

The Science of Spectroscopy: Collaborative Curriculum Development using a Wiki

Stewart Mader, Brown University, Providence RI 02906 slmader@gmail.com

Abstract

A Wiki can be thought of as a combination of a Web site and a Word document. At its simplest, it can be read just like any other web site, but its real power lies in the fact that groups can collaboratively work on the content of the site using nothing but a standard web browser. The wiki is gaining traction in education, as an ideal tool for the increasing amount of collaborative work done by both students and teachers. Students might use a wiki to collaborate on a group report, compile data or share the results of their research, while faculty might use the wiki to collaboratively author the structure and curriculum of a course, and the wiki can then serve as part of each person's course materials. Recently The Science of Spectroscopy, a well-known educational web site, was converted into a wiki so that the growing number of readers can now become writers and collaboratively build a richer and more useful tool.

What is The Science of Spectroscopy?

Spectroscopy has something for everybody. Because it is the study of light interaction with matter, it is the science of seeing, whether with the naked eye or with highly precise instruments. It also relies on math to draw conclusions after data has been collected. For instance, in NMR spectroscopy, "the area under each peak or multiplet is proportional to the number of equivalent hydrogens responsible for that peak"¹ and students need to understand how to calculate this. For these reasons it can be very engaging or extremely challenging for different learners. The Science of Spectroscopy was developed to engage students by first presenting a wide variety of applications, then leading to theory as the underlying explanation. From NASA projects to medical imaging, sunscreen chemistry, and microwaves, the applications are intended to appeal to the different interests of as many students as possible, and encourage them to understand how and why spectroscopy is used. This creates a learning environment in which theory and techniques can be taught with meaning, in which students will see relevance and meaning as they learn theory and techniques, instead of seeing it as useless and uninteresting.

Why did we start using a wiki?

The Science of Spectroscopy started in 1999, and as the site received publicity from reviews, publications, and conference presentations, an increasing number of users sent materials for us to add to the site, so it would better complement lessons and assignments. As the requests increased, I began to think how a system could be developed to get new material posted efficiently and with no unnecessary effort. While researching tools to help me manage the site, I discovered the wiki which allows an entire community to maintain a site. A wiki can be thought of as a combination of a Web site and a Word document. At its simplest, it can be read just like any other web site, but its real power lies in the fact that groups can collaboratively work on the content of the site using nothing but a standard web browser. Beyond this ease of editing, the second

powerful element of a wiki is its ability to keep track of the history of a document as it is revised. Since users come to one place to edit, the need to keep track of Word files and compile edits is eliminated. Each time a person makes changes to a wiki page, that revision of the content becomes the current version, and an older version is stored. Versions of the document can be compared side-by-side, and edits can be “rolled back” if necessary.

The ultimate goal of The Science of Spectroscopy is to become the most comprehensive source of information on spectroscopy available free of charge, and as I learned more about the wiki, it became apparent that it could do much more than simplify my work updating the site. It is the necessary tool to channel the support, involvement, and knowledge of a diverse community to:

- Create a clear, logical platform for any user to contribute content to The Science of Spectroscopy
- Ensure the long-term usefulness of The Science of Spectroscopy by creating a cycle of sustainability in which the content submitted keeps the resource relevant, and the resource’s ease of use encourages any educator to submit content
- Introduce new content topics, such as cutting-edge applications of spectroscopy in astrobiology, space science and medicine, through collaboration with NASA Ames Research Center
- Increase the worldwide usability of The Science of Spectroscopy by hosting versions in multiple languages. The first translation to French is designed to serve the significant Canadian and French user base of the web site. This serves as the starting point for conversion of content to other languages which reflect the site’s user base, such as Italian, German and Spanish, and the wiki makes translation feasible because users can work directly on pages, and translations are available the moment they add them.

How did we design it?

"Because there is no physical analog to a wiki, designing an interface that allows multiple authors to simultaneously collaborate on multiple documents isn't an intuitive process. It's something that I, and many designers like me, are working out as we go along."² A Wiki is both a technology tool and a community forum, and is unique in that it has no physical counterpart. This makes it both challenging because there's no exact historical precedent to guide the development of wiki software, or the conduct of wiki sites. This is also very liberating, and an example of the era we are just entering with technology, where new tools only exist in the online realm because they take advantage of maturing architecture that is only possible online.

For example, in order to make “writing” to the web easier, the makers of Wiki software have created a syntax that simplifies the code and reduces the time needed to perform common tasks, like linking. Using HTML, a link would be written:

<a href="<http://www.scienceofspectroscopy.info/skysight>">Skysight and would appear in a Web browser as [Skysight](http://www.scienceofspectroscopy.info/skysight). Using Wiki syntax, the same link would be

written: [<http://www.scienceofspectroscopy.info/skysight> Skysight] and would appear in a Web browser just like the underlined link above.

For The Science of Spectroscopy, we designed the wiki to be as self-sufficient as possible, with a basic, obvious organization structure that mirrors how content was organized in the former, static site. The wiki main page has just three lists: Applications, Techniques, and Theory, and links can be quickly added as new pages are created. The only part of the wiki that is not "self-service" is account creation. New users must email a request to have their accounts created, so that we can screen out spammers and deter vandals or people looking to boost their search engine rankings by posting lots of links on wiki pages.

Engaging Teachers

One of the biggest barriers to involving teachers in technology-enabled curriculum development is how to solicit their input and build it into the curriculum in a meaningful way that makes the curriculum richer. Most technology tools only attract adventurous, early adopters because:

1. Copyright law is detailed, lengthy, and difficult to understand, so most teachers don't have the time or expertise to understand it. The gray areas in copyright law are so misunderstood and murky that if you ask ten different people, you'll get ten different answers, and each one will likely be to the benefit of the person answering you. This is a reflection on the complexity of the issue, and makes it really easy to see why people don't know what to do with materials.
2. Since the tools to create content have been had fairly moderate learning curves, most teachers haven't been inclined to create their own materials, even when they have the knowledge and expertise to do so.

Because of its natural ability to let authors focus on content over technology, almost-transparent yet familiar operation (uploading an image is like attaching a file to email, creating a link involves a syntax that looks more like natural writing than machine commands), and very low cost compared to most software, the wiki is showing potential to change how information is handled and built - potential whose precedent seems second only to the Internet itself. At its core, it really does enable people with knowledge and expertise in an area to focus on sharing their knowledge and collaboratively authoring materials. Coupled with the wiki, the growth of Creative Commons licensing is a critical catalyst because it provides an "in-between" full copyright and public domain, and a recognized way to give authors proper credit while legitimizing community editing and improvement so content stays fresh, comprehensive, and useful.

How one person's opposition to the project helped articulate the value of the Wiki

In January 2006, I was contacted by a professional organization for spectroscopy, which wanted to link to The Science of Spectroscopy. After we agreed on the link, etc. the organization's web editor indicated that he opposed the link because he felt that the content in The Science of Spectroscopy was not as extensive as the content in Wikipedia. Here's my response:

"The Science of Spectroscopy is quite different from Wikipedia, and the point of putting material on a wiki is to encourage others to make it more comprehensive, better, etc. as they see fit. As much as I respect Wikipedia, I think that we'd all be ill served if one person decided not to improve one site just because he thinks another one is better. There are people who place a lot of credibility on the fact that people have to request accounts to use The Science of Spectroscopy, which allows us to screen out vandals and those looking to improve their own site rankings in search engines by randomly posting links wherever they can.

While Wikipedia has a large volume of information befitting its role as an encyclopedia, the most important goal of The Science of Spectroscopy is to provide a place and a community where educators can come to work on curriculum together, using simple technology that transcends traditional school and geographical boundaries. Also, the way the wiki categorizes information by Applications, Techniques, and Theory, with Applications visible as the starting point is based on the original goal of the project. We want to engage students by showing how spectroscopy is important to their daily lives, and get them to ask why something works the way it does, so that when we teach theory they see it as meaningful, and more than just numbers or equations."

References Cited

1. O'Haver, Tom. "Integration and peak area measurement." An Introduction to Signal Processing in Chemical Analysis. <<http://www.wam.umd.edu/~toh/spectrum/Integration.html>> February 3, 2006.
2. Elfving, Dave. "A Better Collaborative Interface." Machine Chicago. <<http://www.machinechicago.com/>> February 4, 2006.