

From Wikipedia to the Classroom: Exploring Online Publication and Learning

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Abstract: Wikipedia represents an intriguing new publishing paradigm—can it be used to engage students in authentic collaborative writing activities? How can we design wiki publishing tools and curricula to support learning among student authors? We suggest that wiki publishing environments can create learning opportunities that address four dimensions of authenticity: personal, real world, disciplinary, and assessment. We have begun a series of design studies to investigate links between wiki publishing experiences and writing-to-learn. The results of an initial study in an undergraduate government course indicate that perceived audience plays an important role in helping students monitor the quality of writing; however, students' perception of audience on the Internet is not straightforward. This preliminary iteration resulted in several guidelines that are shaping efforts to design and implement new wiki publishing tools and curricula for students and teachers.

Wikipedia: This Just Doesn't Make Sense

A perplexing phenomenon has emerged online. Thousands of individuals have come together in one online community with the goal of building an encyclopedia of all human knowledge. This community relies on the work of volunteers, does not solicit contributions from experts, employs no formal review process, and allows people to change the content of the encyclopedia at any time *without even identifying themselves*. The reaction of most individuals is that it simply should not work. Yet, astonishingly, it seems to be working reasonably well.

Wikipedia is a collaboratively written, freely editable online encyclopedia built on a wiki. The first wikis were introduced by Ward Cunningham in the mid 1990s as a platform for supporting fast, productive collaboration online (Leuf & Cunningham, 2001). Each page on a wiki website has an edit button that allows readers to edit its content. Wikipedia's authority rests in the ongoing, collective review of anyone with an Internet connection. In earlier studies, we found that Wikipedia contributors generally begin as seekers of information, but gradually adopt the practices of proofreading, fact checking, and eventually of authoring new content (Bryant, Forte & Bruckman, 2005). The low barrier to participation on Wikipedia has mobilized thousands of volunteer editors since the project began in January 2001. As of March 2006, it has produced over 980,000 articles. Stylistically, these articles closely resemble those in a traditional, print encyclopedia (Emigh & Herring, 2005) and are generally factually accurate (Giles, 2005). The flexible, relatively lightweight wiki medium has allowed for social norms and rituals to emerge that regulate characteristics of writing on the site.

Many studies of Wikipedia have focused on the quality of its content and the processes that sustain content production and surveillance (Viegas, Wattenberg & Dave, 2004; Lih, 2004). These are important concerns if Wikipedia is to serve as a reliable information resource. For the learning sciences, Wikipedia represents something potentially more exciting than an online resource. In Wikipedia, a kind of global learning community has emerged; individuals from around the world are mutually engaged in constructing knowledge. It has been observed that resources like textbooks often conceal from students the disciplinary practices, passion and effort that authors invest in producing texts (Linn, Davis & Bell, 2004); in Wikipedia, the process is both visible and open to new collaborators. In our earlier work, we learned through interviews that some Wikipedians explicitly treat participation in Wikipedia as a learning experience:

I look up and read books about the subject and I'll look something up. It's not that I'm doing all of this in order to develop an encyclopedia, although I am, it's more that I'm doing this because I want to learn and you have to learn in order to contribute knowledgeably to Wikipedia.

These interviews further suggested that the process for negotiating content includes features of knowledge building discourse (Scardamalia & Bereiter, 1996) such as proposing new ideas, requesting evidence, and synthesizing divergent points of view:

What happens is each side starts insisting that the other have clear citations for everything they're saying and you can end up with some really strengthened articles out of these disputes.

The process is really messy. It means there's a lot of conflict—some interpersonal conflicts, some conflicts over content, a lot of conflict over emphasis. But in the process it means that people are exposed to ideas and information that they wouldn't be otherwise.

Collaborative publishing on Wikipedia offers an interesting model for creating authentic classroom writing activities. Writing can be a powerful tool for constructing knowledge. Researchers of writing-to-learn have long suggested that the process of written composition can empower students to reflect on what they know and integrate existing knowledge with new knowledge (Emig, 1977; Britton et al., 1975). Research also suggests that *authentic* activities can impact motivation and learning outcomes (Harel & Papert, 1991). Shaffer and Resnick (1999) propose that a thick description of “authentic” activities includes four different dimensions:

- personal (students care about it),
- disciplinary (aligned with the intellectual tools and practices of the domain),
- real world (connected to the world outside the classroom), and
- assessment (assessment aligned with learning activities).

Writing assignments often address personal authenticity well—students are generally encouraged to write about aspects of a domain they find interesting. Unfortunately, such assignments frequently neglect other dimensions of authenticity. Disciplinary authenticity suffers because the traditional writing assignment is often a contrived literate act. The purpose, content, and form of written artifacts emerge from students' understanding of teachers' instructions rather than from a natural need to communicate a message well in a particular discipline (Edelsky & Smith, 1984). Moreover, such assignments often maintain only tenuous connections to the real world, since they are often irrelevant beyond the classroom setting. Finally, although process is a critical feature of writing-to-learn (Bereiter & Scardamalia, 1987), assessment of the writing process is difficult and teachers often grade only the final product.

Researchers and educators who have grappled with the problem of inauthentic classroom writing have proposed publication as a solution. Efforts to integrate student publication with school curricula have succeeded in motivating student writers and sustaining engagement over time (Wigginton, 1986). When the Internet became a subject of educational research, student publication was a natural analog. Early research suggested that Internet publication could increase student motivation and even lead to better writing (Cohen & Riel, 1989). Internet publication has been used as a way of breaking down the classroom walls and providing students with a diverse readership (Bos & Krajcik, 1998).

To create authentic writing experiences for students, we have begun a project that leverages the Wikipedia model of collaborative authorship with added support for disciplinary practice and authentic assessment. Students write about topics that interest them and publish their work in an online information resource, thereby creating a real world venue for writing. Moreover, assignments are structured to encourage disciplinary practices like citation and evaluation of information sources. Finally, teachers are encouraged to not only assess students' final product, but to also consider collaboration and revision as critical features of high-quality work. This project is in its early stages. Will students respond to our innovation with as much enthusiasm as Wikipedia volunteers around the world? How will a real world audience and purpose impact students' writing-to-learn experiences? Will the kind of social moderation that governs writing quality on Wikipedia similarly provide social support for student writing?

Pilot Study

We have begun a series of iterative design studies (see Barab & Squire, 2004) to examine wiki tools in the classroom context and to reflexively use this evaluation as an opportunity to improve the tools for science writing. This paper describes an important first step in defining a design and research space. To familiarize ourselves with

the potential challenges of researching wiki publishing and learning, we conducted a semester-long pilot study. In this preliminary iteration, we sought to establish guidelines for design and to explore the relationship between publishing and learning in a natural academic setting. Two further design study iterations including a comparison class study are planned for the next two years.

For the exploratory trial, students in a freshman-level, college American government class published essays about a public policy issue using a type of wiki called CoWeb (Rick & Guzdial, 2006). Participating students were informed of our intention to use their papers as content in a new public policy online resource for students. They used the wiki as a staging ground to choose issues, share resources, critique one another's research, and publish their final essays. The feasibility of asking students to interact online using wikis has been amply established (Guzdial, Rick & Kehoe, 2001; Bruns & Humphreys, 2005). We set out to understand what barriers exist with respect to investigating students' perceptions of their potential audience, their process for writing, and how interacting online influenced their learning. We aimed to answer three basic questions about students' experiences:

1. To what extent do students' interactions online affect their reasoning and writing?
2. How does publishing influence students' beliefs about their writing and motivation to write well?
3. How does publishing influence the content and tone of students' writing?

Methods and Participants

Investigating student publishing as a literate activity is challenging because the written product reveals only glimpses of process. To some extent, using a wiki mediates this difficulty because every edit made in the online environment is archived; however, many students chose to revise extensively offline. Our methods stem from our commitment to understanding learning as a situated, social phenomenon (Lave & Wenger, 1991). This perspective suggests that writing research should seek to understand learners' ability to adapt to the linguistic conventions of an intellectual community and identify ways to support this process. For this investigation, we conducted interviews at three points in the semester to capture students' experiences and process throughout the activity of researching and composing their papers. We also recorded each change that students made to online resource lists, evaluations of resources, to their own papers, and comments on others' papers.

Forty-seven students out of 127 volunteered to participate; however, five ceased participation before the assignment was complete and were removed from the dataset. We conducted interviews with twelve of the remaining students. We surveyed students at the beginning of the semester to establish demographic information such as year, GPA and gender. We also asked them to describe their attitudes toward several different writing tasks using a Likert-style scale to ensure that we interviewed individuals with a broad range of attitudes toward writing and feelings of self-efficacy as writers.

Table 1: Description of Student Activity Online

	Sample <i>42 Students</i>	Interviewees <i>12 Students</i>
Average number of edits	28.45 <i>stdev = 17.35</i>	28.25 <i>stdev = 15.27</i>
Average number of pages edited	10.14 <i>stdev = 3.95</i>	10.92 <i>stdev = 4.48</i>
Average number of resources contributed	3.00 <i>stdev = 2.13</i>	2.33 <i>stdev = 1.15</i>
Average number of evaluations written	2.29 <i>stdev = 0.89</i>	2.50 <i>stdev = 0.90</i>
Average number of evaluations received	2.17 <i>stdev = 1.22</i>	1.83 <i>stdev = 1.27</i>
Students who addressed at least 1 peer comment	78.9%	80%

Results

Quantitative measurements of students' participation on the site, such as number of edits and number of pages edited, suggest highly variable editing practices (See standard deviations in Table 1). Editing trends over time indicated that the largest edits (posting whole drafts) happened just before due dates. Smaller contributions like sharing resources and giving evaluations were more consistently spaced out over many days preceding due dates. These kinds of quantitative descriptions characterize the duration and frequency of engagement with the site; however, we sought to understand aspects of students' experiences like perception of audience and the impact of

online interaction. Our most meaningful data came from interviews with the students and examination of their online interactions.

Students' Online Interactions Helped Improve their Writing

Our first research question asks to what extent students' interactions with peers on the wiki supported their efforts to identify and rectify problems in their reasoning and writing. The wiki environment itself offered no procedural scaffolding for writing a political essay. To mediate the complexity of the assignment, it was given in five stages that included collaborative research, evaluation of sources, composition of a first draft, evaluation of others' drafts, and revision. We expected to find evidence of students supporting one another throughout the writing process. One way of understanding how students influenced and helped one another is through the analysis of their written interactions on the site. We examined first and final drafts of students' essays alongside evaluations that were written by their peers to identify the kind and quantity of revisions based on peer review. We found that about 80% of students used peer evaluations to refine their papers (See Table 1). Of these, 90% addressed issues of argument form or content.

Our most interesting findings about the effects of peer review came from the students' reflections about the experience. Examining artifacts alone did not provide sufficiently rich data to understand *how* their interactions affected students' abilities to respond to research challenges. Students' verbal descriptions of interactions with other students revealed how these experiences affected their research and writing practices. For example, in one instance, a student who chose to write about the rights of foreign nationals in the U.S. explained that he had not thoroughly considered the definitions of the terms that he was using, but another student suggested he do so, which led him to refine the concepts in his paper. He reported that, although he was only "a little off on the definition," he had to make that change in order for his paper to make sense.

In another case, a student described how others' evaluations affected his ability to evaluate appropriate information sources:

One guy liked [the draft]. Another mentioned something about one of my sources having a liberal bias... I cited an ABC article, which quoted a Pentagon official. So instead, I could never find the Pentagon quote, but I went to a Supreme Court document that cited the same thing so I could have a less biased quotation. (student 5)

This would initially seem to be a fairly low-level change; however, later, the same student described how this realization impacted his understanding of how media sources are perceived more generally and how his research practices are changing as a result of his experiences online. While describing his interactions with peers who held different points of view, he explained:

I know they respect, they enjoy Fox news as their resource but I still do not respect it as a credible news resource... they opened my eyes to seeing they think the exact same thing about CNN, which I think is crazy but I never really thought about it, so it was thought provoking and I do respect that, I can understand. So I try not to quote CNN as much and look for more neutral parties. (student 5)

Online Resources Are Not Always Perceived as Public

Our second question asked how publishing would influence students' beliefs about their writing and motivation to write well. We assumed that students would understand the website where they published their writing as a public place with a potential readership. We repeatedly cautioned them not to reveal their identities online *because it is a public site*. To reinforce the sense that their work would serve as a resource for others, students who consented to participate in the study were explicitly asked for permission to continue using their work when the site's final design was launched. We were surprised that, despite the numerous cues about the public nature of the site, some interviewees expressed uncertainty about its publicness. Although they were well aware that other students would read their papers (some first drafts were accompanied by disclaimers), many did not perceive their participation on the site as public.

Some interviewees suggested that their work was not important enough to attract readers. When asked to comment on the potential audience for their papers, many students' comments suggested that they didn't believe

their writing was of sufficient quality or interest to serve as a resource for someone else. Interviewees generally exhibited a low level of confidence in the quality of their work. Sentiments such as the following were typical:

I don't know who would read them. Maybe other students looking for ideas for papers. I can't imagine that anyone would take our advice as expert advice. (student 7)

Most interviewees did not make the connection that because the work was online, it was public. The fact that online places are public does not mean that people perceive them as such (see Hudson & Bruckman, 2005). One interpretation suggests that this reflects students' naïvete with respect to the privacy of online actions. One might also construe students' reactions as adroit cynicism—an indication that they understand perfectly well the enormity of the Web and are skeptical that anyone could find their ideas buried in a wiki with an obscure domain name.

Perceived Audience Plays an Important Role in Revision

Our final research question asked how the public nature of the site would influence students' writing. As stated above, the public nature of the site was not apparent to students, so their perception of audience was limited to the class. Still, this limited audience provided sufficient diversity of readership to influence some students' writing. One student who chose to write about gender equality in sports discovered that some of her peers held views that were in extreme opposition to her own. She explained:

I chose [to write about] Title IX and it was something that I felt pretty strong about because it relates to pretty much the equality of women, or it did. And I'm a pretty big feminist. (laughs) I get made fun of for being a feminist a lot of times, so, it was what mostly closely related to what I have personal experience with. (student 10)

When she described the views of two classmates whose papers she reviewed, she explained that:

He was very blunt and like "physically women should not be—are not athletes, it's obvious they can't run as fast." And he's like "and they're meant to—their purpose is to have babies and not to run a full mile or whatever in four minutes." He's like, "men can just perform better so why waste our energy on women." And he's like, "We should just put all the money dumped into the men." So this is the paper I was reading. (student 10)

In this case, the experience led a student to engage in precisely the kind of audience-aware writing that we hoped online interaction would engender:

I could tell [they] were guys, just because of the way they wrote. Well, and what they were talking about too. They were also talking about Title IX. And, they brought out something that I found was very interesting. They brought out the point that it's almost like, ah, the men are starting to get discriminated about. I never thought about it that way before. It kind of made me a little bit more giving in my paper when I wrote it... if [those two] were reading my paper I wanted to make sure that they weren't going to read the first couple of sentences and be like, "huh, this person's crazy, I'm not reading this." Because I was exactly the very opposite of what they wrote. (student 10)

Confronted with a real, potentially diverse audience, this student adopted sophisticated strategies for presenting her ideas. While writing, she *invoked* that broad audience to guide her revisions. Likewise, the student whose resources were critiqued for being too liberal adopted the practice of invoking audience to consider what kinds of information resources could best support his arguments given a diverse readership. In his interview, he explained that he has begun using this critical practice in other writing assignments, too. It is interesting to note that, in these cases, a review of the artifacts created by students would have failed to reveal their changed practices. The actual papers and reviews contained nothing as extreme as the interviewees described. It appears that *affective response* to others' views was what influenced their writing, especially in the case of the feminist. Her learning experience was only obtainable through direct questioning.

Finally, one student explicitly stated that having an audience who can comment on what is written directly supports efforts to write clearly and to write well. Interestingly, the final line of her statement indicates that getting feedback from peers is, to this student, ultimately in service of the professor's experience as a reader of the paper:

When people read what you have down... they haven't researched it, they don't know anything about it and whether they understand it or not is your whole thing. If they don't understand it, then you have to go by whatever they say. And I think it's a good system because they're going to tell you "well, I would understand it better if you did this." And then that's what you need to do. Because the professor's not going to have done research on all this stuff. (student 8)

Lessons Learned and Design Guidelines for Future Work

This pilot study represents the initial iteration in a series of design studies that explore connections between authentic writing experiences and the effectiveness of writing-to-learn activities. Several lessons and design guidelines will shape our work moving forward. With respect to real world authenticity, we learned that audience is both critical and elusive. Even on the Internet, if we hope to influence student writers by creating a public venue for their work, exposing the very *existence* of a reader is something that needs to be considered in the design of the publishing environment.

We supported authentic academic writing practices—careful citation and evaluation of sources—by structuring the assignment. One of our ultimate goals is to create flexible, lightweight software that can support disciplinary writing practices for student authors. By using existing technology and creating structure through classroom practice rather than by loading the software with features, we were able to evaluate *how much* structure to embed in the software. Wiki software is ill-equipped to consistently depict relationships among information types; we determined that, at a minimum, the interface should make clear connections among students' writing, the resources they use, and feedback about their writing and those resources. If students cannot find peers' comments or resources, they cannot learn from them. When using a wiki with a large number of students, it is essential to provide features for organizing the inevitable information sprawl—our study generated over 700 unique pages. We are currently developing a sourcing toolkit that will standardize relationships among articles, sources and evaluations.

To align assessment with the learning activities (authentic assessment), we gave the course instructor information about students' editing activity to help him assess their participation over the course of the semester. This information was generated from log files and was not available to the instructor within the wiki system on demand. We are currently developing teacher tools to organize information about class participation and student contributions in the wiki system.

Wiki as a Paradigm and Its Potential to Support Learning: Moving Forward

Although wiki-supported information resources are not without problems, they signal a unique opportunity for student writers to enrich public discourse in a way that serves a real purpose and engages a real audience. The success of Wikipedia in engaging volunteer writers and editors to do complex and intellectually demanding work can serve as an inspiration for creating publication venues that support writing-to-learn. Despite the absence of a traditional formal review process, Wikipedia writers produce a highly standardized form of academic writing (Emigh & Herring, 2005). We propose that this model can be leveraged to engage students in authentic collaborative academic writing activities.

Our pilot work suggests that audience plays a critical role in creating meaningful and effective writing-to-learn experiences. A sense of audience is a vital part of written communication. Academic writing is an act of meaning making not by the writer alone or even by the writer for the benefit of a particular reader. Creating meaning through written language is a process supported by the understanding and disposition of both the reader and the writer (Long, 1990). Instead of viewing texts as autonomous, immutable containers of information, we can regard written communications of all kinds as (sometimes painfully) human efforts to invite collaborative meaning making. Some students who participated in our study reported that they reflected on the potential audience for their writing and that it affected their revisions. These results suggest that publishing can encourage students to adopt the view that writing is one part of a collaborative process that involves both their efforts and the disposition and ability of their readers.

Moving forward, we are creating a new wiki publishing environment based on the software underlying Wikipedia. *Science Online* will be an online science encyclopedia collaboratively authored by high school and undergraduate students. Using design guidelines derived from our pilot study, we are currently developing two extensions to existing wiki software: teacher tools for assessment and class management, and a citation toolkit to

provide explicit support for academic writing practices like citation and source evaluation. In future work with the *Science Online* system, we intend to further explore the relationship between perceived and invoked audience and characteristics of collaborative publishing on wikis that can give rise to more powerful learning experiences for student writers.

References

- Barab, S. & Squire, K. (2004). Design-based research: Putting a stake in the ground. *Journal of the Learning Sciences* 13(1), 1-14.
- Bereiter, C. & Scardamalia, M. (1987). *The psychology of written composition*. Hillsdale, NJ: Lawrence Erlbaum Associates.
- Bos, N. & Krajcik, J. (1998). Students' awareness of audience in web-published science writing. Paper presented at the American Educational Research Association, 1998, San Diego, CA.
- Britton, J., Burgess, N, McLeod, A. & Rosen, H. (1975). *The development of writing abilities*. London: Macmillan.
- Bruns, A. & Humphreys, S. (2005). Wikis in teaching and assessment: The M/Cyclopedia project. *Proceedings of the ACM WikiSym 05: International Symposium on Wikis*, San Diego, CA, 25-32.
- Bryant, S., Forte, A. & Bruckman, A. (2005). Becoming Wikipedian: transformation of participation in a collaborative online encyclopedia. *Proceedings of ACM GROUP: International Conference on Supporting Group Work*, Sanibel Island, FL, 1-10.
- Cohen, M. & Riel, M. (1989). The effect of distant audiences on students' writing. *American Educational Research Journal* 26(2), 143-159.
- Emig, J. (1977). Writing as a mode of learning. *College Composition and Communication*, 28, 122-127.
- Emigh, W. & Herring, S. (2005). Collaborative authoring on the web: A genre analysis of online encyclopedias. *Proceedings of the Hawai'ian International Conference on System Sciences*.
- Giles, J. (2005). Internet encyclopaedias go head to head. *Nature*, 438, 900-901.
- Guzdial, M., Rick, J. & Kehoe, C. (2001). Beyond adoption to invention: Teacher-created collaborative activities in higher education. *Journal of the Learning Sciences* 10(3), 265-279.
- Harel, I. & Papert, S. (1991). Software design as a learning environment. *Constructionism* (pp. 41-84). Norwood: Ablex.
- Hudson, J. M. & Bruckman, A. (2005). Using empirical data to reason about Internet research ethics. *Proceedings of the European Conference on Computer-Supported Cooperative Work*.
- Lave, J. & Wenger, E. (1991). *Situated learning: Legitimate peripheral participation*. Cambridge, UK: Cambridge University Press.
- Leuf, B. & Cunningham, W. (2001). *The wiki way*. Boston, MA: Addison-Wesley.
- Lih, A. (2004). Wikipedia as participatory journalism: Reliable sources? Metrics for evaluating collaborative media as a news resource. Paper presented at the Fifth International Symposium on Online Journalism, Austin, TX.
- Linn, M. C., Davis, E. & Bell, P. (2004). *Internet environments for science education*. Mahwah, NJ: Lawrence Erlbaum Associates.
- Long, R. (1990). The writer's audience: Fact or fiction? In Kirsch, G. and Roen, D. (Eds.), *A sense of audience in written communication* (pp. 73-84). Newbury Park, CA: Sage Publications.
- Rick, J. & Guzdial, M. (2006). Situating CoWeb: A scholarship of application. *International Journal of Computer-Supported Collaborative Learning*, 1(1).
- Scardamalia, M. & Bereiter, C. (1996). Computer support for knowledge-building communities. In Koschmann, T. (Ed.), *CSCL: Theory and practice of an emerging paradigm* (pp. 249-68). Mahwah, NJ; London: Lawrence Erlbaum Associates.
- Schaffer, D. W. & Resnick, M. (1999). "Thick" authenticity: New media and authentic learning. *Journal of Interactive Learning Research* 10(2), 195-215.
- Viegas, F., Wattenberg, M. & Dave, K. (2004). Studying cooperation and conflict between authors with history flow visualizations. *Proceedings of CHI 2004*, Vienna, Austria, 575-582
- Wigginton, E. (1986). *Sometimes a shining moment: The Foxfire experience*. Garden City, NY: Anchor Books.

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