Explaining and communicating science using student-created blended media

By Garry Hoban, Wendy Nielsen and Alyce Shepherd

Students engage with science content when they are asked to explain and communicate their knowledge to others. In particular, encouraging students to create various digital media forms such as videos, podcasts, vodcasts, screencasts, digital stories and animations to explain science is usually engaging, especially if they have ownership of the process and use their own devices such as smartphones, digital cameras and computers. Whilst each digital media form has particular affordances, they can also be integrated or 'blended' to provide a new way for students to explain science using a combination of digital media forms. These can be shared widely to communicate with others by uploading to internet sites.

Finding new teaching and learning approaches is needed to help school and university students improve their scientific literacies and ways of communicating science concepts (Rice, Thomas & O'Toole, 2009; Tytler, 2008). One way is to encourage them to create their own representations of science concepts using different modalities (Jewitt, 2009). When students sketch or write about their science ideas, they create mono-modal representations, because each literacy form or mode is an expression of their ideas as a way of making meaning (Lemke, 1990; Prain, 2006). These modes can also be combined in representations such as drawing sketches with labels or adding text to explain them (Ainsworth, Prain & Tytler, 2011). Different ways of engaging with content are also promoted when students re-represent content from one form into another (Yore & Hand, 2010). For example, students could summarise and write facts about phases of the moon, which could then be re-represented as sketches and re-represented again in a table or in 3-D models. Creating multiple representations of the same concept enables students to revisit and reflect upon content as well as allowing for different possibilities of representation (Hoban & Nielsen, 2011; Hubber, Prain & Haslam, 2010).

The rapidly increasing use of digital technologies is offering students new opportunities to represent content in different ways. Technologies, including software programs in mobile devices, support students in integrating different modes such as text, sound, still and moving images (Jones & Issoff, 2007). Additional communication and presentation skills can be gained if students are encouraged to share and justify the design and meaning of their student-created representations with peers. The affordances of Web 2.0 technologies also enablie students to disseminate their ideas widely and seek feedback by uploading their digital media to social media sites such as Facebook and YouTube.

Forms of Student-Created Digital Media

The ever expanding accessibility to personal digital technologies over the last ten years offers a timely opportunity in science teaching and learning to provide new ways to engage students by creating their own digital representations. Making a video as a class or as a group project was unheard of twenty years ago, but with readily available technology such as digital cameras, smartphones, flip cameras, video cameras, webcams and iPads as well as laptops with Web 2.0 connectivity, it is now much easier. As technology becomes increasingly easier to use, it extends opportunities for students to make decisions about how to combine or integrate various modes such as text, sound, still and moving images to produce multi-modal digital representations (Traxler, 2010).

Inviting students to design and create digital media to explain science concepts to peers is a powerful way to learn as, "the people who learn the most from instructional materials are the designers. . . .we have all stated at one time or another that the quickest way to learn about subject matter is to have to teach (design) it" (Jonassen, Myers & McKillop, 1996, p. 95). Perhaps the task of creating a digital representation to be shared with peers could become a part of a class resource system to which new digital resources are added with each cohort. There are a number of forms of student-created digital media that can be used as assignments or tasks in universities and high schools, each with particular affordances that are features or qualities unique to that form. For the purposes of this paper, an 'affordance' is the quality or feature of a technology that allows it to perform a particular action or purpose (Gibson, 1977).

Podcasts

One of the simplest digital media forms for students to create is a podcast, which is usually a 1-3 minute audio recording, often with no images, where students explain an allocated science concept. A simple task for students could be to summarise a section of a science book or internet site as a way of re-representing the content to their peers. Examples of one-minute podcasts are available on the Scientific American website at http://www.scientificamerican.com/podcast/podcasts.cfm?type=60-second-science. A more challenging and imaginative form of podcast is to get students to explain their science knowledge as an analogy. This involves summarising content and

re-representing it in a script for audio production. For example, a chemical reaction could be explained as a 'tug of war' between the reactants and products or oxidation and reduction could be explained using the analogy of a boxing match (Bartle, Longnecker & Pegrum, 2011). The New Media for Science website that can be seen at http://newmediaforscience-research.wikispaces.com/Science+podcasts includes other examples of podcasts using analogies for learning science in universities (Rivkin, Longnecker, Leach, Davis & Lutze-Mann, 2012).

Digital Story

A digital story is a narrated slide show usually with static images that each stay on a screen for 10-20 seconds (Lambert, 2003). The key to a good digital story is writing the narration first to present a compelling explanation, which is then accompanied by finding static digital images to fit the narration. The process of developing a digital story typically requires students to: (i) brainstorm ideas to produce a storyboard; (ii) write a short 250-word script; (ii) take or find 10-12 still images that illustrate the narration that extends for 2-3 minutes; (iv) record the script; (v) produce the explanation using a video editing program to make sure that the narration matches the slides; and (vi) share the final product. In a science context, a digital story is suited to explaining science discoveries such as Faraday's work with electricity or Alexander Fleming's discovery of penicillin. Support and guidelines can be found at http://uow.libguides.com/content.php?pid=82573&sid=612645.

Animation

Many expert-generated representations such as animations, simulations or other visualizations are available, and have proven valuable for learning science concepts, particularly to show changes at macroscopic or microscopic levels (Linn & Eylon, 2011). But learners have been limited in creating their own animations because the professional software available, such as Flash Animation, is usually too time consuming for students to learn and use. There is, however, a simplified way for school and university students to make animations, called *Slowmation* (abbreviated from Slow Animation), which are narrated stop-motion animations that are played slowly at two frames/second to facilitate a narration explaining the slow-moving images (Hoban, 2005; Hoban, Loughran & Nielsen, 2011; Hoban & Nielsen, 2012). Students engage with science content in multiple ways as they write a narration, construct a storyboard, make or use existing models, take digital stills of manual movements and import them into free video software to edit with narration and/or music. Free instructions and resources are available at the project web site www.slowmation.com. Figure 1 shows examples of preservice teachers creating a slowmation.

Figure 1: Preservice teachers taking photos for simplified stop-motion animations (Slowmations): One group is using a hand-held mobile phone and one is using a camera mounted on a tripod to take photos as the models are moved manually.

Video

Students can plan and create a brief demonstration video with images playing at 25-30 frames/second to explain an allocated science concept or demonstrate how to do an experiment. In a secondary science context, some examples include Newton's Laws, states of matter, forces and projectile motion. Encouraging students to enter their videos in a popular international competition called '60-Second-Science' (www.60secondscience.net/) can also be an engaging and motivating influence where student-generated videos compete for cash prizes to provide the best science explanations.

Student-Created Blended Media for Digital Science Explanations

Whilst each digital media form has its own particular affordances, aspects of these forms can also be integrated or 'blended' enabling students to mix and match media for particular purposes (Hoban, in press). When planning for a blended digital explanation of a science concept, students need to be aware of the affordances of each digital form and then select the most appropriate to suit the purpose of the explanation. For example, the four main features or components of a written explanation can be aligned to different digital media forms to generate a succinct digital explanation: (i) an explanation begins by naming a topic and identifying key elements or parts and this can be represented digitally by narrated static images similar to a digital story; (ii) the next part of an explanation shows how the elements or parts dynamically relate to each other and this can be represented digitally by a simple animation or 'slowmation'; (iii) an example of a concept can be demonstrated with a short video if the elements move by themselves or if not, then represented by a slowmation; and (iv) the conclusion of an explanation summarises the main points and can be represented digitally using a static image. What is common across the four media forms is the narration explaining the science.

The key to creating effective explanations using blended media is for students to write the narration first to explain the science and then make decisions about which digital media form best suits the purpose of what is being explained. Table 1 shows the features of a written explanation and how these can be represented digitally using the affordances of different digital media forms. For example, in making a blended media to explain a complex topic such as 'phases of the moon', a student could start by researching the science of how the moon phases change. Once the topic is understood, then resources could be gathered in terms of how to make the digital media form that best suits a particular part of the explanation. For example, the first part of the digital explanation could be naming each phase of the moon with narrated static images; the next part could demonstrate the dynamic relationship between the sun, moon and

TEXT TYPE/PURPOSE	FEATURES OF EXPLANATIONS	DIGITAL CONSTRUCTION PROCESS	AFFORDANCES
An explanation articulates how or why something happens. eg What causes phases of the moon?	1. Starts by naming the topic and identifies elements related to the topic in the right order. eg. Names each phase of the moon in turn.	1. Narrated static images with 10-15 seconds per frame similar to a digital story.	1. Static images stay on the screen as long as necessary allowing learners to focus on each image whilst the narration introduces the topic and elements of the topic.
	2. Explains how the elements relate to each other and to the topic. eg. Shows a slowmation of the moon and earth moving around the sun	2. Narrated slow moving animation with images moving at 2 frames/sec similar to "slow animation". This could be interspersed with static images of tables, flowcharts, graphs or diagrams to illustrate particular evidence for the phenomena.	2. Slow moving images allow a learner to see how the elements move slowly in relation to each other.
	3. Provides an example. eg. shows a video of the phases of the moon	3. Use video with fast moving images at 25 frames/second by itself or static image to show an actual or real life example.	3. Fast moving images like a video allow a learner to see how something moves by itself in real life.
	4. Finishes with a concluding or summary statement. eg. an image with all the phases of the moon showing the progression.	4. Narrated static image presented in a still photo to provide a conclusion.	4. A static image allows a learner to focus on the still image as a summary of the conclusion.

Table 1: Affordances of digital media to suit explanations using blended media.

earth that results in different moon phases as they appear on earth with a slowmation. This could be followed by a video showing changing phases and then a conclusion with one static image of the all the different moon phases as the narration revisits the progression and a final summary. The design process in creating such a blended form encourages students to think about the concept and how best to represent it in multiple and connected ways.

A useful feature of student-created blended media is that combining different media forms is relatively simple. As long as students have planned their narration, which determines the quality of the explanation and what digital media forms suit particular parts, students can take all the images (still and video) with their mobile phone/iPad. Alternatively, they could download copyright free material from the internet, and integrate them using free movie making software on either an Apple (using iMovie) or a PC computer (using Windows Movie Maker). Free images can also be obtained from Google Images as long as they are copyright free. Each media form can also be created separately and then integrated or blended as a whole in the movie making software.

Students can produce their own blended digital explanations at home using their own technologies, with perhaps some class time devoted to demonstrating examples and techniques. Digital media explanations could then be uploaded to a learning management system or a public site such as YouTube or Facebook to communicate students' ideas for feedback. Students therefore not only learn from creating their own digital representation to explain a science concept, but they can also learn from the other digital explanations created by peers. Uploading their digital explanations to web sites enables a level of 'quality control' for these student products to seek feedback on the accuracy and quality of the explanation.

Conclusion

It is clear that the opportunities for students to use their own personal digital technologies to improve their digital literacies in science will only keep increasing during the 21st Century. Science educators should seize this opportunity to encourage their students to take more ownership for creating science content. Understanding the features of a quality explanation and the affordances of different media forms will assist students in making decisions about what and how to blend different media forms to explain and communicate their ideas to peers and teachers. You can see examples of student-created blended media at the slowmation website: www.slowmation.com

References

Ainsworth, S. Prain, V., & Tytler, R. (2011). Drawing to Learn in Science, *Science*, 335, 1096-1097.

Bartle, E., Longnecker, N., & Pegrum, M. (2011). Collaboration, Contextualization and Communication using New Media: Introducing Podcasting into an Undergraduate Chemistry Class. *International Journal of Innovation in Science and Mathematics Education, 19*(1), 16-28.

Gibson, J. J. (1977). The theory of affordances. In R. Shaw and J. Bransford (Eds.) *Perceiving, action and knowing: Towards an ecological psychology*. Hillsdale NJ: Laurence Erlbaum.

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

Hoban, G. (in press). *Engaging with content and language using student-created blended media.* Keynote presentation, First International Conference on Education and Language, Bandar Lampung, Indonesia, January 2013.

Hoban, G., Loughran, J., & Nielsen, W. (2011). Slowmation: Preservice primary teachers representing science knowledge through creating multimodal digital animations. *Journal of Research in Science Teaching. 48*(9), 985-1009.

Hoban, G., & Nielsen, W. (2012). Using "Slowmation" to Enable Preservice Primary Teachers to Create Multimodal

Representations of Science Concepts. *Research in Science Education, 42*(6), 1101-1119.

Hoban, G., & Nielsen, W. (2011). The five Rs: A new teaching approach to encourage slowmations (student-generated animations) of science concepts. Teaching Science, 56 (3), 33-38.

Hubber, P., Prain, V., & Haslam, F. (2010). Teaching and Learning about Force with a Representational Focus: Pedagogy and Teacher Change, *Research in Science Education 40*, 5-28.

Jewitt, C. (Ed). (2009). *The handbook of multimodal learning,* Routledge, London.

Jonassen, D., Myers, J., & McKillop, M. (1996) From constructivism to constructionism: Learning with hypermedia/multimedia rather than from it. In B.G. Wilson (Ed.), *Constructivist learning environments* (pp. 95). Engelwood Cliffs, NJ: Educational Technology Publications.

Jones, A., & Issroff, K. (2007). Motivation and mobile devices. *Research in Learning Technologies, 15*(3), 247-258.

Lambert, J. (2003). *Digital Storytelling: Capturing Lives, Creating Community*. Berkley, CA: Digital Diner Express.

Linn, M., & Eylon, B. (2011). *Science Learning and Instruction: Taking Advantage of Technology to Promote Knowledge Integration.* New York and London: Routledge.

Lemke, J. (1990). *Talking science: Language, learning and values.* Ablex. Norwood, NJ.

New Media for Science http://newmediaforscience-research.wikispaces.com/Science+podcasts

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

Rice, J. W., Thomas, S. M., & O'Toole, P. (2009). *Tertiary science education in the 21st century*. Sydney: The Australian Council of Deans.

Rivkin, W., Longnecker, N., Leach, J., Davis, L., & Lutze-Mann, L. (2012). *New media to develop graduate attributes.* Australian Learning and Teaching Council Final Report. http://newmediaforscience-research.wikispaces.com/Project+information.

Scientific American. http://www.scientificamerican.com/podcast/podcasts.cfm?type=60-second-science

Traxler, J. (2010). Students and mobile devices. *Research in Learning Technologies, 18*(2), 149-160.

Tytler, R. (2008). *Re-imagining Science Education,* Melbourne: ACER.

Yore, L., & Hand, B. (2010). Epilogue: Plotting a research agenda for multiple representations, multiple modality, and multimodal representational competency. *Research in Science Education, 40,* 93-101. TS

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