applications" (p. 16).

An excerpt from an interview with a first year university science student in 2010 indicates that he used a surface approach to learning as he rote learned information for exams. In particular he used the phase of "data dumping" meaning that he forgot the information immediately after the exam because he was just rote learning it without any intention to develop deep meaning ("Int" means Interviewer, "St" means Student):

Int: Could you tell me a little bit about the subject that you did last semester?
St: It was Bio, which is a first year university subject, obviously a biology subject, mostly about the knowledge and science of organisms, how they are made and created and stuff.
Int: OK, was there much science to learn in the subject?
St: Yes, there was a fair bit of like rote learning science, especially about photosynthesis, and mitosis and meiosis, about their different cell structures and stuff. A lot of it was information that you weren't familiar with and you just had to memorise it.
Int: So how did you learn it then, how did you memorise it?
St: Mostly just by writing out notes and process the different steps of like photosynthesis, writing them out in order and reading them over and over.
Int: It's now three months since you've done the subject, did you understand most of it?
St: I got the general gist of most of it, most of the time, yeah, again like I said it was just rote learning information.
Int: So if you had to sit the test today how do you think you would go?
St: I would probably fail, just cause its been three months from now and I since them I have data dumped it, you kind of study up before the test and then straight after, you forget it all because you never use it again.
Int: OK, so how do you think your learning could be improved?
St: I don't know, I am sure there are other different strategies that I could use to probably study with so that are more in your long term memory rather than just in my short term memory just right before a test, I am not sure what those other study techniques would be that would help me.
Int: So it was really just a lot of rote learning and memorisation.

St: Yep.
Int: And what did you call it, "data dumping"?
St: Yes, data dumping,
Int: Data dumping
St: After the test you just forget it all.
Int: Oh, OK, but what if you needed the information again in another subject?
St: Then I would learn it all again for it.
Int: Oh right, so you learn it one by one do you?
St: Yes.
Int: OK, thanks

It appears from the interview transcript that the type of tasks required by the students promoted a surface approach to learning relying on memorizing information to pass an exam. The challenge, therefore, for science educators is to use teaching strategies that promote deep approaches to learning to engage students in thinking about content knowledge in different ways. This means designing tasks that encourage students to interpret content and if possible re-represent it (Ainsworth, 1999; Prain & Waldrip, 2006; Tyler & Prain, In Press; Waldrip, Prain, & Carolan, 2006).

One way to promote engagement by students in to offer opportunities for them to create their own digital media about science concepts. Twenty years ago, getting students to make a mini movie about a science concept was unheard of because of the expense of acquiring a movie camera and a video player. Also, digital still cameras for personal use were science fiction. But times have changed. Nearly all university students now have access to digital cameras (still or movie cameras), iPods for playing and recording sound tracks, and computers preloaded with free movie making software. It is therefore not surprising that the most popular web sites in the world, Facebook, Wikipedia, MySpace and YouTube, are all driven by user-generated content because of this widespread accessibility to media making technology.

This type of learning, using different modes of digital media is consistent with ways of learning in authentic science communities. According to Lemke (1998), "When scientists think, talk, write, work and teach, they do not just use words; they gesture and move in imaginary visual spaces defined by graphical representations and simulations. . . .they combine, interconnect, and integrate verbal text with mathematical expressions, quantitative graphs, information tables, abstract diagrams, maps, drawings, photographs and a host of unique specialised visual genres seen nowhere else" (p. 88). There is a growing acknowledgement, therefore, that university students need to use various forms of literacies — text, images, models, and voice—not only as a way of recording information, but also to facilitate learning. (Prain, 2006; Prain & Waldrip, 2006).

SLOWMATION: A SIMPLIFIED FORM OF STOP-MOTION ANIMATION

A "Slowmation" (abbreviated from "slow animation") is a stop-motion animation created by university students that played in slow motion at 2 frames/second to explain a science concept (Author, 2005, 2007, 2009). Slowmation is a simplified way of making an animation that encourages students to design a multimodal representation of their learning and integrates features of clay animation, object animation and digital storytelling. Like clay animation, slowmation uses a stop-motion technique involving the manipulation of models made out of plasticine or soft play dough as digital still photos are taken of each manual movement. Like object animation, a range of materials can be used such as plastic models, wooden, paper or cardboard cut-out models commonly found in primary classrooms to animate. Similar to digital storytelling, a key part of creating a slowmation is that a narration and authentic photos can be added by the students to explain the science concept as the models are animated. In sum, a slowmation displays the following five features:

- *purpose* — the goal of a slowmation is for students to make an animated mini-movie to explain a science concept and through the creation process, learn about the concept. Its design can include a range of technological enhancements to improve its educational value such as narration, music, other photos, diagrams, models, labels, questions, static images, repetitions and characters.
- *timing* — slowmations are usually played slowly at 2 frames/second, not the usual animation speed of 20-24 frames/second, needing ten times fewer photos than in clay or computer animation, hence the name "Slow Animation" or "Slowmation";
- *orientation* — models are made in 3D and/or 2D and usually manipulated in the horizontal plane (on the floor or on a table) and photographed by a digital still camera mounted on a tripod looking down or across at the models, which makes them easier to make, move and photograph;

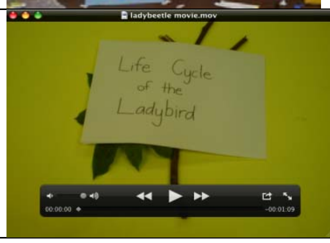
- *materials* — because models do not have to stand up, many different materials can be used such as soft play dough, plasticine, 2D pictures, drawings, written text, existing 3D models, felt, cardboard cut outs and natural materials such as leaves, rocks or fruit; and
- *technology* — students use their own digital still cameras (with photo quality set on low resolution) and free movie making software available on their computers eg IMovie or SAM Animation on a Mac or Windows Movie Maker on a PC.

In sum, slowmation greatly simplifies the process of making stop-motion animations by students manipulating 2D or 3D models often lying down on a flat surface and requiring a tenth as many photos as a normal animation because they are played ten times slower at 2 frames per second.

EXAMPLE OF UNIVERSITY STUDENTS CREATING A SLOWMATION

Over the last three years, over 600 slowmations have been made by preservice teacher education students at The University of Wollongong and Monash University through a funded national research project by the Australian Research Council. The preservice teachers learn to make a slowmation for the first time in a two-hour workshop and then create one as an explanatory resource on an allocated science topic as a university assignment. This can take up to 5-10 hours and they make it at home using their own digital still camera, everyday materials and the free movie making software on their own computers. Examples have been made of many science concepts as shown in mini 1-2 minute

Table 1: Five Connected Multimodal Representations in Creating a Slowmation

Sequence of Representations	Action	Example
Representation 1 *Research* — text — diagrams	University students research information about the topic on their laptops and record them by creating notes summarizing the key points.	
Representation 2 *Storyboarding* — diagrams — text	The students design a brief storyboard called a “chunking sheet” to plan out the design of their slowmation.	
Representation 3 *Modelling* — 3D models using playdough	The students make different models or are given existing plastic models of the science concept they are trying to represent.	
Representation 4 *Photographs* — digital still images of the small manual movements	Students take digital still photographs of models as they are manipulated manually.	
Representation 5 *Animation* — computer generated digital animation —narration	The students download the photos onto the computer, edit them, make static images, add a narration and export it to a QuickTime format.	

animated movies explaining a variety of concepts such as seasons, lunar cycles, life cycles of various plants and animals, particle motion, magnets, plant reproduction, weather cycles, movement of the planets, water cycle, simple machines, mitosis, meiosis and phagocytosis. Research has shown that students develop a deep understanding of the science content when they create a slowmation because they are engaging with the content in many different ways (Hoban, 2009). In effect they are creating a sequence of five multimodal representations culminating in the animation. Table 1 summarises the sequence of five representations involved in creating a slowmation along with a photo of students making a particular representation.

DISCUSSION AND CONCLUSION

Getting students to create an animation to explain a science concept has traditionally been too difficult to achieve in university classrooms either due to lack of equipment or the complexity of the process and technology. Because of its simplified technique, all students can learn how to make a slowmation in a two hour workshop and then use their own technology— a digital still camera and their own free movie making software — to design and make their own animation explaining a science concept at home. Such a university assignment encourages a deep approach to learning a science concept because they create their five multimodal representations culminating in the animation. Moreover the digital format lends itself to the students showing their animation to other students by uploading them to an internet site within the university or for public display such as to YouTube. This can result in the students sharing and evaluating each other’s animations.

Note

Free examples, instructions and other resources can be viewed on the project web site www.slowmation.com which was funded from Australian Research Council Discovery Grant DP O8799119.

REFERENCES

Biggs, J. (2003). Teaching for quality learning at university: What the student does. Berkenshire, UK and New York: Open University Press, McGraw-Hill.

Committee for the Review of Teaching and Teacher Education. (2003). Australia's teachers: Australia's future, Advancing innovation, science, technology and mathematics Canberra: Department of Education, Science and Training.

Davis, E. A., Petish, D., & Smithey, J. (2006). Challenges new science teachers face. Review of Educational Research, 76(4), 607-651.

Hoban, G. (2005). From claymation to slowmation: A teaching procedure to develop students' science understandings. Teaching Science: Australian Science Teachers' Journal, 51(2), 26-30.

Hoban, G. (2007). Using slowmation to engage preservice elementary teachers in understanding science content knowledge. Contemporary Issues in Technology and Teacher Education, 7(2), 1-9.

Hoban, G. (2009). Facilitating learner-generated animations with slowmation. In L. Lockyer, S. Bennett, S. Agostino & B. Harper (Eds.), Handbook of Research on Learning Design and Learning Objects: Issues, Applications, and Technologies (pp. 313-330). Hershey, PA: IGI Global.

Hubber, P., Tytler, R., & Haslam, F. (2010). Teaching and learning about force with a representational focus: Pedagogy and teacher change. Research in Science Education, 40(1), 5-28.

Lambert, J. (2002). Digital storytelling: Capturing lives, creating community. Berkeley, CA: Digital Diner Express.

Lemke, J. (1998). Multiplying meaning: Visual and verbal semiotics in scientific text. In J. R. Martin & R. Veel (Eds.), Reading science: Critical and functional perspectives on discourses of science (pp. 87-113). New York: Routledge.

Marton, F., & Saljo, R. (1976). On qualitative differences in learning: Outcomes and process. British Journal of Educational Psychology, 46, 4-11.

Marton, F., & Saljo, R. (1984). Approaches to learning. In F. Marton, D. Hounsell & N. J. Entwistle (Eds.), The experience of learning. Edinburgh: Scottish Academic Press.

Prain, V. (2006). Learning from writing in secondary science: Some theoretical and practical implications. International Journal of Science Education, 28(2-3), 179-201.

Prain, V., & Waldrip, B. (2006). An exploratory study of teachers' and students' use of multi-modal representations of concepts in primary science. International Journal of Science Education, 28(15), 1843-1866.

Tyler, R., & Prain, V. (In Press). A framework for re-thinking learning in science from recent cognitive perspectives. International Journal of Science Education.

Waldrip, B., Prain, V., & Carolan, J. (2006). Learning junior secondary science through multi-modal representations. Electronic Journal of Science Education, 11(1).

Waldrip, B., Prain, V., & Carolyn, J. (2010). Using mulit-modal representations to improve learning in junior secondary science. Research in Science Education, 40(1), 65-80.