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Incorporating Wikipedia in the Classroom to Improve Science Learning and Communication

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Many people today consult Wikipedia to get answers to questions like these:

- How is the flu spread?
- Why is the sky blue?
- What is climate change?

Wikipedia, the digital encyclopedia, has approximately 15 billion page views a month (Anderson, Hitlin, & Atkinson, 2016; "Report Card," n.d.) and is a platform where editors worldwide collaborate to improve content on topics, including the questions above. For students, Wikipedia presents opportunities to collaborate with global editors, engage in discussion about topic presentation, and develop effective science communication skills. In this chapter, we provide an overview of Wikipedia to introduce the platform, outline ways students can contribute to the creation of articles, illustrate scaffolding of Wikipedia-based assignments, share faculty and student examples to highlight benefits and challenges of working with Wikipedia, and offer tips for students and teachers.

Wikipedia is a repository of increasingly reliable information, primarily due to implementation of strict guidelines for contributors. The Centers for Disease Control and Prevention monitor Wikipedia access logs to gauge interest in communicable diseases and forecast potential outbreaks (Generous, Fairchild, Deshpande, Del Valle, & Priedhorsky, 2014), and medical professionals consult Wikipedia articles for reference about particular diagnoses (Haigh, 2011; Heilman, 2011; Purdy, Thoma, Bednarczyk, Migneault, & Sherbino, 2015). This online, open-access encyclopedia bridges the knowledge gap between scientists and the public by providing science information in a comprehensible, neutral format ("Citing sources on Wikipedia," n.d.). Millions of editors contribute to Wikipedia, making scientific information broadly available to anyone with Internet access (Salvaggio, 2016c). Through its straightforward, user-friendly platform, Wikipedia increases public familiarity with science content and the scientific process (Horrigan, 2006; Moy, Locke,

Coppola, & McNeil, 2010). Wikipedia is a unique source of information not only for the public, but also for students learning to communicate scientific information.

Wikipedia supports science communication in several ways. It helps readers comprehend information and contributors clarify the meaning and implications of scientific knowledge. It provides an easily accessible source to research scientific topics and participate in the investigative process. By doing so, Wikipedia increases the general public's awareness, interest, and involvement in science (Burns, O'Connor, & Stocklmayer, 2003). Wikipedia depends on writers and editors who employ the standards of effective scientific communication. University students are well-suited to create and improve the quality of Wikipedia, expanding access to scientific content while developing their own communication skills. Since 2014, 645 students in 32 courses at Louisiana State University (LSU) have edited 912 articles and created 90 new articles on Wikipedia. Collectively, these articles have received over 32.7 million views ("Campaign: Louisiana State University," n.d.). Since 2010, 22,000 students in classrooms throughout the United States have contributed to ~35,000 Wikipedia articles ("How do you measure the difference that open knowledge makes?" 2015); these numbers continue to grow (Dewey, 2016). Students contributing to Wikipedia disseminate course content and share knowledge beyond their academic settings. By delving into scientific topics and publishing information through Wikipedia, students both learn and teach.

In this chapter, we apply the methodology of practitioner inquiry (Liggett, Jordon, & Price, 2011). Practitioner inquiry values the experiential knowledge of practitioners who use reflexive research and dialectical means to investigate and validate new knowledge. A reflexive practitioner critiques through encounters with others, including related literature and observation (Qualley, 1997). We apply practitioner inquiry to class observations and student samples from several semesters at LSU, showing how students can develop skills in science communication by contributing to Wikipedia. We share feedback from faculty and students who have participated in Wikipedia-based assignments (first names or pseudonyms were used when referencing course work, with permission of students and faculty). We share examples of assignments demonstrating how students develop an appreciation for and understanding of the sciences, develop self-confidence by participating in scientific conversations, and engage global audiences through Wikipedia content creation and collaboration.

The Wikipedia Platform

One daunting aspect for students (and perhaps teachers) who use Wikipedia is in the initial stage, familiarizing themselves with the Wikipedia interface. Wiki Ed is a non-profit organization that provides tutorials for professors and students to help increase their confidence in contributing to

Wikipedia. Wiki Ed aims to improve student learning in higher education by partnering with instructors, supporting student-driven Wikipedia contributions that enrich course learning objectives and content access (Wiki Education Foundation homepage, n.d.). Eileen, a student in the course Natural Disturbances and Society at LSU said,

> As I was beginning the assignment, I was far more than apprehensive. The editing tools on Wikipedia look a far cry from user friendly… [T]he workshops and online training were useful and necessary. These are certainly two or three hours that are necessary for becoming familiar with and mastering the editing process.

Providing an introduction to the Wikipedia platform, including the guidelines for Wikipedia use and publication, is a key step in helping student contributors. The guidelines are centered on Wikipedia's three core content policies: contributions must have a neutral point of view, be supported by verifiable sources, and include no original research ("Core content policies," n.d.). Design and layout consistency permits edits to any page, further facilitating Wikipedia's concept of open, crowdsourced knowledge generation. Article pages, found in the Wikipedia mainspace, contain neutral, topic-specific information. Well-written article pages, devoted to notable topics, are focused, organized, and verifiable, and include appropriate graphics. Article pages are organized by a set of tabs outlined in the Anatomy of Wikipedia section, including Talk.

The Talk page is an integral component of Wikipedia where students can collaborate with each other, as well as other editors, to discuss topics, offer advice, and resolve disagreements. Students new to Wikipedia can examine Talk pages on articles of interest to see how these online conversations help to shape or modify existing articles (Jenkins, Purushotma, Weigel, Clinton, & Robison, 2009). For example, editors may discuss page content or reference suggestions. Comments, questions, or ideas added to Talk pages require editors to "sign" their posts with four tildes (~), leaving a Username and timestamp. This exchange is recorded on the Talk page, providing students with artifacts of interactions and documenting differences and consensus in knowledge construction. Evaluating Talk pages allows students to develop a sense for specific guidelines on Wikipedia and gain experience in "netiquette" to be effective contributors (Brailes, Koskinas, Dafermos, & Alexia, 2015).

Summary and additional information about the Wikipedia platform, including descriptions of key features such as the Sandbox or Stubs, can be found in the list below.

Anatomy of Wikipedia

The anatomy of Wikipedia is symmetric, allowing for ease in contribution and discussion. Key terms used on the platform are defined below.

Article pages: Article pages are found in the Wikipedia mainspace. Well-written article pages, devoted to notable topics, are focused, organized, and verifiable; written in a neutral style; and include appropriate graphics.

Edit: The Edit tab enables an editor to add and modify content in Wikipedia. It allows the editor to input information similarly to word processing software. Editors concisely note contributions in an Edit Summary, where each addition is recorded lending to transparency. The Edit Source tab is another option for editing, allowing for edits to be made in wikicode. Editors will find access to formatting options such as bold, italics, and a citation wizard in both the *Edit* and *Edit Source* tabs.

Read: The Read tab provides a view of the article in its current state. Consumers of Wikipedia articles typically see this view.

Sandbox: Every Wikipedia User has a Sandbox in which to draft and organize contributions and test code. The Sandbox has fewer restrictions compared to the live article pages, though civility is still required because the contents can be viewed by anyone on Wikipedia. The Sandbox also has an associated Talk page, a useful space for providing peer and instructor feedback and critique before content goes live in the mainspace of Wikipedia.

Stub: A Stub is a short, undeveloped article on a notable topic that does not provide adequate coverage. Stubs are pages that students may choose to modify or enhance for a course assignment.

Talk pages: Talk pages are where Wikipedia editors discuss topics. Talk pages are associated with each Wikipedia Article, User, and User Sandbox pages where conversations between editors occur. Comments, questions, or ideas added to Talk pages require editors to "sign" their posts, leaving a Username and timestamp.

User pages: User pages provide space to organize new content and facilitate interaction with other editors. User pages have an associated Talk page where editors can converse about edits, ask questions, provide resources, resolve conflicts, and praise each other's work.

View history: The View history tab allows a user or editor to review the development of any Wikipedia page. This tab is particularly useful to examine how an article has evolved with updated information, research, etc. From this tab, page statistics can also be accessed, providing additional information about interest in the topic.

Wikipedia-Based Assignments

Wikipedia-based assignments range from making small edits, such as copyediting a series of science-related topics, adding citations, or inserting internal links to existing Wikipedia pages, to more substantial contributions, such as adding paragraphs of information to existing pages, updating content to convey research developments, creating new article pages, or adding visuals or audio. In this chapter, we offer three

assignments used over multiple semesters at LSU that showcase the important role Wikipedia can play in science communication and illustrate the benefits to students. These assignments include exploring referencing and plagiarism in Wikipedia articles, contributing content, and critiquing content. These assignments can stand alone or, if assigned over the course of a semester, provide scaffolding for a major project. Such assignments familiarize students with how to contribute to Wikipedia as they build scientific knowledge. The assignments were designed to aid students in developing the following skills:

- Assessing accuracy of content
- Identifying needs of a target audience
- Using online technology and netiquette
- Applying and developing information literacy in the sciences
- Understanding science concepts
- Integrating information from various courses and sources
- Evaluating neutrality in resources and writing styles
- Generating, revising, and editing written communication
- Collaborating effectively with peers and editors

For each assignment, we briefly describe its objectives, include student examples, and indicate the benefits to students. The main course used to illustrate Wikipedia assignments is Natural Disturbance and Society, a science course for non-science majors taught at LSU by Dr. Becky Carmichael. The course is designed to introduce the principles of disturbance ecology, explore how natural disturbances shape ecosystems, examine ways humans affect and are affected by disturbance events, and introduce scientific methodology and principles. During the course, students selected several Wikipedia articles about natural disturbances or natural disasters, evaluated the articles' current state, edited the articles to improve clarity, and revised their contributions based on feedback from their peers, instructor, and global Wikipedia editors. Additional LSU courses that employed Wikipedia assignments are discussed to emphasize skills developed or show other assignment options.

Assignment 1: Exploring Existing Wikipedia Articles for Referencing and Plagiarism

Students new to science are often unfamiliar with how to find and cite peer-reviewed resources. Contributing to Wikipedia can help them develop these skills. Ideally, every sentence in Wikipedia should be verifiable and referenced ("Citing sources on Wikipedia," n.d.). Because such documentation is missing from many Wikipedia pages, students have several opportunities to identify statements needing verification. Through the processes of statement verification, students gain skills

using tools such as Google Scholar or Web of Science. They also learn how to discern the differences among "gray" literature, peer-reviewed scientific articles, tertiary references, and online sources. Along with differentiating the value of sources, students can gauge the neutrality of information, sorting verifiable data from unsupported opinions.

In the course Natural Disturbance and Society, students are tasked to locate resources related to a chosen disturbance event. However, students have difficulty determining whether sources are appropriate and struggle to retain meaning of content without directly copying the original text. For example, one student located information on a recent hurricane event from an online source, but inserted the content almost verbatim without attributing text to the original author. Other students had difficulty ascertaining reliable content, selecting blog posts or advertisers over peer-reviewed scientific journals or reputable news agencies as references.

Challenges faced by students necessitate "just-in-time" instruction on reference reliability, content incorporation, and rules regarding plagiarism (including Wikipedia standards). In the Natural Disturbances course, students are provided with criteria for evaluating reliable sources. Students then assess the reliability of several sources, comparing popular news media outlets (BBC News, NPR), governmental agencies (National Aeronautics and Space Administration (NASA), National Oceanic and Atmospheric Administration (NOAA)), organizations (Greenpeace, Red Cross), and scientific journals (*Nature*, *Science*). Discussions typically center around accuracy of content, biases and neutrality, motive for publication, and intended audience. In one lesson, students ranked example sources from most to least reliable to gain an appreciation for source bias and reliability. Students also compared content among these sources, exploring how information was presented to different audiences. Next, students learn how to locate reliable scientific references. Many times, searches for scientific literature begin on Google, but during this in-class exercise, the search was expanded to library databases, such as Web of Science. With these resources at hand, students reviewed Wikipedia's criteria for paraphrasing, identifying what is considered ideal incorporation of new information, when to use direct quotation, and how to use appropriate citation metrics ("Citing sources on Wikipedia," n.d.). Such exercises initiate discussion on the ways publication guidelines differ across journals and disciplines.

After developing new skills for assessing source reliability, students assess a Wikipedia article for existing statements requiring citation. In a recent semester, students copied statements into a Google search and attempted to locate an original reference. Many students discovered that content on Wikipedia was repeatedly plagiarized. As a class, students scrutinized the existing pages, discussing how to paraphrase statements under Wikipedia guidelines. Every Wikipedia User has a Sandbox in

which to draft and organize contributions and test code. When plagiarism or close paraphrasing were located, students drafted revisions in their Sandboxes and noted changes they made on the article's Talk page (see *Anatomy of Wikipedia*). The following revision example from the article "Pine processionary" (2016) is the work of Connor, who corrected plagiarized statements from the source, www.impactproject.eu. In the revised statement, Connor identified alternative ways to communicate information from this source.

> Before: "The typical cylindrical egg masses range in length from 4 to 5 cm."
>
> After: "The eggs of the Moth are laid in cylindrical bodies ranging from 4 cm to 5 cm in length."

Connor's revision conforms to Wikipedia guidelines for paraphrasing and use of quotations. Contributors to Wikipedia are encouraged to summarize an original author's work, limiting direct quotations to short statements. In the revision, Connor synthesized the necessary components and summarized the ideas in his own words, demonstrating his understanding of the original content and methods for removing plagiarism.

Understanding where to locate sources and how to evaluate information are integral components of building literacy in a field. Relevant, reliable sources are required to support statements and build arguments. Wikipedia assignments challenge students to locate appropriate scientific articles they can use to cite new content and translate ideas to the broader Wikipedia audience. Dr. Cameron Thrash at LSU, who uses Wikipedia for his course Prokaryotic Diversity, found,

> The primary challenge [for students contributing to Wikipedia] is identifying all the relevant information. This is the process I most want them to experience…because that's what we do as scientists both in writing papers to report our results, but also in creating background for our grant proposals.

Colleen, a student in Dr. Thrash's course, said that she doubted her ability to read scientific papers and apply their content to Wikipedia:

> I not only had to read the papers but read them quickly and understand what the researchers were trying to communicate. However, the more papers I read the better I was able to understand them and recognize key information. … A large part of the process was absorbing the information from the scientific papers, then figuring out how to report [it] … with proper citations to avoid plagiarism.

Wikipedia assignments require students to develop literacy in different styles and genres of scientific communication and help them to increase confidence in reading and translating scientific information. As another student explains, "I can use this in the future … now I know how to find scientific sources through Wikipedia and check for validity and also be involved in the scientific community."

Assignment 2: Contributing to Wikipedia

Contributing to Wikipedia provides an opportunity for students to improve their writing skills. Writing engages students in the construction of coherent content through critical analysis of information and is one of the best ways to learn new material (Barkley, Cross, & Major, 2005). Purposeful writing assignments require that students conduct research to expand their knowledge and information literacy and develop an understanding of how experts in the discipline construct content and share it with an audience (Bean, 2011). When contributing to Wikipedia, students must consider course content, connect new information to familiar understanding, and evaluate novel ideas in the context of foundational disciplinary concepts. Traditionally, students have worked toward these goals through term papers and lab reports. By reframing the class term paper using Wikipedia contributions, students expand learning, evaluate what information to share, and engage in a global exchange of knowledge, informing a massive audience on specialized topics (Salvaggio, 2016b). The following three examples show how an assignment can be designed to involve different levels of content creation by students.

Small Contributions

Students in Natural Disturbances and Society are tasked to contribute content to a series of disturbance articles on Wikipedia based on research in primary literature. These small contributions consist of a few sentences that connect the science or mechanisms of how a disturbance occurred to a specific incidence and build available information on the disturbance type. Connor, the student quoted above, added the following excerpt to the article "Pine processionary" (2016). The contribution provides Wikipedia readers with details on the disturbance caused by pine processionary caterpillars, filling content gaps and supporting the information with citations from peer-reviewed scientific journal articles.

> The pine processionary caterpillar is responsible for most of the defoliation of southern Europe (Li, Daudin, Piou, Robinet, & Jactel, 2015). Although pines are most susceptible to the caterpillar,

> other trees such as larches are also vulnerable. The caterpillars can completely defoliate trees if large quantities are present.
>
> (Forestry Commission, 2017)

Another Natural Disturbance and Society student examined the article "2013 Colorado floods" (2013) and identified ways to expand knowledge of the event. The student noticed the article was missing information related to the United States federal government shutdown and its implications on relief efforts, a topic that had been discussed in class. The student added the following excerpt connecting content from the course with this event:

> … The [United States federal government] shutdown compromise signed on October 17, 2013 includes funding for Colorado relief efforts, specifically referencing Rep. Gardener's bill H.R. 3174; 113th Congress. The cap typically set at $100 million has been raised to $450 million in light of Colorado's current conditions. It is not uncommon for this cap to be raised for disaster struck areas such as those states hit by Hurricane Sandy or Hurricane Katrina.

In this excerpt, the student identifies omitted details and provides context for a reader to better grasp what occurred during the event. Further, the student recognizes the need to include a hazardous impact section describing the potential disruption to clean water due to flooding.

> Structures located in high risk flood zones were soon inundated. Sewage treatment plants affected by the flood waters released 20 million gallons of raw sewage as well as 150–270 million gallons of partially treated sewage, as estimated by the State health department. What resulted was higher levels of *E. coli*, some as high as 472–911 colonies per millimeter of water (126 colonies per millimeter of water is considered unsafe) (Denver Post, 2013). The Colorado Oil and Gas Conservation Commission (COGCC) reports that oil lines and containment facilities failed and leaked a total of 1,027 barrels of 43,134 gallons of oil. The COGCC is monitoring 13 substantial leaks as of October 8, 2013.
>
> (Colorado Oil and Gas Commission, 2013)

By adding content to Wikipedia, students become familiar with the editing process, observing how their written contributions are interpreted by a larger community of informed editors outside academia.

Substantial Contribution

Substantial contribution to Wikipedia can be as simple as locating and expanding a Stub, short undeveloped articles on a notable topic.

Students can select one of the many designated Stub articles from a variety of topics on Wikipedia. This encourages students to take ownership of information learned in class. Students must identify gaps in the content currently available, recognizing missing information, and clarifying ideas. Although the exercise can be challenging, it has rewards for students and the online community alike. Creation of new content requires students to cover a topic comprehensively, identifying subsections, choosing citations, selecting or generating relevant images, while following Wikipedia guidelines for a neutral style.

Several students in the Natural Disturbance and Society course elected to expand existing Wikipedia Stub articles. This assignment required students to research their topics, seek updated references, consult the Article Talk page to access what additions were needed, and incorporate new content.

Brad elected to expand the Stub page on the Morris J. Berman oil spill. The article, created in January 2010, consisted of only 2,281 characters and two references (see Figure 13.1). Beginning in his Sandbox, Brad added more than 16,000 characters to existing content and expanded the article to address effects of the oil spill on the environment, tourism, and wildlife (see Figure 13.2). Brad's addition was not only substantial, but also earned a place in the "Did you know…?" section on the main page of Wikipedia, receiving 875 views in one day. This was rewarding for the student and demonstrated global readers' interest in the topic.

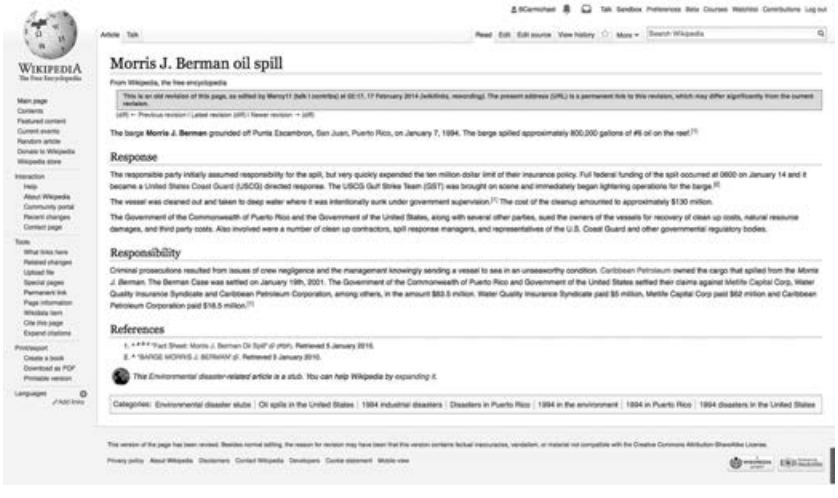


Figure 13.1 The "Morris J. Berman oil spill" Wikipedia article as a stub before Ben's contributions ("Morris J. Berman oil spill," 2014a). CC BY-SA 3.0. Wikimedia Foundation, Inc. (WMF) Marks are trademarks of WMF, the authors of this chapter are independent of WMF, and the WMF Marks are used under license.

Figure 13.2 The "Morris J. Berman oil spill" Wikipedia article after Ben's contributions. ("Morris J. Berman oil spill," 2014b). CC BY-SA 3.0. Internal images: "Condado Beach," (2012), CC BY-SA 2.0; "Brown booby," (2005), CC BY-SA 3.0. Wikimedia Foundation, Inc. (WMF) Marks are trademarks of WMF, the authors of this chapter are independent of WMF, and the WMF Marks are used under license.

New Article Creation

Dr. Alex Webb, University of Hong Kong, used Wikipedia assignments as an alternative to term papers in two geology courses (Plate Tectonics and Evolution of the Terrestrial Planets) while a professor at Louisiana State University. Creating a new Wikipedia article was a semester-long project that consisted of four sections: selecting a topic, drafting a contribution in the student's Sandbox, moving a revised contribution into Wikipedia (making it live), and interacting with the Wikipedia community. Each section was sequenced to allow for development of the article, instructor and peer-review, and feedback from global editors. Students had to select topics relevant to the course at the beginning of the semester and have a polished draft within the first month to allow time for interaction with other students in the class and the global community.

Success of the assignment hinged on students selecting appropriate topics, providing feedback on each other's projects, and understanding audiences. Students identified topics by conducting Wikipedia searches for key terms and determining those that did not have pre-existing articles. Once Dr. Webb approved their topics, students drafted articles in their Sandboxes. Each class member critiqued three of their fellow classmates' articles at the draft and live stages, evaluating a total of six different topics. Dr. Webb also provided feedback on the students' article Talk pages, modeling constructive feedback for the class.

The goal of Dr. Webb's Wikipedia assignment was to provide students with a publication-like experience based on the scientific method that would foster deeper learning of topics and ideas covered in the course. Students had a high-stakes investment in the outcome of the project because they knew their work would be visible to a global audience. For the Fall 2014 Plate Tectonics class, 21 students created 25 new Wikipedia articles, which collectively received more than 454,000 views. Student additions included the article "Lwandle Plate" (2014), which received almost 4,000 views on the day it was featured in the "Did you know…?" section on the main page of Wikipedia.

The assignment engaged students in the scientific method: asking questions, evaluating, problem-solving, and providing evidence for ideas at multiple steps. The result was better science communication and understanding for both the class and the Wikipedia community.

Assignment 3: Collaborating, Critiquing, and Interacting

The advancement of science depends on the collaborative construction and development of scientific knowledge. Exploration and experimentation in the sciences are rarely individual efforts (Hara, Solomon, Kim, & Sonnenwald, 2003). Instead, many people collaborate in the process of communicating science, contributing ideas, discussing theories,

challenging results, and shaping the presentation of findings. The peer-review process, which is at the foundation of science communication, is by its very nature collaborative, calling upon those with expert knowledge to assess the accuracy and reliability of information.

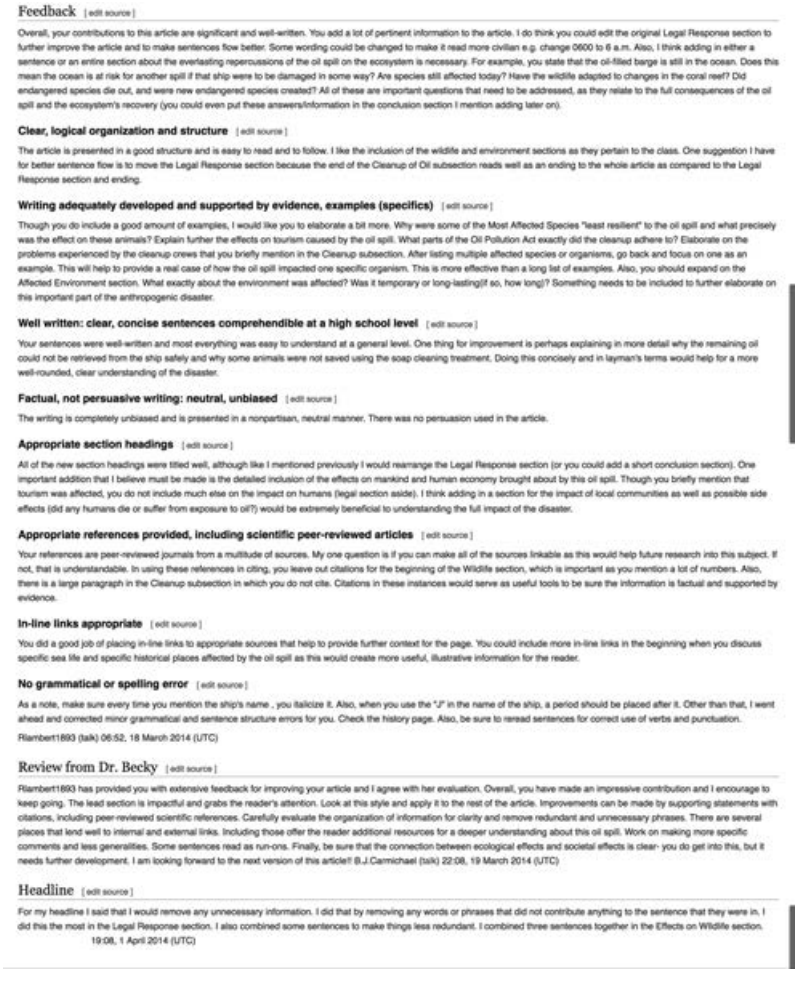
Collaborating on a group project is a key activity that helps students develop communication and problem-solving skills, teaches conflict resolution, increases academic achievement, and gives students a more positive outlook on learning (Colbeck, Campbell, & Bjorklund, 2000; Forte, 2015; Smith & MacGregor, 1992). Furthermore, collaborating on a project creates a knowledge community in which each contributor can advance the overall project. In exchange for collaborative participation, individuals build confidence in their understanding of a topic (Smith & MacGregor, 1992) and become part of a network of people with shared interests.

Wikipedia is a collaborative group project that fosters participation on a global scale. It draws upon a large-scale peer review process where a diverse community of contributors with a variety of expertise helps validate content (Kaplan & Haenlein, 2014). This collective experience improves the quality of scientific content available online by employing crowd-sourced knowledge construction.

Including a peer-review component in a Wikipedia assignment is an excellent way to facilitate collaboration. As student editors construct contributions in their Sandboxes, classmates can offer critiques on the associated Sandbox Talk page. Rubrics provided by the instructor or designed collaboratively by the class help students learn to critique content systematically and shape constructive assessment to improve contributions. After editing online, classmates can meet face-to-face to share their thoughts about content and organization, offering opportunities to address different reactions to feedback while assisting student editors. Through feedback and revision, students develop an appreciation for the peer-review process, learn to accept criticism, and modify their contributions to meet standards of scientific rigor. Students also learn to provide written constructive feedback, further increasing their ability to participate in knowledge construction. Giving and receiving peer feedback allows students to hone their critical skills in a supportive environment. This process continues to reinforce students' sense of authority by interacting with others to construct knowledge (Camihort, 2009). Being able to constructively exchange feedback while supporting and defending their stance is necessary for students to be successful in science (more about feedback training see Chapter 12).

This review component was interwoven throughout the Natural Disturbance and Society course. Each student was randomly assigned to review two of their classmates' articles and provide critiques based on criteria outlined in a rubric. Dr. Carmichael reviewed both student contributions and critiques, providing an additional layer of feedback.

Students in the class demonstrated excellent skills at providing feedback. One student, Rachel, said it was her "duty to make a difference, not only with her own contributions, but also to support her fellow classmates." Figure 13.3 illustrates the quality of Rachel's feedback, where she summarized the overall strengths of her classmate's contribution, highlighted specific areas to address during revision, and provided a detailed critique based on the assignment rubric. While students in the class were only required to provide feedback for two of their peers, Rachel and others enjoyed the exercise and joined other online contributors in improving contributions.



Feedback [edit source]

Overall, your contributions to this article are significant and well-written. You add a lot of pertinent information to the article. I do think you could edit the original Legal Response section to further improve the article and to make sentences flow better. Some wording could be changed to make it read more civilian e.g. change 0600 to 6 a.m. Also, I think adding in either a sentence or an entire section about the everlasting repercussions of the oil spill on the ecosystem is necessary. For example, you state that the oil-filled barge is still in the ocean. Does this mean the ocean is at risk for another spill if that ship were to be damaged in some way? Are species still affected today? Have the wildlife adapted to changes in the coral reef? Did endangered species die out, and were new endangered species created? All of these are important questions that need to be addressed, as they relate to the full consequences of the oil spill and the ecosystem's recovery (you could even put these answers/information in the conclusion section I mention adding later on).

Clear, logical organization and structure [edit source]

The article is presented in a good structure and is easy to read and to follow. I like the inclusion of the wildlife and environment sections as they pertain to the class. One suggestion I have for better sentence flow is to move the Legal Response section because the end of the Cleanup of Oil subsection reads well as an ending to the whole article as compared to the Legal Response section and ending.

Writing adequately developed and supported by evidence, examples (specifics) [edit source]

Though you do include a good amount of examples, I would like you to elaborate a bit more. Why were some of the Most Affected Species "least resilient" to the oil spill and what precisely was the effect on these animals? Explain further the effects on tourism caused by the oil spill. What parts of the Oil Pollution Act exactly did the cleanup adhere to? Elaborate on the problems experienced by the cleanup crews that you briefly mention in the Cleanup subsection. After listing multiple affected species or organisms, go back and focus on one as an example. This will help to provide a real case of how the oil spill impacted one specific organism. This is more effective than a long list of examples. Also, you should expand on the Affected Environment section. What exactly about the environment was affected? Was it temporary or long-lasting(if so, how long)? Something needs to be included to further elaborate on this important part of the anthropogenic disaster.

Well written: clear, concise sentences comprehendible at a high school level [edit source]

Your sentences were well-written and most everything was easy to understand at a general level. One thing for improvement is perhaps explaining in more detail why the remaining oil could not be retrieved from the ship safely and why some animals were not saved using the soap cleaning treatment. Doing this concisely and in layman's terms would help for a more well-rounded, clear understanding of the disaster.

Factual, not persuasive writing: neutral, unbiased [edit source]

The writing is completely unbiased and is presented in a nonpartisan, neutral manner. There was no persuasion used in the article.

Appropriate section headings [edit source]

All of the new section headings were titled well, although like I mentioned previously I would rearrange the Legal Response section (or you could add a short conclusion section). One important addition that I believe must be made is the detailed inclusion of the effects on mankind and human economy brought about by this oil spill. Though you briefly mention that tourism was affected, you do not include much else on the impact on humans (legal section aside). I think adding in a section for the impact of local communities as well as possible side effects (did any humans die or suffer from exposure to oil?) would be extremely beneficial to understanding the full impact of the disaster.

Appropriate references provided, including scientific peer-reviewed articles [edit source]

Your references are peer-reviewed journals from a multitude of sources. My one question is if you can make all of the sources linkable as this would help future research into this subject. If not, that is understandable. In using these references in citing, you leave out citations for the beginning of the Wildlife section, which is important as you mention a lot of numbers. Also, there is a large paragraph in the Cleanup subsection in which you do not cite. Citations in these instances would serve as useful tools to be sure the information is factual and supported by evidence.

In-line links appropriate [edit source]

You did a good job of placing in-line links to appropriate sources that help to provide further context for the page. You could include more in-line links in the beginning when you discuss specific sea life and specific historical places affected by the oil spill as this would create more useful, illustrative information for the reader.

No grammatical or spelling error [edit source]

As a note, make sure every time you mention the ship's name , you italicize it. Also, when you use the "J" in the name of the ship, a period should be placed after it. Other than that, I went ahead and corrected minor grammatical and sentence structure errors for you. Check the history page. Also, be sure to reread sentences for correct use of verbs and punctuation.

Rlambert1893 (talk) 06:52, 18 March 2014 (UTC)

Review from Dr. Becky [edit source]

Rlambert1893 has provided you with extensive feedback for improving your article and I agree with her evaluation. Overall, you have made an impressive contribution and I encourage to keep going. The lead section is impactful and grabs the reader's attention. Look at this style and apply it to the rest of the article. Improvements can be made by supporting statements with citations, including peer-reviewed scientific references. Carefully evaluate the organization of information for clarity and remove redundant and unnecessary phrases. There are several places that lend well to internal and external links. Including those offer the reader additional resources for a deeper understanding about this oil spill. Work on making more specific comments and less generalities. Some sentences read as run-ons. Finally, be sure that the connection between ecological effects and societal effects is clear- you do get into this, but it needs further development. I am looking forward to the next version of this article!! B.J.Carmichael (talk) 22:08, 19 March 2014 (UTC)

Headline [edit source]

For my headline I said that I would remove any unnecessary information. I did that by removing any words or phrases that did not contribute anything to the sentence that they were in. I did this the most in the Legal Response section. I also combined some sentences to make things less redundant. I combined three sentences together in the Effects on Wildlife section.
19:08, 1 April 2014 (UTC)

Figure 13.3 Rachel's feedback provided for the article "Morris J. Berman oil spill" during the Spring 2014 semester. An assignment rubric was used to organize critique ("User Sandbox Talk Page," 2014). CC BY-SA 3.0.

Shyrece, another student in the class, said, "The project helped me understand course material because I could not fake it. If what I said was half-baked bologna, I would get called out. I actually had to understand my topic and be able to effectively convey the information. The Wiki[pedia] project pushed me to understand the material better than any test."

Along with peers, students may receive comments and suggestions from individuals around the globe about ways to improve their Wikipedia contributions. Though the experience can be intimidating, it allows students to participate in the publication experience while learning course content. This exchange teaches students how to adopt critical feedback, leading to improved contributions. Students learn about the process of scientific writing and publication, personally interacting with a community of editors, which in turn builds confidence in topic knowledge and prepares them for interactions with Wikipedia, scientific, and social communities at large. While critique by the global audience is not automatic, when provided, it helps reinforce the importance of accuracy of contributions and increases the stakes of these assignments. For example, the Talk page of the "2012 Kamaishi earthquake" article (2014) documents an exchange between a student and an editor, who points out the lack of relevance of the source.

> I added information that researchers found could have led to the 2012 earthquakes in Kamaishi. This journal article can be found here [on the Talk page]…
>
> Student editor

> I'm not clear that there is any implication that they were in any way precursors to the 2012 event. The paper doesn't mention this at all. Without a clearer link I think that this section lacks relevance.
>
> Wikipedia editor

Students in Dr. Alex Webb's Plate Tectonics course also received feedback from a Wikipedia editor who is interested in geology.

> I am happy to report that this appears to be your own work made without copying others' writings. This would be much better with some diagrams. Examples of real structures would be great. It would be good to have more references. At least one is a review, and the other is highly relevant. 5 or 6 references could be the right number to match your peers! "surface of the crust" is a bit confusing, as salt lakes will have a crust, but do you mean crust of the Earth?
>
> User: Graeme Bartlett

Because Wikipedia is visible to anyone with an internet connection, students sometimes have concerns about how content they add will be received. Sierra, who created a Wikipedia article as an independent project for a bacterial ecology course, said, "I did not enjoy the feeling of impending doom that comes with submitting anything [to Wikipedia] and thinking it would get pulled/deleted, come under super harsh criticism from 'internet trolls.'" Breea, a Natural Disturbance and Society student, had the same concern: "I was hesitant to edit a Wikipedia article because it is something that can be accessed by millions of people worldwide, and I was worried about making a mistake or getting a citation from the Wikipedia administration." Despite these reservations, students' recognition that their work is open to the public encourages them to develop a better product, and the skills they gain learning to communicate effectively with other members of the Wikipedia community help them become better at receiving and responding to criticism. Receiving editorial critiques to students' contributions is real-world training for the rigorous scrutiny and reviews that science writers face professionally.

Benefits of Wikipedia Assignments

Students and professors alike recognize the benefits of using Wikipedia lessons in the classroom. Given a choice of technologies, including Google tools and TED ED Lessons, 29% of students in Natural Disturbance and Society courses over four semesters reported enjoying using Wikipedia and planned to use it again in the future. Additionally, Wiki Ed reports 97% of instructors would teach with Wikipedia again because it improved literacy skills in a collaborative setting (Salvaggio, 2016a). Dr. Thrash cites multiple course goals as being met through the Wikipedia project: "namely developing critical thinking ability, improving reading comprehension with primary literature, and exposing students to modern technological elements of information transfer."

As Breea, the student quoted above, states,

> …having to be responsible for the information to the extent of creating your own content for the Wikipedia articles is a more challenging and more rewarding experience [than traditional classroom assessments such as exams]. It involves understanding the course material at some level, conducting research on the material, and eventually, writing on the topic for other users, which requires a higher level of understanding. To truly contribute to an article, one cannot simply regurgitate information from class or a source; to make the information accessible to other users, it requires synthesis, which requires a high level of understanding.

Students as Authorities

Students often struggle with feeling they are not authorities on a topic, and Wikipedia provides an opportunity to increase their sense of authority as scholars (Salvaggio, 2016c). Individuals who contribute to Wikipedia show increased self-confidence in their grasp of subject matter (Yang & Lai, 2010), a trait documented in LSU students. As contributors, students develop self-confidence in their understanding of science and ability to employ scientific material to communicate. Shyrece, a student quoted above, reported "becoming more familiar with scientific jargon and research-style writing" by contributing to Wikipedia. Students also gain an appreciation for their current breadth of knowledge and can recognize what remains to be understood. Another student, Eileen, said that editing Wikipedia "transformed" the way she consumed information, helping her become more adept at verifying the credibility of information. By contributing to Wikipedia, students increase self-confidence in understanding course content and are more willing to share their knowledge with a large audience.

Higher Level Learning Strategies

The Association of American Colleges and Universities (Kuh, 2008) recognizes that the integration of high-impact practices (HIPS) promotes deeper learning of content and strengthens development of information literacy. Wikipedia assignments provide an opportunity to promote deeper, interdisciplinary learning. Learning occurs when students combine ideas from multiple classes and publicly demonstrate synthesis and application of knowledge in a project that evolves and fosters discussion beyond the classroom setting (Kuh & O'Donnell, 2013; Prince & Felder, 2007). Applying knowledge and skills in the digital landscape capitalizes on students' critical thinking capabilities and increases the likelihood students are engaged in HIPS. Such assignments incorporate several levels of Bloom's Taxonomy, including understanding, analyzing, evaluating, and creating (Perkins, 2008) information. Further, Wikipedia-based assignments can be designed to address recall and reproduction, skills and concepts, strategic thinking, and extended thinking, as described in Webb's Depth of Knowledge (Aungst, 2014; Webb, 1997). Such assignments challenge students to think critically through content creation, provide opportunity for students to draw connections among ideas learned in class, justify contributions, and produce new work to expand understanding.

Tips for Incorporating Wikipedia Successfully in the Classroom

Faculty who elect to use Wikipedia assignments in their courses must plan carefully and be invested in all stages of the process to help students achieve desired learning outcomes. The following tips for designing

effective Wikipedia assignments are based on Wiki Ed suggestions, Wikipedia protocols, and our experience using Wikipedia in the courses.

Creating a Course Page via the Wiki Education (Wiki Ed) Dashboard

The goal of Wiki Ed is to recognize the value of student research by making scholarship available beyond the classroom, enabling students to share knowledge with the global community. Connecting to Wiki Ed ensures access to online training tools, instructor orientation, editing resources, and personal assistance from knowledgeable staff. Students can access online resources and handouts such as "Editing Wikipedia," "Moving out of your Sandbox," and discipline-specific resources, like "Editing Wikipedia articles on Environmental Sciences," which are all available at wikiedu.org. Wiki Ed offers educators assistance with assignment design and evaluation, online and printed training resources, and metrics to track student involvement. An important resource for Wikipedia-based assignments is Wiki Ed Dashboard. The Dashboard is a landing spot for all members of a class, housing an overview of course assignments, resources and tutorials that guide students through each step of the project, and a platform for quick interaction with students, including direct access to their Sandboxes and articles to which they are contributing. Use of the Wiki Ed Dashboard also connects professors and students to Wiki Ed staff, facilitating contact when issues arise.

Ensuring Students have Individual Wikipedia User Accounts to Track Their Contributions

Individual student accounts help professors track student progress, provide professors with direct access to students' content additions and modifications, and validate students as Wikipedia editors.

Establishing Clear Expectations and Rubrics

Expectations for Wikipedia activities should be clearly outlined at the beginning of the course and accompanied by a rubric that will be used to evaluate contributions. Reminding students to focus on content development in their Sandboxes helps ensure appropriate information is added. Coding and formatting issues can be resolved later.

Participating in the Editing Process with Students and Testing the Projects

Instructors should be involved in all facets of the assignment, from editing articles to interacting with global editors, to model excitement and engagement for the students. Remember: incorporating Wikipedia-based

assignments in the classroom is a process and, just like writing a paper, flexibility and critique are necessary.

Searching for Topics to Determine If They Exist in Wikipedia

Students should search for their intended topics via Google and Wikipedia before creating new article pages. Google searches provide a more in depth, thorough search compared to the Wikipedia internal search. Searching an intended topic also helps students discover possible knowledge gaps to determine if there is room to edit and improve the selected topic. Searching first saves energy later.

Checking in with Students Periodically to Monitor Their Progress

Short, in-class conversations encourage students to ask questions and voice concerns about their assignment. These check-ins can address editing concerns or serve to clarify scientific concepts.

Including Peer-Review on the Sandbox Talk Page

Students can be assigned to edit each other's articles before they go live. Participating in peer-review teaches students to give constructive feedback on content and construction, while building a supportive classroom community. Such activities prepare students for addressing comments from global Wikipedia editors and give them practice justifying their contributions.

Moving Student Contribution into the Live Space of Wikipedia

Student work should not remain in Sandboxes; rather it should be placed in the live article as soon as possible to receive feedback from editors and expose students to the editing process. To increase interaction, consider moving student contributions into the Wikipedia mainspace at least a month prior to the end of the semester.

Encouraging Interaction with Global Wikipedia Editors

Experts and enthusiasts edit Wikipedia on a range of topics. Notice which specific editors are contributing to your students' pages and reaching out to them via their User Talk pages. Some editors may be willing to provide feedback to your students or even suggest existing pages that require attention.

Providing Opportunities for Students to Reflect on the Process

Receiving student feedback can help professors streamline and modify the Wikipedia assignment for future courses. Short, low-stakes reflection essays are ideal for students to share thoughts about the process, examine how their skills have changed, and provide suggestions to improve the experience for future student editors.

Conclusions

Wikipedia is a unique resource and, when incorporated into the classroom, gives students ownership of their work, improves their understanding of scientific topics, strengthens communication skills, and builds their confidence to participate in science.

As Wikipedia contributors and editors, students work to highlight points of confusion in existing course content, crafting new ways to illustrate concepts. An integral part of the learning process is researching what is currently known. Students combing through the aggregation of references (Cox, 2014) within Wikipedia articles are challenged to decipher meaning and determine if the content agrees with external peer-reviewed scientific research (see Assignment 1). As students explore article content, they develop the credentials to evaluate existing information and contribute new information (see Assignment 2). Content creation requires that students locate and assess written material, hone their skills in presenting information, and adopt and provide critical feedback (see Assignment 3). Wikipedia provides an authentic opportunity for students to participate in the collaborative process of science communication, while concurrently increasing the accuracy and reliability of Wikipedia.

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