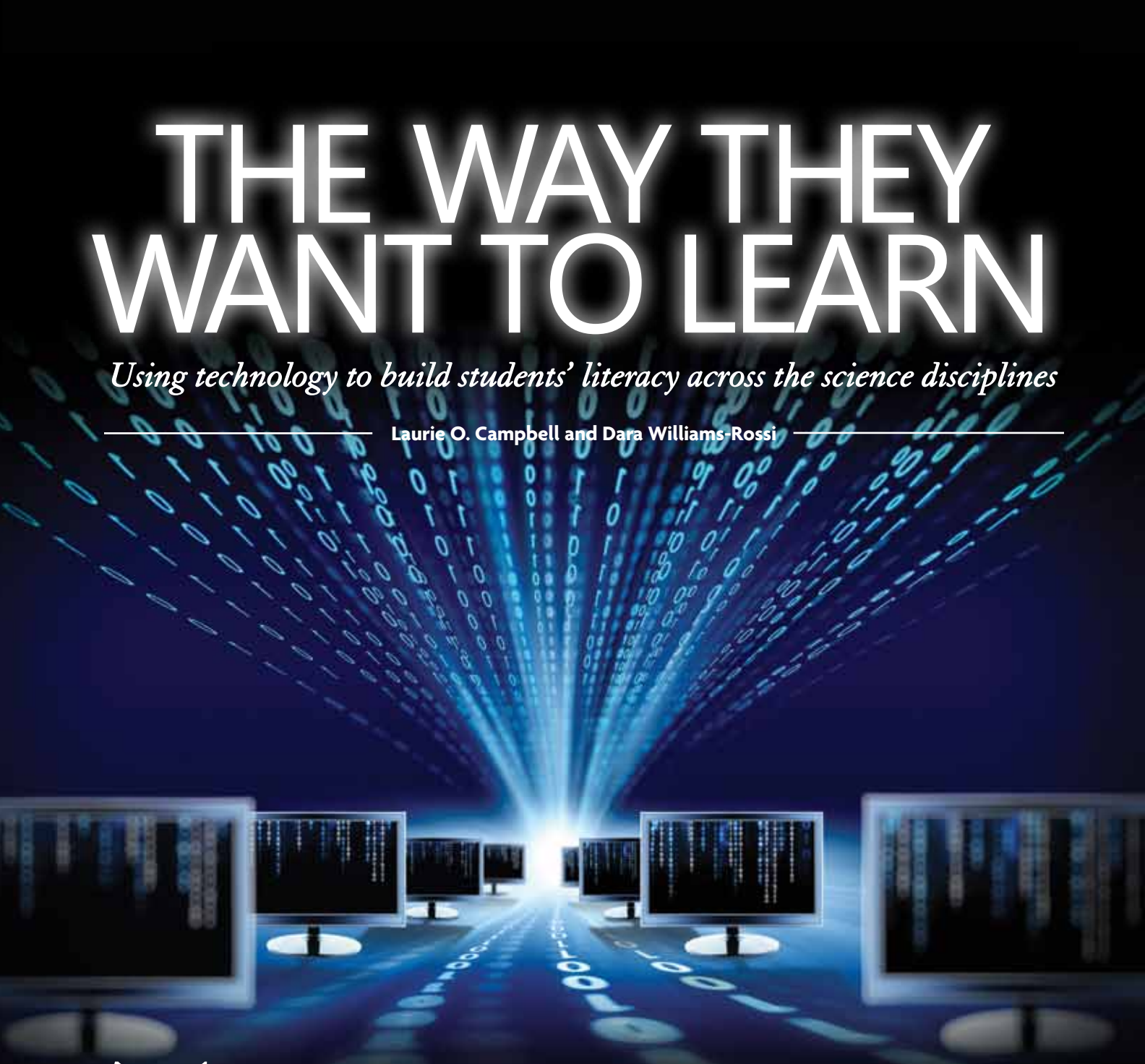
THE WAY THEY WANT TO LEARN

Using technology to build students' literacy across the science disciplines

Laurie O. Campbell and Dara Williams-Rossi



Teens love to spend time on Facebook, search YouTube, tweet, text, and play online games. Some spend their free time actively creating and mashing up text, images, audio, and video. Then they come to school, and are, as one teen described it, "trapped in a time warp…where lectures and notes are the only way we are taught." But these active creators and consumers of knowledge don't have to become passive consumers of information when they step inside school walls. Technology can enhance their lives in the classroom, too.

The benefits of technology

Technology-based activities and tools help students learn science content, increase academic vocabulary, build background knowledge, and foster 21st-century skills. Students tend to interact with each other when using technology, so these tools and subsequent assignments can also help students increase their communications skills.

This article describes six free software and web applications and ways to use them in the science classroom. These programs encourage students to express their thinking and understanding, cultivate their motivation for learning through collaboration, and instill a sense of belonging and ownership (Glasser 1998). The programs require students to demonstrate facility with both verbal and nonverbal representations, helping them remember content (Marzano, Pickering, and Pollock 2001).

CMAP Tools

What is CMAP Tools?

CMAP Tools (see "On the web") is a free software program that students can download and use individually or collaboratively to create Novakian concept maps. Concept mapping has been used in science education since the early 1980s (Novak 1998). However, not all concept maps are created equal: Novakian concept maps are the gold standard of concept mapping. Novakian concept maps differ from general bubble maps or webs in that they include guided focus questions, hierarchal structures created in open environments without spatial or quantity restrictions, and labeled links and cross links that demonstrate interrelationships among major content elements. Students can combine concepts and links to form propositions that read like sentences (Figure 1).

CMAP Tools in the science classroom

When using CMAP Tools to create Novakian concept maps, students start with a focus question from the teacher such as, in a biology class: How do alleles interact? They brainstorm to develop a list of words related to the focus question and then classify the words from general to specific to make propositions for their concept maps. Teaching students to create Novakian concept maps (Figure 2, p. 54) encourages them to think, discuss, and demonstrate their inclusive understanding of the science content relative to the focus question. Students can easily modify their maps with CMAP Tools as they increase and refine their knowledge over the course of a science unit.

Webspiration Classroom

What is Webspiration Classroom?

Webspiration Classroom, a free, web-based service, and its software counterpart, Inspiration, are visual thinking and learning tools. Webspiration Classroom includes all of the functionality of Inspiration. Students can use the program's graphic organizer templates, teacher-made templates, or their own graphic organizers to take notes, develop outlines, or demonstrate understanding. In the latter case, they can use the built-in art gallery to add images to their demonstrations. The program's collaborative aspects are beneficial for peer-review and student revisions. Student-developed visuals can aid in information retention and provide teachers with accurate reflections of students' understanding.

Webspiration Classroom in the science classroom

Webspiration Classroom documents are stored online. As a result, learning can continue beyond the classroom as students can use their own time to improve their documents. For example, after reading and discussing Boyle's law in a chemistry class, students can use Webspiration Classroom to graphically demonstrate, explain, and label the relationship between pressure and the volume of gas. The teacher can then review students' graphics and provide immediate feedback to correct misunderstandings and reinforce accurate illustrations. Alternatively, students can conduct lab experiments relative to Boyle's law, modify their initial diagrams, and submit their work to the teacher for grading.

Prezi

What is Prezi?

Prezi (see "On the web") is a free, web-based tool that allows users to create nonlinear, slideless presentations with zooming capabilities. Students can place ideas, images, videos, and even audio tracks on a large canvas; zoom in on details; and move around their presentations with ease. They can import PowerPoint or Keynote presentations to extend the power of formerly linear presentations and download presentations to their computers or digital mobile devices. Users can share Prezis—through communities, such as Facebook or Twitter (see "On the web"), or numerous blogs—or keep them private.

Prezi in the science classroom

Teachers can use Prezi to present content graphically, and students can create presentations that demonstrate their

FIGURE 1

Novakian concept map example.

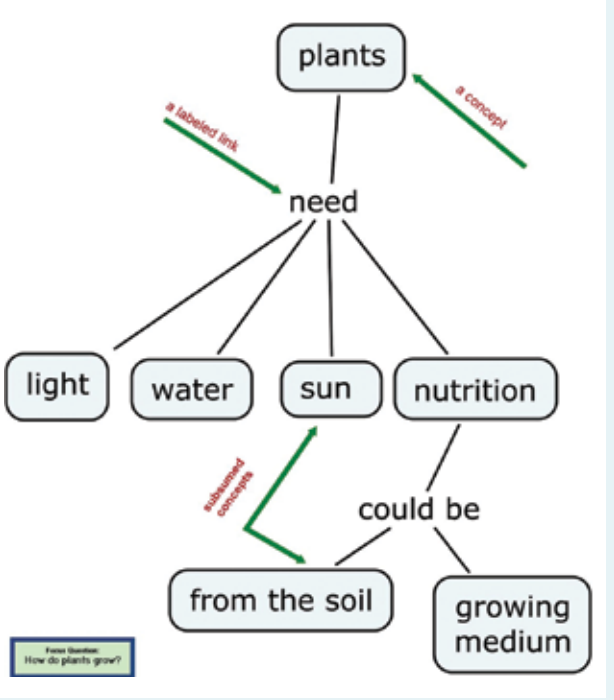


FIGURE 2

How to implement Novakian concept maps.

1. The teacher posts a focus question.
2. Students brainstorm and write words related to the question.
3. Students order the words from general to specific.
4. Students identify potential propositions that answer the focus question.
5. Students use CMAP Tools to create concept maps.
6. The teacher divides students into small groups for peer feedback and discussion related to the maps.
7. Students review and revise maps as necessary.
8. The process may be repeated at any point during the unit of instruction.

learning. Many students love science but hate completing "boring" lab reports, so they enjoy using this online tool to share their ideas and present their findings. Based upon feedback from our students, Prezi motivates students to learn more science as they create presentations for their classmates. Students can even record portions of their labs and embed videos in their presentations to support their conclusions. Prezi also allows students to collaborate in real time with up to 10 peers. The social aspect adds a new dimension to brainstorming, collaborating, and editing a group project: Students don't have to be in the same place or even the same class.

Tagxedo

What is Tagxedo?

A free, web-based application similar to Wordle, Tagxedo (see "On the web") allows students to create visually dramatic word clouds, using custom shapes like turtles, flowers, checkmarks, footprints, and callout boxes (Figure 3). Students can modify the advanced settings for color, font, text direction, layout refresh, aspect ratio, and word spacing as often as they want. They can create their own text or submit text from a website, Twitter account, news article, or other source. Tagxedo sizes words according to their frequency of occurrence.

Tagxedo in the science classroom

Students can individually use Tagxedo to create study tools with their lecture notes or analyze their writing for specific vocabulary or overused words. Collaboratively, Tagxedo is a means to summarize a reading, create a visual summary tool of a brainstorming session, or document a field trip by using related shapes for emphasis. Students can also use Tagxedo with an online dictionary to expand their science literacy: They can type a word into the dictionary to generate a list of related words or phrases and then use Tagxedo to create a word cloud out of this list (Leung 2011). Word clouds can highlight key points of a lecture or reading.

VoiceThread

What is VoiceThread?

VoiceThread is a free web application and collaborative learning tool (see "On the web"). Students can view, listen, or read media—such as images, videos, audio files, documents, or presentations—and respond with their own text, voice, or video comments and annotations. VoiceThread is similar to a Facebook wall in that students can add personal comments or answer teacher-posed questions. They can also use landline phones to call VoiceThread, record comments, and navigate the thread; a mobile VoiceThread application will soon be available for tablet computers and smartphones. The application's design is simple and easy to use.

VoiceThread in the science classroom

There are multiple ways to use this web application in the science classroom. For example, a physics teacher can upload images, videos, and audio related to the theory of acoustic resonance. Students can then work together in groups of

FIGURE 3

A Tagxedo word cloud.

FIGURE 4

Tidal inquiry using VoiceThread.

four, role-play as investigators, and answer questions relative to the posted media. Teachers can also use VoiceThread to explain complicated scientific formulas, provide tutorials for homework, or conduct formative assessments at the end of class.

Students can create their own VoiceThreads to document labs, demonstrate science principles, ask questions regarding reading, or study for a summative assessment. For an environmental lab experiment about local drinking water, students can take pictures on their phones or conduct Skype (see "On the web") interviews with local water authorities and post them on VoiceThread. They can even incorporate local maps, images, or diagrams from other programs and include them on VoiceThread (Figure 4).

Museum Box

What is Museum Box?

Museum Box is a free web application developed for social studies classrooms but versatile enough to be used in science, as well. A virtual Museum Box stores and organizes video, movies, text, audio, document files, and web links (Figure 5, p. 56) in trays. It is similar to a shadow box in that it contains artifacts relative to the same time period, event, or topic. Teachers can easily review students' collections of media and make comments regarding their boxes. Students like that the boxes are customizable.

Museum Box in the science classroom

Teachers can introduce Museum Box at the beginning of a unit, and students can collect artifacts and place them in their boxes throughout the unit. Students can work together, using multiple trays, or fill their boxes individually. For example, students studying plate tectonics in an Earth science class can include short videos of the lab experiment, diagrams, drawings of plates, and one-page summaries explaining subduction or convergence. They can also add pictures and videos of volcanoes or earthquakes and create voiceovers explaining how plate tectonics relate to these forces of nature. Teachers can view the final collections through Museum Box, or students can incorporate them into Prezis.

Implementation and assessment

The implementation of these online tools varies based on students' needs and skills, course content, the school's culture and equipment, and the academic outcomes expected. Teachers may need to call their schools' Information Technology Department to make sure students have access to these programs. (**Safety note:** Check with your school district for policies and action plans to protect students from inappropriate or undesirable material and ensure safe use of the internet.)

Teachers can use pre-established rubrics, checklists, and holistic grading methods to assess students' work. They can

FIGURE 5

Virtual Museum Box.

summatively assess students' cumulative knowledge near the end of a unit using a program like Prezi. Conversely, teachers can formatively assess students' ongoing development of understanding throughout a unit using a program like CMAP Tools.

Conclusion

Students love using technology. Tapping into this love can encourage them to spend more time engaging in science content, increase their academic vocabulary (vital for English language learners), and collaborate with their classmates. Teachers don't have to be program experts; instead, they can rely on student experts to assist those who may need help.

The intuitive nature of both students and technology make the integration of these computer applications an easy fit. Teachers can start small by adding one of these programs to their next appropriate unit of instruction. Students will love demonstrating their science knowledge in a way of learning that they enjoy. ■

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On the web

CMAP Tools: *http://cmap.ihmc.us/download*
Facebook: *www.facebook.com*
Museum Box: *http://museumbox.e2bn.org*
Prezi: *http://prezi.com*
Skype: *www.skype.com*
Tagxedo: *www.tagxedo.com*
Twitter: *www.twitter.com*
VoiceThread: *http://voicethread.com*
Webspiration Classroom: *www.inspiration.com/WebspirationClassroom*
Wordle: *www.wordle.net*

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