LEARNING IN PUBLIC: INFORMATION LITERACY AND PARTICIPATORY MEDIA

A Dissertation
Presented to
The Academic Faculty

by

Andrea Forte

In Partial Fulfillment
of the Requirements for the Degree
Doctor of Philosophy in Human-Centered Computing in the
School of Interactive Computing, College of Computing

Georgia Institute of Technology

August, 2009

LEARNING IN PUBLIC: INFORMATION LITERACY AND PARTICIPATORY MEDIA

Approved by:

Dr. Amy Bruckman, Advisor
School of Interactive Computing
Georgia Institute of Technology

Dr. Rebecca Grinter
School of Interactive Computing
Georgia Institute of Technology

Dr. Mark Guzdial
School of Interactive Computing
Georgia Institute of Technology

Dr. Janet Kolodner
School of Interactive Computing
Georgia Institute of Technology

Dr. Jonathan Grudin
Microsoft Research

Date Approved: July 01, 2009

For my baby boy, I can't wait to meet you and show you this world.

ACKNOWLEDGEMENTS

In 2002, when I began the enterprise of completing a PhD, I had little idea what it would mean to take up the life of a researcher. Certainly I could not have foretold how critical it would be to surround myself with brilliant individuals—both as guides and as strong counterpoints to my own ideas and ideals. Moreover, the patience and humility required to enter into a new field makes demands not only on a graduate student, but also on the people who love and support her. I take a great deal of pleasure in writing here my thanks to the people who have played these roles in my life.

Naturally, I need to begin by thanking my mom and dad, Anne and Joe Forte, for their unfailing belief in my abilities and commitment to my education. I often tell people with pride that when I was a little girl, my mom taught me to program and my dad taught me to play chess and that I still remember many lessons from both of these experiences. My parents set amazing examples for me of achievement and perseverance and instilled a belief that anything could be accomplished if I only chose to do it.

The partners of PhD students need to develop some special skills as well in their roles as cheerleader and therapist. My husband, Jay Forbes, has amazed me with his constancy and love throughout the many unforeseen joys and distresses of the past several years. In my worst moments of doubt and frustration, he saw the best in me. He is wonderful.

Time and attention are something one might expect from parents and partners, but I have also had the advantage of an advisor whose commitment to her students is unparalleled.

TABLE OF CONTENTS

CHAPTER 8
CONCLUSIONS AND FUTURE DIRECTIONS:
INFORMATION LITERACY IN A READ/WRITE WORLD **160**

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1
INTRODUCTION

Free culture, open content, open-source software, peer production, citizen journalism, participatory media—these ideals represent a culture of technophilia. The idea that "information wants to be free" has inspired visions of a public informed and educated as never before, a world in which every individual can not only freely access information, but also can amplify her own voice in the public sphere and participate in communities that span geopolitical and cultural boundaries. The past couple of decades have seen fundamental changes in public life and in the ways that information is created and consumed and these changes have been made possible by novel technologies. Open content and Free/Libre Open Source Software (FLOSS) movements have provided testimony to the feasibility of using networked technologies to support new, open, free, collaborative, transparent processes of production. For the believers, more open, accessible and equitable governance, community building and education are just around the corner.

Yet these same developments in the domain of information production and publication have also sparked debate, confusion and fear. From worries about the continued viability of traditional economic models of media production to epistemological questions about the nature of authority and truth, the arrival of "everybody" on the Internet is also viewed as problematic. If *just anybody* can contribute to a news site, an encyclopedia, or even publish her own new resource, where does credibility come from? How does one know what is true? Traditional models of scientific peer review, investigative journalism,

historical inquiry are well understood and have the benefit of decades—even centuries—of refinement. How, then, do people cope with radical changes in the production and dissemination of media that entertain and inform their lives? What challenges and opportunities do new forms of information production present for those who would become information literate?

Project Overview

My dissertation research both examines new participatory publishing models and explores how participation in creating user-generated content can serve as a learning experience. My classroom work is both a technology design project and a study of how young people learn and become critical information consumers by producing media themselves. In a read/write world, information literacy means more than knowing where to find information or how to interpret messages from advertisers, government agencies, educational institutions and other publishers. Literacy involves both becoming able to interpret information and becoming an adept participant in the construction of new knowledge. Information literacy skills are inextricably bound to the socio-technical systems in which media are constructed and consumed. In order to explore opportunities for young people to participate in and reflect on these systems, I have designed specialized tools to support high school students as they learn to be both media critics and producers.

I started this project by studying a group of people who are collaboratively building an information resource: Wikipedians. In order to understand the challenges and opportunities presented by new systems of information production, it is critical to understand those new forms themselves. This is important for two reasons: first, because it is difficult to understand how to assess a new kind of resource like Wikipedia without first understanding how it is produced and maintained and, second, because

understanding the process of creating Wikipedia can inspire new insights about how to leverage this new form of production for other purposes, such as education.

Writing an encyclopedia is hard work. It requires editors to integrate information from a variety of sources. Why do they do it? What do they get out of it? How is the community organized and bounded? How does the technology help or hinder participants? Understanding these issues involved getting to know Wikipedia not just as an encyclopedia, as a wiki, or as a community, but as a socio-technical system that is both articulated through and shaped by the artifact it produces. In my early studies, I used Legitimate Peripheral Participation (Lave and Wenger 1991) and Activity Theory (Engestrom, Miettinen et al. 1999) as frameworks for understanding how editors learn to write an encyclopedia and the roles that tools, identity/goals, and community play in encouraging sustained participation. I showed the trajectory that newcomers take as they become enculturated in the community and how their goals, roles, and use of wiki software change as their participation changes over time (Bryant, Forte et al. 2005). More recently, I investigated Wikipedia governance in order to understand how the community has dealt with its rapid growth. I found that governance mechanisms are becoming increasingly decentralized as the community scales and that the form of governance has largely followed social structures predicted by Lin Ostrom's theories of self-organizing communities (Forte, Larco et al. 2009). These studies (presented in detail in Chapter 3) provide a foundation for understanding Wikipedia as a new system of publication; however, they also yielded an inspiration.

As I conducted these Wikipedia studies, I began to notice something interesting: Wikipedians described powerful social learning experiences. In order to manage article production, they must engage in conversations about why they believe a statement to be accurate, how well accepted different theories and ideas are, what constitutes a reliable information source, and how an article should be written to educate readers. From an

education perspective, this is precisely the kind of reflective discussion that is desired in schools. These kinds of conversations are components of knowledge building discourse as described by Scardamalia and Bereiter (Scardamalia and Bereiter 1996). Having made these connections between the learning sciences literature and the potential for Wikipedia to serve as a model for formal learning experiences was exciting, I wanted to explore how students might have such writing experiences as part of their school work and to study how publication and the design of writing tools affected their learning experiences. I proposed creating a specialized, wiki-based science encyclopedia for high school students in which citing information sources would be a central practice.

Over three years, I conducted three iterations of design-based research in which I aimed to understand how American youth think about information sources as they participate in online publishing activities themselves. My primary goal was to discover **in what ways participating in the creation of an information resource for others might affect students' reasoning about the sources they use themselves.** In my classroom studies, I addressed the questions: "How do students write and reason about information when contributing to an information resource for others?" and "What role does the wiki medium play in shaping their writing and information use?"within the context of design-based research that introduces new wiki publishing tools in formal secondary education.

In this document, I explore what information literacy means in the age of participatory media, how participation in the creation of user-generated content is accomplished, how it can be a transformative experience for those involved, and how and why such experiences might be integrated into formal educational experiences for youth. In this chapter, I begin with an overview of media education and explore the problem of information literacy in the context of learning sciences and media education literature. In the second chapter, I explain my methodological assumptions and outline my approach to researching both Wikipedia as an example of a new publication model and the potential

to use this model as a learning activity in formal education. The third chapter focuses on understanding Wikipedia as a case of open content production using wiki as a platform; I examine Wikipedia as a community of practice with a particular set of governance mechanisms and cultural norms. Based on my empirical findings, I analyze Wikipedia as an informal learning environment for its authors and suggest that the publication experience can be a transformative one. In the fourth chapter, I turn my attention to wiki technology and its potential to support not only communities of authorship "in the wild," but also delve into the literature on wikis in formal education contexts. I present findings from a pilot study that suggest refinements to wiki software in order to better support the kinds of academic writing practices, unique social relationships and privacy concerns that are present in the classroom. I also describe a suite of wiki tools that I developed to meet these needs. The fifth chapter provides rich descriptions of two iterations of fieldwork in which I used my newly developed tools in high school science classrooms. It is from these studies that my analysis of information literacy practices is drawn. In the sixth chapter, I present the first part of a grounded analysis of my data and the kinds of heuristics that students in my studies used to assess information they encountered. In the seventh chapter, I bring this analysis to fruition and connect students' publishing activities with their information seeking, assessment and use. I discuss a theoretical framework for understanding wiki publishing as a learning activity that emphasizes the roles of genre and audience in constructing meaningful practice.

Table 1: Overview of Work Completed Toward Dissertation

		Details	Collaborators	Publications
2004-2005	Wikipedia Participation Studies	Conducted two rounds of interviews with 23 Wikipedians to understand participation trajectories	Susan Bryant Juan Munoz Bill Julyan, Adam Wilson	(Bryant, Forte et al. 2005)
Spring 2005	Pilot Study	Conducted pilot study using existing wiki software in undergraduate American Government class with 42 participants.		(Forte and Bruckman 2006)
2005-2006	Teacher Study	Interviewed teachers to understand needs and identify potential collaborators.		
2005-2007	Technology and Instructional Development; Site Launch in Summer 2006	Iterated on MediaWiki extensions to support references and classroom use; conducted usability testing; consulted with local teacher on assignment design; launched the site *Science Online*	Amruta Lonkar	Demos at WikiMania and WikiSym 2006
2006-2007	Field Study Iteration I	Conducted fieldwork at local public high school with 19 students in two Advanced Placement Environmental Science classes using *Science Online*.		(Forte and Bruckman 2007) (Forte and Bruckman 2008)
Spring 2007; Summer 2008	Wikipedia Governance Study and Followup	Conducted interviews with Wikipedians involved in different aspects of Wikipedia governance. Followed up with in-depth look at local governance in the site.	Vanessa Larco	(Forte and Bruckman 2008) (Forte, Larco et al. 2009)
Spring 2008	Field Study Iteration II	Conducted fieldwork at local private high school with 14 students in one honors biochemistry class using *Science Online*.		

Information Literacy,Media Education, and Learning Sciences Foundations

Information literacy and media education are closely related concepts that reflect a set of similar concerns among educators. Both are concerned with equipping people to assess the messages they receive from publishers, advertisers, government agencies and other sources. The term "media education" evokes a tradition of teaching critical awareness of the messages that are embedded in the media that we encounter every day, thereby shielding young people from manipulation and freeing them to engage with the world of ideas as sophisticates (Buckingham 1998) (See also (Leavis and Thompson 1933) (Masterman 1985) (Buckingham 2003)). Information literacy is a more recent concept that emerged at least in part as a response to the perceived overabundance of information that people encounter each day and to the development of new publishing systems at the outset of the digital age. Information literacy suggests people need to refine their ability to seek out relevant information and filter the good information from bad (Zurkowski 1974). Media education takes a somewhat broad view by encouraging learners to think critically about the context and purpose of messages they receive, whereas information literacy research often looks closely at strategies people use for assessing specific pieces of information that are embedded within a medium. I will mainly use the term information literacy to describe the practices I study; however, the media education literature plays an important role in setting the tone for my work and in many places either term could be used.

Information literacy and media education are not new problems, but the proliferation of user-generated content and opportunities to participate in the creation of widely distributable media has altered the context of media education dramatically within the past several years. Young people are poised to contribute to the production of information sources that others use by blogging, reviewing products, rating news articles, and even coauthoring encyclopedia articles. The ubiquity of information sources like blogs and wikis—in particular Wikipedia—causes educators, parents, and students to grapple with

epistemological questions about the creation of knowledge and what warrants proof and expertise.

Many young people in the United States (Jenkins 2006), across Europe (Livingstone and Bovill 2001) (Livingstone 2002), Japan (Ito 2008), and other industrialized nations are raised in media-rich cultures of convergence and mixing. As with every generation, young people are entering a culture different from that of their teachers' and parents' youth and are differently equipped to make sense of new forms and uses of media. In the learning sciences and in education, approaches to understanding problems associated with media and information literacy borrow from traditions of both cognitive and social sciences. In this section I will explore the meaning of "information literacy" and begin to make connections to literature in the learning sciences that I will develop further in later chapters, as I examine different facets of information literacy in more detail.

Definitions of information literacy abound (Owusu-Ansah 2005). In this dissertation, information literacy is not defined according to one pre-defined set of behaviors; rather, it involves understanding how information is assessed and produced within a particular cultural and social context. Information literacy is not a monolithic concept; rather, it comprises a set of possible competencies. Linda Flower defines literacies as "*diverse discourse practices* that grow out of the needs and values of different communities" (Flower 1994) (p1). When applied to information literacy, this means that an individual may be possessed of sophisticated information literacy skills in one context—say making decisions about personal health care—and yet may falter in another context such as scholarly writing. In academic domains, sophisticated information literacy skills traditionally have included competencies like negotiating library systems, identifying respected publications and authors, and marshaling what one finds in the production of texts using citations as intertextual signposts.

The concept of information literacy was introduced in 1974 by Paul Zurkowski, then president of the Information Industry Association. He suggested that individuals experience an "overabundance of information whenever available information exceeds our capacity to evaluate it" (Zurkowski 1974) (p.1) and that this was a universal condition because of the explosion of information sources that had become available in 1974 due to the proliferation of novel forms of publication. He went on to explain that "people trained in the application of information resources to their work can be called information literates" (Zurkowski 1974) (p. 6). This forward thinking but somewhat cryptic definition has been expanded and elaborated over the years; yet its basic message remains surprisingly unchanged. In 2000, the Association of College and Research Libraries (ACRL) defined five standards for information literacy competency in higher education. These include recognizing information needs, finding information efficiently, evaluating information sources critically, using information to accomplish goals, and understanding social and ethical issues surrounding the use of information ((ACRL) 2000). My work proposes a sixth standard for literacy: participating competently in the construction of information resources for others. This standard becomes important feature of information literacy in a media landscape filled with opportunities for participation; however, most work to date has focused on critical consumption, not participation.

Media education, too, has put a great deal of emphasis on critical consumption—educating consumers of information to be aware of subtext, positioning and other forms of potential manipulation through media (Leavis and Thompson 1933), (Masterman 1985). Media theorists have suggested that the days of protectionism are over—that educators who once warned against the detrimental effects of media on vulnerable youth no longer seek to insulate young people from new media (Buckingham 2003). The rhetoric of contamination and abstinence may be less universal with trends such as the popularization of games for learning and the liberal attitudes of many teachers who

embrace the creative possibilities of digital media production and sharing; however, the legacy of protectionism remains. In particular, suspicion of new media persists where they challenge familiar economies of information production and where new forms of engaging in media production stand in contrast to the epistemological assumptions underlying traditional assessment of media quality. This is particularly noticeable where Wikipedia is concerned; some educators have gone so far as to ban students from using the site altogether and even block it from school computers (see (Olanoff 2007) (Cohen 2007))

Peppler and Kafai note that within the media education literature, construction of media has historically been marginalized in favor of critical analysis; however, in recent decades, the blurring of producer and consumer roles has been widely recognized and production has become a more visible feature of media education (Peppler and Kafai 2007). Note that the idea of media consumers taking part in actively constructing reality through the interpretation of media has been acknowledged for decades (Masterman 1985); here I am talking not simply about *active reading* but literally about the act of transforming and creating media for others to consume and transform themselves. I am concerned with engaging students in the creation and modification of public artifacts. This transition to understanding media creation as a part of information literacy is a place where learning sciences are a natural complement to existing work; the learning sciences have a tradition of engaging learners as active producers of media. For example, knowledge building (Scardamalia and Smith 2002) and project-based learning (Blumenfeld, Soloway et al. 1991) both point to the production of media and other artifacts as an ideal context for engaging learners in content and problem-solving activities. In particular, the emphasis and inspiration for my work stems from a constructionist approach to learning.

Constructionism (Papert 1991) suggests that constructing public artifacts is an activity that supports learning particularly well. Constructionism as an approach to learning carries with it an ideology of empowerment and choice. Ideally, learners choose what it is they want to do and learn through the process of engaging in open-ended, unstructured, playful but productive construction activities. These ideals have found their way into my assumptions about what makes for a productive, motivating learning experience.

Early work with computer programming that led Papert to articulate his constructionist approach (Papert 1980) has been complemented by a profusion of research projects that support constructionist learning through the development of different kinds of (often computational) construction kits (For example (Bruckman 1998) (Lamberty and Kolodner 2003) (Millner 2008) (Wilensky 2001)) In my classroom work, I continue in that tradition. In chapter 4, when I describe the design of the wiki tools that I created for my studies, I will also examine the notion of using a wiki as a construction kit for written composition in more detail. By designing new wiki tools and classroom activities, I sought to embed structure and guidance in ways that would not inhibit informal uses of the technology but would support students and teachers in formal classroom environments.

Thinking through the design of a toolkit is a way for researchers to identify and articulate what kind of learning they expect the construction of a particular artifact to afford. In the case of writing, there is a wealth of literature on how process of written composition can be a powerful tool for constructing new knowledge. Researchers have long suggested that writing can empower students to reflect on what they know and integrate existing knowledge with new knowledge (Bereiter and Scardamalia 1987) (Emig 1977) (Britton, Burgess et al. 1975). It is commonly accepted by both educators and researchers that learners can benefit from written assignments in many ways; however, the mechanisms

through which writing affects learning and, in particular, the social conditions for successful writing to learn are still poorly understood (Klein 2000) (Applebee 1984).

Influential work on writing as a learning activity in the learning sciences was done by Scardamalia and Bereiter. In *The Psychology of Written Composition* (Bereiter and Scardamalia 1987), they developed a model wherein expert writing involves the transformation of knowledge and novice writing involves the simple, linear exposition of ideas. They suggested that expert writers engage in a process of knowledge transformation that involves organization and reorganization of ideas as they write. In contrast, knowledge telling is what younger and inexperienced writers do when they set ideas to paper, the process is much closer to making a list than transforming ideas. This process of reorganization and transformation is not unlike the process of "refactoring" a wiki page in progress as more and more ideas are added and need to be connected and arranged. In general, researchers have paid quite a bit of attention to the design of toolkits (Resnick, Bruckman et al. 1998), but the role of audience has received less attention from constructionist theorists, this is where my work builds on the existing learning sciences literature.

The research questions that I addressed in my classroom studies are designed to explore the notion of audience that is inherent in all constructionist approaches to education. If the public nature of the artifact is an important feature of constructionist learning environments, why? What makes this "publicness" important for learning? Written publication is one place to examine this question. 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 and Riel 1989) (Riel 1985). The Internet was seen as a way of introducing a real-world audience for students' work—breaking down the classroom walls and allowing for contact with peers in remote locations and subject matter experts (Bos and Krajcik 1998)

(Ellis, Bruckman et al. 1999) (Songer 1996) (Renninger, Shumar et al. 2004) (Zagal 2008). In recent years, the emergence of publicly editable, free content information resources such as Wikipedia signals a unique opportunity for student writers to enrich public discourse. What benefits might such broad new audiences for school work hold?

Table 2: Research Questions Addressed in this Dissertation

Understanding new publication systems – the case of Wikipedia	
How do newcomers to the Wikipedia community learn to write an encyclopedia? What role do social relationships and technology play in that process?	See pages 64-94
How is Wikipedia governed and why has governance evolved in the way that it has?	See pages 40-63
Using wiki in formal education – pilot study	
1. How does interacting with peers in a public wiki influence the content and tone of students' writing? 2. How does publishing an information resource for others affect the ways that students think about their written assignments? 3. What features do wikis need to support writing and publication activities in the context of formal education?	See pages 106-115
Using wiki in formal education – high school studies	
What strategies do students use when they encounter information sources on the web?	See pages 146-163
1. How do students write and reason about information when constructing an information resource for a broad audience?	See pages 170-208
2. What role does the wiki medium play in shaping their writing and information use?	See pages 213-217

CHAPTER 2
METHODS

In this chapter I explain the theoretical underpinnings for my approach to research and the methods I adopted (and adapted) to examine information production and consumption online and in the classroom. I have been strongly influenced by readings in phenomenological sociology (Schutz 1967), activity theory (Engestrom, Miettinen et al. 1999) and situated action (Suchman 1987) (Lave and Wenger 1991) that suggest human activities simultaneously *bring about* and *acquire meaning from* the perceptions of the actors themselves. In other words, people aren't simply shaped by the socio-technical systems in which they participate, nor do they altogether shape those systems through individual will; instead, actors and systems can only be defined in relationship to each other. I "take activity as the term for the process through which a person creates meaning in her practice, a process we can neither see or fully recall but a process that is ongoing as part of the participation in a community of practice" (Chistiansen and Nardi 1996). Moreover, these approaches share a common suggestion that *things and environments* also play a critical role in defining a socio-technical system: hence the "technical." In my dissertation work, I am particularly concerned with information literacy practice and how individuals position themselves in the cycle of information production and consumption. I sought to study not only process—or what people did—within a particular technical environment, but also how their perceived relationship to information informed their activities and vice versa. In order to do so, I devised my methods by borrowing heavily from social science and education methods that were designed to provide insight into the ways that individuals construct and understand social processes.

The Interventionist and the Sociologist

Some social science research involves watching what people do, some involves testing, prodding, asking and listening, and some research involves actively facilitating change in the communities being studied. In my work, I integrate aspects of all these. I draw on sociological and anthropological traditions of inquiry to understand social structure and cultural practices in communities. Critical and interpretive approaches to social science research view the researcher herself as an instrument of inquiry. Anthropologists and sociologists conduct fieldwork to observe human activities in their natural contexts. They often participate in the social systems they study in order to better understand them, they interview people, they collect and analyze documents and artifacts and, when all is said and done, they filter and interpret what they have learned to make it meaningful to a scholarly audience. Yet, despite the fundamental ways that researchers interact with the social systems they study, both in the processes of data collection and meaning making, traditional anthropological and sociological research is not deliberately interventionist. For my dissertation work, I have done both design-based research in which I introduced new tools and practices in classrooms as well as more traditional sociological investigations in which I conducted hands-off explorations of little-understood practices among Wikipedia editors. In this section, I will discuss my approach to both of these research contexts.

In all of my work I borrow heavily from the traditions of anthropology (Geertz 1983) and phenomenological sociology (Weber 1966) (Schutz 1967). From Geertz I have adopted the approach that studying complex systems of human activity involves getting to know a once strange culture in a way that renders its seeming foreignness intelligible and explainable in ways that do not distort the experience of those being studied. For Wikipedia studies, that meant not only spending many hours talking with Wikipedians in formal interviews, but also reading and writing on the site, learning the software on which the community is built, and spending time with developers and other community

members to learn about what it's like being part of the community. In my studies of information literacy, that meant approaching the problem of "how high school students use and think about information" with a willingness to step into the high school as a listener and learner. The influence of anthropology can also be seen in the presentation of this dissertation, in which I take care to provide rich descriptions of the classrooms and schools where my research took place, so that the reader has access not just to my final interpretations, but to the experiences that led me to these interpretations and can judge for herself the ecological validity of my analysis.

Design-Based Research

Design-based research (DBR) was introduced by psychologists as a methodological departure from the experimental tradition. Influential publications on design-based studies for educational research appeared in the early 1990s (Brown 1992); (Collins 1992). Ann Brown and Allan Collins' pioneering work described variations on a similar theme: how research methodology in education might evolve to accommodate increasingly influential theories of situated learning. The assumption that context matters—that learning is situated in a system of social relationships, technologies, linguistic and conceptual tools as well as cognitive ability, personal experience and prior knowledge—has become axiomatic for many education researchers. When new methods or tools for education are developed, it makes sense to examine these tools in the context of use and to reflexively use such evaluation as an opportunity to improve the new tool that is being examined. Over fifteen years later, researchers still struggle to manage studies that take into account (or at least don't discount) the elaborately interdependent features of learning in context. In recent years, the journals *Educational Researcher* (vol 32)*, Educational Psychologist* (vol 39) and *Journal of the Learning Sciences* (vol 13) have all devoted entire issues to the problems of design-based research.

Despite their very different origins, DBR as an approach to educational research makes sense in conjunction with the critical and interpretive traditions that I described in the previous section. An important feature of DBR is the assumption that research participants take an active part in co-constructing the research context with the researcher herself. It is a critical approach to research in that the researcher remains aware of her own role in shaping activities and uses her experiences as an opportunity for critical reflection. Likewise, the emphasis on understanding learning in the "buzzing blooming confusion" of the classroom echoes the interpretive anthropological concern for understanding culture as richly complex, multivariate systems.

I have used a design-based approach in my studies of students' information seeking and citation practices while they participate in the creation of user-generated content as part of their coursework. My agenda was transformative in that I sought to introduce a new learning activity and supporting technology in high school science classes. I took care to involve teachers not only as designers of assignments, but also in the process of establishing design goals and refining new wiki tools. In all, I conducted three iterations of design and fieldwork that will be described in detail in this document. Throughout each iteration of fieldwork, I refined the tools when necessary. Just as the teachers responded to student and administrative needs by changing features of the assignments throughout the course of my studies, I likewise responded to needs by tweaking the technology where necessary.

It is not enough to explain that one is engaging in a design-based program of research. DBR describes a general approach to research that can be executed in many different ways depending on the goals of the researcher. Philip Bell notes that design-based programs of research represent a wide array of methods and theoretical commitments (Bell 2004). Perhaps because of this breadth, DBR resists institutionalization and no clear genre representing the "design-based research report" has yet emerged. Each chapter of

this document presents a piece of the complex process of investigating a phenomenon using design as a research instrument. I have begun to articulate the theoretical assumptions that underlie my research; in the following section, I will justify the specific methods that I chose, not only in my classroom studies but also in my studies of Wikipedia as an example of a new publication model based on participatory media.

Collecting and Analyzing Data

In the above sections, I described my overall approach to research and the assumptions that inform my work. In this section I will describe the methods that I used in my dissertation work to collect and analyze data. Detailed information about the data I collected for each of the individual studies appears throughout this document; in this section, I provide an overview of my methods for collecting that data, my rationale for choosing them, and my approach to analysis.

Phenomenological Sociology and Interviewing as a Primary Source of Data

I have used a variety of data collection methods including in-situ observation, log files of wiki activity, interviewing, and pre- and post- testing. The empirical anchor for my research is the interviews I conduct with research participants; other methods provide me with supporting data that help me understand and interpret the words of interviewees. From phenomenological approaches to sociology, I have adopted the assumption that knowing about a social space involves gaining access to the experiences and interpretations of people who live in that world. These same assumptions were articulated by Irving Siedman in his book on *Interviewing as Qualitative Research*: "at the root of in-depth interviewing is an interest in understanding the experience of other people and the meaning they make of that experience" (Seidman 1998) (p3).

From oral history, to interrogation, to journalism, different traditions of interviewing emphasize different techniques for interacting with interviewees. In my Wikipedia work, my interviews were semi-structured and designed to elicit reflections about interviewees' experiences that could help me understand specific issues like participation and governance. My interview work in schools presented some special methodological challenges. I was interested in understanding students' processes for constructing wiki articles at a fine level of detail. Naturally, it is difficult to capture students' process for completing homework assignments. School writing happens at different times and in different places—at home, at the library, in the classroom and any other place students have access to a computer. Some students wrote sections by hand and then typed them up. I was seldom present to observe what students did as they completed their homework assignments. Wikis partly mitigate this problem by providing a log of all editing activity on the site; however, as I will demonstrate in my discussion of my pilot study in Chapter 4, comparisons between the wiki editing history and students' explanations of their process for revising their work revealed that the editing history was insufficient for understanding their process. Obviously, an edit history reveals little about what the editor was thinking about. Furthermore, many students revised extensively offline before making changes on the wiki. To address these challenges, I devised a strategy of using a three-phased approach to interviewing.

At the beginning of interviews, students typically led the conversation by responding to very broad prompts like "Tell me about your classes?" and "Describe the kinds of things you use a computer for." This relatively unstructured approach led to a range of topics being covered. Once I had a sense of what the student felt was relevant, I turned to a semi-structured approach and used a topic guide to ensure that certain data points were obtained for each student. Interviews also had a more formal segment, during which students reconstructed their writing activities. Finally, I asked students to review their writing with me, including revisions when applicable, and to reconstruct their process for

constructing the text. Students explained changes they made from macro-level changes in the structure of their document to micro-level changes in word choice or citations. By grounding their explanations in documentation of their revisions, I did my best to strike a balance between the fallibility of memory and the incompleteness of the editing history itself.

Interviews and other forms of verbal protocols have been critical for researchers of social systems whose epistemological stance is derived from phenomenological literature. Still, verbal protocols present some interesting problems. Although many researchers—myself included—are committed to the idea that participants' own interpretations of their actions are critical for understanding human action, human memory is notoriously fallible. What if students simply don't remember what they did? Moreover, the very idea that research participants should be respected as theorists in their own right, who constantly construct accounts of their actions to make sense of the world within a particular social context (Dervin 2000), (Garfinkel 1967) introduces doubt about their ability to accurately describe what they *were* thinking at any given moment in time. How do I know that students really thought and did what they say they thought and did? Finally, the research interview is a particular kind of social context for making sense of one's actions. Because interviewing is itself a social event, the interviewee is performing for the interviewer, reconstructing his experiences for a particular audience, for a particular reason. If a teacher interviews students about their experiences on a school wiki for feedback on the assignment, it is likely that the students would respond differently than if a peer interviewed them for the school newspaper, or a graduate student interviewed them for a dissertation. So which of these is the "real" wiki experience?

The final two of these methodological concerns are in part mediated by the phenomenologist's explicit interest in constructed social meaning. If research participants construct explanations to account for their actions rather than simply recount decisions

they made, it is precisely this construction that researchers want to tap into in order to understand the social system in which the participants' actions took place. It is interesting for me to know how students account for their writing activity after the fact because this tells me about their understanding of the task and what was important *to them* about their actions.

Ericsson and Simon addressed methodological concerns with verbal protocol analysis in service of obtaining accurate and valid data about cognition during the completion of a task (Ericsson and Simon 1993). For them, verbal protocols are about gaining access to the cognitive processes of research participants in order to better understand phenomena like decision making and problem solving. Although interviewing plays a somewhat different role in my work, I was also concerned with obtaining realistic accounts of process from my participants. Ericsson and Simon suggest that video of a task session can be used for stimulated recall, or as a basis for asking participants to reconstruct their thought processes more reliably. I used wiki editing history similarly to Ericsson and Simon's proposed use of video. By reviewing what students had done over time and asking them about it, I was able to moor their reconstructed process to actions that were recorded in the writing environment. This was not a perfect solution—some students had very noisy edit histories including hundreds of formatting tweaks and others did much editing offline—however, it frequently served as a stimulus for students to recall the different steps they took.

Grounded Theory

In my classroom studies, I used grounded theory as described by Glaser and Strauss (Glaser and Strauss 1967) (see also (Strauss 1987) (Strauss and Corbin 1998)) to develop explanations of students' writing practices based primarily on interview data and supported by observations and other data. Grounded theory is an inductive approach to understanding a phenomenon, in which researchers use iterative rounds of data collection

and coding in order to work from empirical data to construct theoretical explanations of the phenomenon under investigation. This is an appropriate method for building a description and explanation of process that is grounded in actual practice. I chose this approach because I set out to understand from the students' perspective how they make sense of participatory media and where their processes for constructing media afford opportunities for learning.

Broadly speaking, the theory building process consisted of two phases. The first, open coding, involved closely examining all the data multiple times in order to identify salient concepts that occurred in the data and label these segments of the data so that they could be revisited. For this phase, I used the open source software WeftQDA to support analysis in my first classroom field study and the commercial package ATLAS.ti in the second classroom study. The second phase of analysis, axial coding, involved revisiting each identified concept, examining its properties and the relationships between concepts to create explanations of how students' thought about and assessed information in the context of their writing activities. The goal of this analysis was to identify one or two core concepts that provide the foundation for building a theoretical framework to explain what I saw. The axial coding phase of analysis was done using concept mapping software Inspiration! and the built-in concept network view in ATLAS.ti.

The outcome of grounded theory is a set of propositions about the phenomenon of interest; propositions are suggested, not proved. "The result of grounded theory is an explanation of a set of practices" (Grinter 1998) (p 395). My explanation of students' information literacy practices as they engaged in the construction of wiki articles and the data that support my interpretation are presented in Chapters Six and Seven. In this section, I will describe the process I used for constructing these explanations.

My explanation of information literacy practices among students is grounded in two rounds of data collection in Atlanta-area high schools. Coding of the data was an ongoing process, the second round of data collection allowed me to build on and extend what I learned in the first. In grounded theory, data collection and analysis are concurrent; as analysis reveals areas of theoretical interest, more data is collected in a targeted fashion. Because my studies were design-based and conducted in classrooms, I was not able to simply go "back" into the field to collect more data at will; I had to arrange for another study iteration using the same technology and writing activities in order to collect more data. In my first classroom field study, I began the process of coding student interviews to understand their processes for using and constructing information sources. I found that I had a great deal of data that spoke to students' information seeking and assessment practices, but little data to help me connect these practices to their writing activities. This resulted in initial concepts that described strategies students used when they searched for information on the web and allowed me to construct the taxonomy of information assessment strategies described in Chapter Six. In other words, I was able to identify concepts in open coding and begin the process of axial coding, but could not move any further to select primary concepts that would help me *explain* process.

The dearth of process data was due to two related challenges that I faced in the first field study. In Chapter Five, I will describe the setting and participants for each of the field studies in detail; here I will describe how data collection and analysis were interleaved. The first study iteration was long; data collection took place over eight months. Students in the first study completed seven wiki assignments. This meant that understanding students' processes for finding, assessing, and constructing information sources was spread over long periods of time and changed with each assignment. Process was difficult to study in this long time frame. A second problem compounded the challenge of studying process—students in the first field study resisted being interviewed. In order to interview students, they needed to agree to meet me either before or after school, or

during their lunch break. Even students who enthusiastically agreed to the first interview resisted scheduling subsequent interviews. Not only did I obtain fewer interviews than I would have liked, but they were staggered over long periods of time. These interviews yielded good information about certain aspects of practice—for example, search and information assessment—but the data were too sparse to support the kind of explanations that I sought to construct about how participation in building an information source for others served as a context for information seeking, assessment and use. In order to collect more data to extend my analysis, I conducted a second study, in a similar context using the same technology. I used several of the same data collection methods and a similar interview guide so that I would be able to discern if students were engaged in comparable activities; however, I also modified interviews to focus on phenomena of interest that were not well represented in data from the first study. In addition, the second iteration was much shorter and the students proved more amenable to being interviewed. In this way I was able to deepen my understanding of students' activities through iterative data collection and ongoing analysis. In Chapter Seven, I present the outcome of these iterations as a grounded, theoretical explanation of students' writing process and the opportunities for reflection and learning that their experiences yielded.

Grounded theory as a method is congruent with my overall interpretive, critical approach to research. It is compatible with interviews as a data collection method because it assumes that the researcher discovers meaning through data—in this case, the reflections and actions of participants. The use of interviews to understand process was strengthened by my observations and by my method of retrospective reconstruction of writing activities using wiki artifacts as a basis for reflection. It is important to note that grounded theory is not concerned with counting the frequency of particular phenomena in the data, but with the conceptual coherence of the framework that is crafted to explain the variety of phenomena that is present in the data; however, at various points in the document, I

use quantitative descriptions of wiki activity to help readers understand what students and other participants did.

CHAPTER 3
INFORMATION IN THE AGE OF WIKIPEDIA

Social Media and New Publishing Models

Imagine you recently learned from your doctor that you are insulin resistant. If you are like 80% of Internet users, one of the steps you would take to educate yourself about this condition would be to search for information online (Fox 2005). But how would you decide which sources to trust? How might your understanding of publishing play a role in helping you make decisions about your health? In the first chapter, I discussed the problem of information literacy. People sometimes have difficulty assessing the quality of information sources they find and, it has been argued, young people in particular struggle with assessing Web-based sources (Kafai and Bates 1997) (Wallace, Kupperman et al. 2000); (Kuiper, Volman et al. 2005). I suggest that part of this problem stems from a lack of understanding about how these sources are produced and managed.

Helping people learn to critically assess sources has sometimes been portrayed as a typical learning problem: expert practices need to be made accessible to a generation of learners. Research has sought to identify differences between expert and novice strategies for assessing information sources (Wineburg 1991); however, the recent proliferation of user-generated content has complicated matters. Sometimes experts disagree altogether about what constitutes a reliable source. In the absence of agreed-upon expert practices, what should people learn?

Wikipedia sits at the center of this confusion. Students, teachers, parents, and researchers alike often do not understand how to critically assess Wikipedia articles because there is no widely shared understanding of how information production is regulated in a wiki environment. The nomenclature of "Web 2.0" represents, among other things, broad recognition of new, distributed models of information production. Strategies like metacognitive prompts can help novices become more reflective about the sources they use (Stadtler and Bromme 2007), but without a clear understanding of how publication works, it is unclear that novices have a useful model on which to reflect. Before people can learn to assess sources like Wikipedia, they need to first understand how such resources are created and maintained. That is the first goal of research presented in this document.

In this chapter, I begin to explore the phenomenon of new models for information production through the case of Wikipedia. I review the literature on Wikipedia and present findings from several studies I conducted that demonstrate how the community of Wikipedia functions. I collaborated in four rounds of interview studies to examine both how people become proficient encyclopedia editors on Wikipedia and how the site is structured socially and technically. My findings counter the "million monkeys" misconception: Wikipedia is not a receptacle for the random musings of anyone on the Internet, it is a community of cooperative authorship in which policy and tradition govern editors' behavior and protect the integrity of the resource. This is a model of publishing that has not existed before and requires careful examination to understand, assess and value appropriately; however, I have found that as a community, it behaves much in the ways that theories of off-line communities predict it should.

Understanding Wikipedia

"The problem with Wikipedia is that it only works in practice. In theory, it can never work."

– New York Times, 2007

No-one's quite sure who first said it, but the above quote has become a favorite among Wikipedians. For a scholar, it reads like a challenge: if our theories can't explain Wikipedia, then our theories need some work. Wikipedia surely isn't magic, but without a clear public understanding of how it works, misconceptions are sure to arise. In my interviews with students, I heard a variety of explanations of Wikipedia and a variety of strategies for using it. Never use Wikipedia, it might be wrong. Only use it in conjunction with other sources. Use it but don't cite it. Use it, but only if you cite it. Use it for personal things, but not for school. In order to know how to use Wikipedia appropriately and what to teach young people, we first need to understand how it works.

Scholarly research on Wikipedia has examined many different facets of the organization. Comparatively little research has focused on the artifact itself—Wikipedia as a product. One example of such research is the 2005 Nature article comparing the quality of a sample of Wikipedia articles to a sample of Britannica articles as determined by a panel of experts. Wikipedia came out the underdog but by a surprisingly narrow margin (Giles 2005). The methods and interpretation of findings were highly contested by Britannica (Encyclopedia Britannica 2006); however, the much-cited study remains one of the only examples to date of comparative studies of quality that ranks Wikipedia among other reference works.

In another comparative study, Emigh and Herring applied discourse analysis methods to better understand genre differences between Wikipedia articles and other information sources (Emigh and Herring 2005). They found that, unlike the online encyclopedia Everything2, Wikipedia entries are stylistically indistinguishable from those found in a traditional, print source. They attribute this surprising result to the fact that, because it is a wiki, multiple authors and revision cycles are common on Wikipedia. On Everything2, entries are owned and edited by individual users; if the content needs to be revised, the

author receives comments from peers and can revise the entry. These findings suggest that the traditional model of publishing print resources does not yield comparable results in the collaborative, voluntary, online environment. In this case, a new publishing model better supports a seemingly conventional goal—writing in an encyclopedic style.

Most Wikipedia research, including my own, has focused on understanding Wikipedia as a community—its culture and social structures, quality control mechanisms, governance in the site, and the experiences of its authors. Viegas et. al.'s *history flow* visualization method was developed to examine editing trends on wikis   (Viegas, Wattenberg et al. 2004). Application of the *history flow* method to Wikipedia allowed the researchers to recognize and describe four patterns of cooperation and conflict on the site: vandalism and repair; anonymity versus named authorship; negotiation; and content stability. They conclude that the Wikipedia interface is designed to encourage surveillance of others' contributions. For example, watch lists help community members find and repair vandalism. In addition, the discussion pages provide a space for reaching consensus that is separate from the article space. Finally, the emphasis on neutral point of view provides an underlying principle that guides dispute resolution. These design elements and the culture of Wikipedia contribute to the enterprise of creating a collaborative encyclopedia by separating conflict from the articles themselves and emphasizing the importance of consensus.

Much quantitative research on Wikipedia has sought to analyze editing activity to understand community practices. In some cases, this approach has been used to suggest ways of supplementing human labor and judgment with automated tools. For example, Burke and Kraut used edit counts to model the editing activity of successful candidates for promotion to administrator status and suggest that the model could be used to identify candidates for adminship or to facilitate discussion about the merits of various candidates (Burke and Kraut 2008). Kittur et. al. examined edit counts to determine what kinds of

users do most of the work on Wikipedia (Kittur 2007) and uses public visualization of edit counts to boost perceptions of Wikipedia reliability (Kittur, Chi et al. 2008).

Processes of coordination in Wikipedia have also been examined; Kittur et. al. quantified conflict and coordination costs at global, article, and user levels and moved in the direction of identifying groups of collaborators by mapping out "revert relationships" among editors (Kittur, Suh et al. 2007). Kittur and Kraut examined the relationship of explicit and implicit approached to coordination with the quality of Wikipedia articles. Explicit approaches are characterized by overtly setting goals and making a plan for meeting them and implicit approaches involve editing the page in such a way that it leaves work for someone else to finish . They found that both approaches are effective but that explicit coordination was correlated with smaller numbers of collaborators and implicit coordination with larger number of editors (Kittur and Kraut 2008).

Many researchers have focused on interactions on talk pages as a way of examining processes of conflict and coordination. In more recent work, Viegas et. al. as well as Kittur et. al. demonstrated that Wikipedians use talk pages to engage in a variety of coordination activities (Kittur, Suh et al. 2007; Viegas, Wattenberg et al. 2007). Kriplean and Beschastnikh et. al. analyzed active discussions to understand how policy is used to support coordination activities in Wikipedia. In a study of sixty-nine talk page discussions, Kriplean et. al. found that the invocation of policy in talk pages serves as a catalyst for discussions and also plays a role in facilitating power plays and territorial behavior (Kriplean, Beschastnikh et al. 2007). Beschastnikh et. al.'s quantitative analyses of policy citation practices revealed that these practices have increasingly stabilized over the life of the encyclopedia and that citation of policy is an inclusive practice engaged in consistently by administrators and regular users, veteran policy citers and new policy citers (Beschastnikh, Kriplean et al. 2008). These findings of widely spread policy citation practices suggests that governance in Wikipedia is a process that is engaged in by

a broad cross-section of Wikipedia community members. In the next section, I will present a summary of my own findings from an empirical investigation of Wikipedia governance (Forte, Larco et al. 2009).

Wikipedia Governance

In order to understand Wikipedia as a model for publishing a reference work, it is important to understand the social system that governs the behavior of contributors to the encyclopedia. Governance in the Wikipedia community includes both quality control mechanisms for the content of the encyclopedia and rules that regulate the behavior of the individuals who contribute. Through in-depth interviews with twenty individuals who have held a variety of responsibilities in the English-language Wikipedia, I obtained rich descriptions of how various forces produce and regulate social structures on the site. Although Wikipedia is sometimes portrayed as lacking oversight, my analysis describes Wikipedia as an organization with highly refined policies, norms, and a technological architecture that supports organizational ideals of consensus building and discussion. In this section, I present findings from a study of Wikipedia that explain how governance on the site works, how it is becoming increasingly decentralized as the community grows and how this is predicted by theories of commons-based governance developed in offline contexts.

Wikipedia governance is always changing, adapting to new challenges. One of these challenges has been the substantial growth and flood of new editors that has accompanied the site's popularity. Models of Wikipedia editing activity suggest that growth is sustainable (Spinellis and Panagiotis 2008); however, this growth comes with costs. Kittur et al. and Viegas et al. have noted that as Wikipedia has grown, the costs of coordinating activities have also grown (Kittur, Suh et al. 2007) (Viegas, Wattenberg et al. 2007). I describe the ways in which governance in the site is becoming increasingly decentralized over time as the community responds to the challenge of growth and why

the form that decentralization takes, including the emergence of subcommunities called WikiProjects, is consistent with literature on commons-based resource management. The trend of decentralization is noticeable with respect to both content-related decision making processes and structures that regulate user behavior.

I build on the work of Viegas et. al. in using Ostrom's principles of self-organizing communities to understand governance mechanisms on the site (Ostrom 1990; Ostrom 2000) (Viegas, Wattenberg et al. 2007). I borrow from the literature on self-organizing communities to analyze the structure of Wikipedia governance. Elinor Ostrom's eight design principles for self-organizing communities that manage natural resources are as follows (Ostrom 2000):

Principle 1. Clearly defined community boundaries

In order to define who has rights and privileges within the community (traditionally rights to draw on the resource being managed) the community must be clearly bounded.

Principle 2. Congruence between rules and local conditions

The rules that govern behavior or resource use in a community should be flexible and based on local conditions that may change over time, or from one part of the community to the next.

Principle 3. Collective-choice arrangements

In order to best accomplish the congruence called for in principle 2, principle 3 suggests that people who are affected by the rules of the community can participate in changing them.

Principle 4. Monitoring

Some individuals within the community act as monitors of behavior in accordance with the rules derived from collective choice arrangements.

Principle 5. Graduated sanctions

According to Ostrom's principles, community members actively monitor and sanction one another when behavior is found to conflict with community rules. Sanctions against members who violate the rules are aligned with the perceived severity of the infraction.

Principle 6. Conflict-resolution mechanisms

In cases when rules need to be interpreted, parties in conflict need access to low-cost, local conflict resolution mechanisms.

Principle 7. Local enforcement of local rules

Local jurisdiction to create and enforce rules should be recognized by external, central authorities.

Principle 8. Multiple layers of nested enterprises

By forming multiple nested layers of organization, communities can address issues that impact resource management differently at broader and very local levels.

Ostrom's principles were derived from studies of communities that manage natural resources. Although Wikipedia is not a natural resource, it is a valuable one. Community members strive to manage Wikipedia namespace as its value increases with the site's popularity and the consequences of misuse become more dire. It should be noted that, like many natural resources, namespace is consumable; only one article exists on any given topic in Wikipedia and improper use of namespace, though recoverable, is a loss. Of course, differences do exist between online and physical resources. For example, in communities studied by Ostrom, defining membership boundaries is important because members reap the rewards from resources being managed. In the case of Wikipedia, this distinction does not have the same meaning since millions of people outside the community benefit directly and immediately from the efforts of its membership.

Ostrom's work is a natural fit for understanding processes of governance on Wikipedia because the community is not only managing a resource, it is striving to encourage

collaboration and cooperation among volunteers. Ostrom's work is built on the proposition that the evolution of social norms within a community is a more effective means of accomplishing cooperation than the imposition of external rules. She notes not only that social norms are equally effective at "generating cooperative behavior" but also that "moreover, norms seem to have a certain staying power in encouraging growth of the desire for cooperative behavior over time, while cooperation enforced by externally imposed rules can disappear very quickly" p.147 (Ostrom 2000). Preece echoes this sentiment with the observation that social capital is developed in online communities when policies are subsumed by community-determined social norms (Preece 2004). In Wikipedia, governance is less akin to rule imposition by external authority than to constant reform and refinement of social norms within the community.

In his chapter on governance of synthetic worlds, Castronova notes that one clear obstruction to community-organized governance online is when users are not equipped with the technical powers required to perform acts of governance (Castronova 2005). The idea is not new. Morningstar and Farmer argued as early as 1990 for developers to relinquish control, and that users "should be able to materially effect each other in ways that went beyond simply talking, ways that required real moral choices to be made by the participants," and recommended that "a virtual world need not be set up with a 'default' government, but can instead evolve one as needed" (Morningstar and Farmer 1990). The potential for sophisticated, community-generated social norms and governance mechanisms is partly a designed feature of the technological architecture in which the community grows. In other words, artifacts have politics (see (Winner 1986)) and code influences the development of policy and norms. Not all wiki platforms are the same— some platforms include permissions structures, voting mechanisms, and other features that provide different affordances for the development of social structures. In their analysis of Wikipedia governance, Butler et. al. suggest that the power of wikis as collaborative environments is their flexibility; they can support diverse forms of social

organization (Butler, Joyce et al. 2008). The founder of Wikipedia, Jimmy Wales, explained in an interview that "insofar as possible, the software should leave the social rules open-ended… in terms of how the software is designed to support social mechanisms, it's a design of not interfering with or not attempting to pre-specify those social mechanisms." In Wikipedia, code, policy, and social norms all support the wide distribution of power to govern.

Before launching into a thick description of regulatory mechanisms in Wikipedia, it is helpful to understand some of the different kinds of social roles that make up the community. Power relationships that exist on the site are complex and subtle; however, I have identified three basic user states that affect in fundamental ways the kind of social authority individuals can exert in the English language site: unregistered user, registered user, Arbitration Committee member.

Unregistered users can exert little individual influence in shaping policy and establishing norms, but en masse they represent an important part of the context in which day-to-day operations take place. In most cases, unregistered users have the ability to edit the encyclopedia freely but one interviewee noted that their ability to influence content is weaker than registered users, "You can't track anything. The community views their edits to be particularly suspicious" (I7).

Registered Users includes everybody else on the site; I will use "regular users" to refer to registered users who hold no special technical powers. It is impossible to describe all the possible roles that regular users can play and the nuanced forms of authority they may hold. Power relationships are difficult to define. "It's such a strange place because the structure is so informal" (I5) and, ultimately, "power in Wikipedia is: sufficient people listen to you and are inclined to consider what you want done" (I10). Boundaries that

define community relationships are flexible and indistinct; however, Wales suggested that community boundaries are undergoing a process of demarcation.

The *Arbitration Committee* wields considerable influence in the community. The Arbitration Committee (Arb Com) was conceived of as the last step in a formal dispute resolution process put into place in early 2004; however, today it appears to often serve as a more general decision-making body for the English language site. Arb Com was initially charged with interpreting policy and making binding resolutions in the case of interpersonal disputes. Explained one Arb Com member: "It's kind of a quasi-legal type of thing. Some people like it, some people don't, but hey, it works" (I7). Committee members are selected through a hybrid process of election by the community and appointment by Jimmy Wales. Arbitrators have no special authority with respect to content or any formal power to create policy, yet I found that Committee action can play a role in influencing both policy and content.

The data that I use in the next sections to explain Wikipedia governance is drawn from interviews with individuals who are involved in the governance of the site. As I explained in the previous chapter, interview-based research is about the participants; what one can learn from them is constrained by their experience. Sampling methods, then, are a critical feature of this study. I used a layered approach to strategically recruit participants who could provide me with insights about specific issues that I wished to understand better. I began by soliciting five interviews from long-standing, central members of the community who told their stories about how norms, policies, social roles, and software have changed over time. When themes began arising over and over in these interviews, I followed up by recruiting participants who had been involved in particular issues and policies. In all, nineteen individuals were interviewed by telephone and one via email, all of whom had been involved in the site in many different capacities (See Table 2 for a breakdown). These interviews resulted in roughly sixteen hours of audio.

Table 3: Selected Interviewee Roles

Site and Wikimedia Foundation founder, Jimmy Wales
Arb Com member/former member (6 interviews)
Regular user (5 interviews)
Involved in Wikimedia Foundation (3 interviews)
Volunteer contributor to MediaWiki software (1 interview)
WikiProject founder and/or participant (15 interviews)
Users with some combination of access levels including: administrator, checkuser, oversight, bureaucrat, steward, developer (10 interviews)

Policy in Wikipedia

Wiki policy is fluid. Traditionally, it has tended to echo community practices rather than prescribe them. Explained one Arb Com member, "even though they're written down, anybody can edit a policy page even, because it's a wiki. That includes every single policy that exists. So it's possible on any given day that a policy—this is what's kind of odd, I think—can not really reflect exactly what is right" (I4). This openness might initially give the appearance that policy on Wikipedia is "up for grabs" by anyone who wanders along when, in fact, the creation and refinement of policy is a complex social negotiation that often takes place across many communication channels and in which power, authority and reputation play decisive roles. I found that on-wiki activity only accounts for a portion of governance activity on the site. Often, critical decisions are discussed in public and private IRC channels, mailing lists, personal email, and other off-wiki communication.

Policies are not the only "legal" artifacts on the site. *Guidelines* are strong recommendations for behavior, content, stylistic conventions and the like that are not followed as strictly as policy. Policies and guidelines are similar in that they are established by consensus and require broad community support. Other artifacts of governance include essays, policy proposals, rejected proposals, Arb Com decisions, and pages of historical significance. In several dimensions, I found that governance mechanisms around policies and guidelines are becoming increasingly decentralized as the site becomes larger (see Figure 1).

	of content-related policy/guidelines	of behavior-related policy/guidelines
Creation		has slowed
Modification	has become increasingly decentralized (WikiProjects)	is done by consensus
Interpretation		has become increasingly decentralized (Wales -> ArbCom -> Admins)
Enforcement	is done by consensus (WikiProjects have no local authority)	remains distributed among admins

Figure 1: Trends in Management of Wikipedia Policies and Guidelines

In the early days of Wikipedia, the community was small and policy making was less formal. One interviewee mentioned that the editor-in-chief of Nupedia, Larry Sanger, played a large role in guiding the earliest Wikipedia policies. Because we did not interview many individuals who were active in that stage of the project and because we do not have access to the earliest policy-related wiki pages, we do not have detailed data about those earliest policy making efforts. We do know that early policy making on the

site was comparatively informal and done in an ad-hoc fashion. This process has become more formalized over time as the site grew and informal consensus became harder to manage.

> In the early stages it was just a matter of just a couple people getting together and saying "Does this work? No not really. Does this work? Yeah, I think that's good… Let's just do this. At least for now." And that "at least for now" part is really ironic because now it's hard set policy. (I7)

> When we made that [undeletion] policy there wasn't a policy on how to create policy, which there is now. [laughs] So it was done very informally, just people discussing it together… The reason [the policy on how to create policy] had to come about is that people just kept writing pages up and then other people didn't know whether it was policy or not. And in the early days that just wasn't a problem because you could just go in and discuss, ok, is this really policy or is this just someone's idea? But as the project got larger, new people coming in and reading these pages and not knowing whether it was just someone's random thoughts one day or whether the whole community agreed with it. So they got a little bit more formal about tagging things as policy or policy-in-development or rejected policy or whether it's just an essay and not a policy at all. (I1)

Wales noted that today there are a few common forms of policy making:

> You can have a community-wide vote with a fairly overwhelming majority and that will normally then cause something to become policy. You can have someone just boldly going in and changing policy and if it sticks, it sticks… The last way that policy can get made is I just say so. And that's done very rarely and I don't do it unless I feel I have strong support from the community.

Although he has introduced policy and policy modifications, Wales' changes have generally already been discussed by many individuals. His support of a policy appears to be more often a culmination than a germination of policy discussion.

Some interviewees suggested that policy making has not just become more formal, but that policy making efforts have slowed in recent years:

> I think that as the site got older and there was a lot of policy there already it wasn't necessary to create new policies even though people are still doing that. (I1)

> The reality is there's been very little change in policy since Wikipedia became wildly popular. If you look at where policy was at in say the beginning of 2005 and where it's at today there's very little difference. What's happened is that since policy making is by consensus and the number of active contributors has grown into the 1000s, it's almost impossible to achieve consensus anymore. (I5)

The process for removing policy is embedded in the detailed specifications for removing articles from the site. A close examination of this process is beyond the scope of this dissertation; however, it is important to note that article deletion is usually grounded in the "WikiProcess" of discussion and consensus building, with some exceptions for blatant examples of vandalism or content-related policy violations. Consensus building among interested parties is the foundation of nearly all decision making on Wikipedia; this norm embodies Ostrom's third principle of successful self-governing communities: collective choice arrangements, meaning that those who are affected by the rules of a community have the ability to participate in modifying them.

Decentralization in Policy Creation

The problem of achieving consensus about content guidelines as the organization grows has led to a proliferation of small, decentralized social structures. These nodes, called WikiProjects, are particularly important when it comes to developing guidelines for stylistic conventions and the creation of content. One might think of these as local jurisdictions in the site, within which local leadership, norms, and standards for writing are agreed upon by editors familiar with a particular topic, in accordance with Ostrom's second principle of self-governing communities, that local rules should be devised in accordance with local needs and conditions. Here we will explain the role of WikiProjects in the site as a whole; in a later section we will provide more detail about governance within the projects themselves through a case study of one of the largest and most prolific WikiProjects: Military History.

WikiProjects are most commonly organized around subject matter; however, many WikiProjects for specific tasks such as creating audio versions of articles (Spoken Wikipedia), or identifying and eliminating bias (WikiProject Countering systemic bias) also exist.

> One thing that is worth mentioning is that there's a lot of niche areas in Wikipedia… Often times it comes down to what do the people who are interested in that particular niche, what is the standard way of doing it will come down to what do those 4 or 8 people agree on. (I6)

> The fact that it's gotten so big, it's hard—people can't keep up to date with everything that happens anymore. So in a sense I think the growth of WikiProjects has been partly a reaction to that. In that, you know, you no longer feel part of a community of thousands and thousands of people. So people set up smaller communities. (I10)

> As it gets larger it's kind of hard to know everyone who's there, so… people try and find new ways of dealing with issues when they don't know everything that's going on… from the content side, WikiProjects are formed to kind of focus on articles in a particular area. And they can develop policies that just relate to their area. So it enables people to still work together within a small community even though Wikipedia itself is a really huge community. So I think this kind of breaking up within Wikipedia itself is one of the ways that it's changing. People are organizing themselves into smaller groups so they can still work the same way they did originally. (I1)

Even within WikiProjects, one interviewee remarked that it is often preferable to leave stylistic guidelines loosely defined:

> We [WikiProject Military History] have a number of style guidelines, but most of them are presented as recommendations, rather than something that is necessarily enforceable. In a lot of cases, we have a lot of very talented article writers so we found that it is better to let them decide what exactly needs to be done to an article rather than trying to come up with a one size fits all policy that we have to enforce on them. (I20)

WikiProjects run into governance issues themselves when two or more projects claim that a particular article falls within their province or when there is a need to enforce local policy. Essentially, no governance mechanisms exist to address either of these situations

directly and users employ the standard wiki process of discussion and consensus building. When it comes to local disputes, keeping up good relations with neighboring projects is important. One interviewee explained that he acts as the informal organizer for one WikiProject and that this involves liaising with projects in related subject areas "to make sure that everybody is on the right track when editors from other projects come and edit [our project] pages, this kind of thing." (I2)

Another interviewee explained that not long after starting a WikiProject, he left because participants were not interested in following guidelines that he felt ensured quality content production. He told us that:

> In the case of general guidelines or policies that exist for Wikipedia articles under normal circumstances, people can get chastised or ostracized by the community for constantly breaking those … Now in the case of the [WikiProject] obviously you can't do that" (I8)

Another WikiProject founder observed that WikiProject guidelines are nested within but must not deviate from general Wikipedia guidelines: "we always have to base our guidelines on the ones of Wikipedia. And of course, we can't become a unique wiki inside the whole Wikipedia" (I9). One interviewee suggested that the authority of WikiProjects to manage themselves is viewed with some misgivings:

> I suspect that as the site gets bigger, WikiProjects will have more of an influence because there can't be as much central authority, the place is simply too big. Groupings of editors interested in a particular topic will— that may also be a problem in that groups of editors might decide to overwrite important site-wide goals. And I think that will be a source of conflict in the future. (I10)

One interviewee noted that projects have no special authority to defend their content and fall back on the Wikipedia standard of patience and persistence:

> [WikiProject] Military History as a group has no authority so if someone wants to trash an article that's under the Military History project, there is nothing the Military History folks can do about it. So it winds up being

whoever has the patience to keep revising the article long enough wins.
(I16)

So, for the time being, WikiProjects exist as an administrative structure that carries out many of the functions related to organizing content production and setting editorial standards and stylistic convention. Ostrom's principles 7 and 8 can be recognized in the organization of WikiProjects as nested enterprises within the whole of Wikipedia. They have the authority to devise their own local stylistic conventions; however, they may not always have the authority to compel editors to follow those rules. The emphasis on setting stylistic conventions within WikiProjects is consistent with Beschastnikh et. al.'s finding that site-wide policies regarding writing style have been cited with decreasing frequency over the past several years (Beschastnikh, Kriplean et al. 2008) .

A counterexample to the trend of decentralization in Wikipedia can be found in the case of policies regarding behavior on the site that could result in harm to individuals or represent a direct legal or financial threat to the Wikimedia Foundation. Some such policies are simply "inherited" by the Wikipedia project from the Foundation, such as rules regarding copyright. Sensitive issues regarding children or illegal activity have also motivated unilateral decision making by Arb Com and Jimmy Wales. Decisions that threaten the well-being of project contributors or the health of the Foundation may result in policy setting that is uncharacteristically opaque, centralized, and not open to discussion.

Policy making has in one sense always been highly decentralized because it requires consensus of the community to stick. As I will demonstrate in the next section, even if some policies are initiated as unilateral decisions by central authority figures, it requires the consent of the governed to actually become policy because enforcement remains highly decentralized.

Decentralization in Policy Interpretation and Enforcement

In order for Wikipedia policy to matter, someone needs to decide when it applies and enforce it. When it comes to interpretation and enforcement, Wikipedians make some distinctions between content-related and behavior-related policy. Interpretation of content-related policy tends to be highly decentralized. The entire community monitors content and if a dispute arises, it is generally resolved through discussion by the people involved in the situation. When behavior-related policy is broken, a series of graduated sanctions can be imposed that begin with the posting of warnings and can lead to banning from the site. Ostrom describes precisely such a system in her 5th principle, graduated sanctions, which calls for community members and community leaders to actively engage in assessing infractions and levying sanctions as appropriate. In Wikipedia, if a dispute or behavior-related policy infraction cannot be resolved locally using mild sanctions by the people directly involved, it can be referred to a formal, centralized dispute resolution process with the authority to impose more severe punishments, in accordance with Ostrom's 6th principle, which is access to dispute resolution mechanisms. We found that growth of the community has resulted in increasing decentralization of the final stages of dispute resolution and severe sanctions.

When the community was young, Jimmy Wales often handled interpersonal disputes by fiat, so authority was as centralized as it possibly could be. As the community grew, his ability to invest the time necessary to make good decisions was reduced. Eventually it was necessary to create a formal process and a kind of judicial body that could interpret official policy in the best interests of the project.

> Originally Jimmy Wales had the power that the Arbitration Committee has. You know, the power to ban people, the power to put restrictions on people above and beyond the ordinary ones imposed on everybody. So in a sense our power is the devolved power from the king so to say. (I10)

> There was no way that Jimmy was able to keep up with all the type of crap that was going on really and he needed help. (I7)

As with the reification of practice in other policies, the formalization of dispute resolution also alleviated the difficulty of communicating common practices to newcomers, which was important for the growing community.

> As the site got larger… people who were having a problem didn't really know who to go to. It's not like when there's a small community, you know who to go to because you know who the lead people in the community are. Once it gets larger and you don't know everyone anymore, you don't really know if there's anyone to turn to, what to do about this problem that you're having. So I think it made it a lot easier for new people who are coming in and finding themselves in some sort of fight to get help from a more experienced editor. (I1)

I understand from interviewees that Arb Com procedures underwent an initial period of refinement, but after nearly three years of operation, Committee procedures have stabilized as a quasi-legal process of collecting evidence and statements, deliberation, and issuing findings of fact, principles, and remedies.

The role of Arb Com seems to have changed from a dispute resolution body to a more general decision-making body and counsel. Although arbitrators were not charged with creating policy, and cannot officially take policy-making action, their actions may have far-reaching repercussions on how policy is interpreted and even on the creation of policy in the site.

So with the creation of the dispute resolution process, final interpretation of behavior-related policy moved out from Wales to Arb Com. Today it is in the midst of further decentralization. Despite the traditional division between technical and social powers on the site, administrators are beginning to step into more authoritative roles and are making more and more interpretive and "moral" decisions about user behavior. Nearly every interviewee suggested that, for better or for worse, the role of administrator carries with it more social authority today than it ever has in the past.

Originally the whole idea of administrator was seen as somebody that was seen as more custodian, you know? And they have in some ways turned into more—I mean there's a group of administrators who work at more policing problems, disruptive problem editors and don't just do like cleaning up vandalism and removing stuff that is just not appropriate. (I4)

As time goes on, we're now to the point where the Arb Com can't possibly hear all of the cases that come up and so you see administrators getting together having adhoc decisions about what to do with a user and kicking people off of the site when they think it's justified and when they think they'll have support from the arbitration committee and the community at large. –(I5)

Arb Com is… taking fewer less complex cases and leaving the easier ones to sort out to the administrators. That has been the trend. (I6)

We have the development that the administrators more and more are assuming the roles and the discussing the things and making the decisions. Because we're just a small group of people and we hear a few cases but the bulk of the action is actually in the larger committee of the administrators. (I3)

It's less and less of a janitorial role and it's becoming a little bit more, at least from what I've seen, more and more of an independent—especially since the administrator's notice board was created. A bunch of administrators get together and they decide on particular things. They're kind of deciding more and more on the type of things that the early Arb Com used to do on how to handle certain cases. (I7)

Ostrom's principle 6 does not only suggest a need for conflict resolution mechanisms, but stipulates that the community needs access to local and low-cost mechanisms. As features of the dispute resolution process in Wikipedia become more decentralized, the cost associated with dispute resolution is further reduced as it is further devolved among members of the community.

The blurring of the distinction between social and technical powers of administrators means that a substantial amount of power is consolidating in one section of the Wikipedia community. Administrators, after all, are the traditional enforcers of policy. As of November 2008, there are approximately 1600 administrators in the English Wikipedia. In the past they relied on community consensus or Arb Com to make decisions about

which users should be blocked, which pages should be protected, and which pages should not exist. If administrators are stepping into the role of interpreter of policy, they are positioned to wield what some consider excessive authority over Wikipedian behavior. The corollary to this development is that requirements to become an administrator on the English language site have become increasingly rigorous.

> They go through this ridiculously insane process in order to become an administrator… I don't even know if I could become an administrator now. (I7)

> Nowadays it is much harder to become an administrator because the standards have risen… the consensus seems to have emerged that, firstly, once someone is admin they should not be revoked again, and secondly, as a corollary of that we should very carefully select our admins. (I8)

The process for becoming an administrator is called Request for Adminship or RfA; it involves either being nominated for adminship or nominating one's self and undergoing a week-long review by the community during which the candidate for adminship may answer questions and defend her editing record and contributions to the community. Finally, the community comes to consensus one way or another through discussion and, if the RfA passes, a bureaucrat confers the new user privileges. The English-language site has set criteria that need to be met before a nominee can be considered. Burke and Kraut have studied actual editing histories of RfA candidates and modeled the kinds of behavior that successful candidates engage in on the site. They note that participating in WikiProject organization and in policy page editing are predictors of success in the RfA process (Burke and Kraut 2008). It is not surprising that admins are taking on more responsibility in governing the site, given that experience in governance issues is a predictor of successfully obtaining the position in the first place.

The distributed model of community enforcement has traditionally provided a check on the power of any governing body in the site. Arb Com, Jimmy Wales, or any other

segment of the community must act with widespread support or decisions simply do not get enforced.

> We post our decision and let the administrators go ahead and enforce it. (I6)

> The main limit on the power of the arbitration committee is the fact that we rely on the community for enforcement… I think almost every major decision that we've encountered there has been—the committee discussed one or another remedy that has had to be abandoned because we didn't think the community would go along with it. (I5)

> Since it's generally accepted as a policy that admins don't have to do anything, the fact is, if we made an unpopular ruling the admins can simply vote with their feet and refuse to enforce it. (I10)

A noteworthy example of community solidarity in declining to enforce an Arb Com decision can be found in the case of William Connolley. William Connolley is a British climatologist who makes many contributions to the encyclopedia in the area of global climate change. One Arb Com member pointed out that "He has had to deal with some really problem users. You can imagine if you edit on the global warming article the kind of crap that comes his way." (I6) Connolley eventually got into a dispute with another editor and the case was accepted by Arb Com. The case was problematic because Connolley had broken behavior-related policies in order to defend the content of the encyclopedia. One Committee member explained how the ruling was made to avoid the appearance of Arb Com involvement in content decisions:

> William Connolley is citing established journals for specific facts. This other person is citing Michael Crichton and periodicals and crackpot webpages. We had to make a distinction—we had to use the existing policy on references to say ok, "this other person who is citing Michael Crichton is not following this policy to use science-related references which have to be to established journals but William Connolley is. Therefore the behavior of this other person on citing these poor sources is going to be penalized" We weren't saying "Connolley is right, this other person is wrong, this other person needs to get hit on the head." (I7)

But Connolley had broken rules as well. Explained another Committee member, Connolley "doesn't suffer fools. Well, so we said 'look, we've got lots of fools here. You're just going to have to suffer fools. [laughs] You're going to have to be polite to them anyway.'" (I3) The decision was made that Connolley was restricted to one revert per day, which essentially meant that he could only remove another user's edits once per day. A third Arb Com member explained this action had the effect of "restricting his ability to deal with those problem users." (I6) Many members of the community disagreed that these restrictions should have been placed on Connolley; as a result, the Arb Com decision was not enforced. "He just raised hell and everybody else raised hell and finally we had to say, well, that was a bad idea." (I3) Arb Com eventually reversed its decision, but not until the term of parole had nearly expired. Still, the action is emblematic of the power held by administrators.

The administrators who should have been blocking him if he did that or whatever, said "I don't want to block him. I don't feel like it's harmful…" Administrators are not like police officers. You're not sworn to block people, you're not sworn to carry out things. Nobody is. So if no one does it then it's not something that can be enforced. But more or less in this particular case, that is what happened. And eventually it got lifted because it was said "nobody wants to do this and no-one thinks it was a good decision." And so it ended up being reversed. (I4)

Understanding Wikipedia Participation

A complementary view to Wikipedia governance is Wikipedia participation. How do people join the community and learn to be a proficient contributor? Here, too, it seems that Wikipedia is surprisingly unremarkable. In my earliest study of Wikipedia with master's student Susan Bryant, I found that English-language Wikipedia contributors told surprisingly consistent stories of enculturation that followed the archetype of Lave and

Wenger's *legitimate peripheral participation* (Lave and Wenger 1991). Legitimate peripheral participation describes participation in a community as an adaptable process that evolves over time. I used ideas from activity theory as an analytical framework to guide the interpretation of interview data.

Legitimate peripheral participation (LPP) is a theoretical description of how newcomers become members of communities of practice (Lave and Wenger 1991) . According to LPP, newcomers become members of a community initially by participating in peripheral yet productive tasks that contribute to the overall goal of the community. These activities are typically simple and carry low risk to the community as a whole. For example, Lave and Wenger describe the activities of novice tailors as they learn their trade. Initially, tailor apprentices work on informal children's clothing and undergarments while they practice sewing. They begin by attending to "finishing touches" on garments, and only later move on to sewing and, eventually, to cutting the cloth. Gradually, they accrue enough experience to create the garment in which their shop specializes—men's trousers. Through peripheral activities, novices become acquainted with the tasks, vocabulary, and organizing principles of the community. Gradually, as newcomers become oldtimers, their participation takes forms that are more and more central to the functioning of the community. Interviews with Wikipedians revealed that the three characteristics of communities of practice identified by Wenger (Wenger 1998) are present on the site: community members are mutually engaged, they actively negotiate the nature of the encyclopedia-building enterprise, and they have collected a repertoire of shared, negotiable resources including the Wikipedia software and content itself.

LPP suggests that membership in a community of practice is mediated by the possible forms of participation to which newcomers have access, both physically and socially. If newcomers can directly observe the practices of experts, they understand the broader context into which their own efforts fit. Conversely, isolating newcomers can have

negative effects. For example, Lave and Wenger describe a scenario in which apprentice butchers have little physical access to the tools and spaces in which advanced meat cutting is done by experts (Lave and Wenger 1991). This isolation from more advanced practices limits apprentices' possible forms of participation in the community. In the world of online collaborative spaces, the technological architecture of the community can be seen as analogous to the physical arrangement of community spaces such as the one in which the apprentice butchers practiced their trade. Transparency of the wiki medium and low barrier for participation suggest that, given a supportive social norms, it should be an ideal technological substrate on which LPP to take place.

In investigating participation in Wikipedia, I examined how users' motivations and their perceptions of their roles in Wikipedia change as they become more engaged in the community. In particular, how do technological and social structures mediate user activity in Wikipedia? What forms does initial participation in Wikipedia take? How does the character of participation change over time as users become full participants in Wikipedia? Do barriers like the physical ones that isolated the apprentice butchers also isolate individuals in the online world of Wikipedia? In what ways does social organization in Wikipedia regulate the forms of participation that are available to newcomers?

One of the challenges of phenomenological approaches to research is making sense of large amounts of unstructured data and doing so in a systematic fashion. In order to identify salient features of participation on the site, I wanted a framework that would help not only find thematic similarities in participants' stories; but do so without divorcing people's practices from their technological and social context. To meet this goal, I borrowed a framework from activity theory. Activity theory suggests a structure for thinking through technology use and emergent social norms on Wikipedia and how they influence the transformation of members' participation over time. It is often described as

proceeding from the work of Russian psychologists Vygotsky, Leontev and Luria, who sought to understand human activities as complex, socially-situated phenomena.

In the interdisciplinary world of human-centered computing research, investigators inherit tools from a variety of intellectual traditions. Psychology and cognitive science traditions have provided us with sophisticated conceptual tools that allow for a nuanced examination of individual cognition and consciousness such as developmental theories (Piaget 1950), models of human action (Norman 1988), and theoretical accounts of human reasoning (Kolodner 1993). From the tradition of sociology we inherit conceptual tools and methods that allow us to examine the social and contextual features of a situation, for example, symbolic interactionism and dramaturgical analysis (Goffman 1959), ethnomethodological approaches (Garfinkel 1967), and Luhmann's systems theory. Nardi argues that activity theory provides a valuable framework for human-centered computing research because it numbers among the few conceptual frameworks for understanding human interaction that allow us to simultaneously consider context and individual consciousness (Nardi 1996). For an in-depth discussion of its theoretical roots, see Engeström (Engestrom, Miettinen et al. 1999).

Today, activity theory is most often used to describe activity in a socio-technical system as a set of six interdependent elements:

- Object - the objective of the activity system as a whole

- Subject - a person or group engaged in the activities

- Community - social context; all people involved

- Division of Labor - the balance of activities among different people and artifacts in the system

- Tools - the artifacts (or concepts) used by subjects to accomplish tasks

53

- Rules - the code and guidelines for activities and behaviors in the system

These six elements and their mutual interdependencies are often depicted by the activity triangle diagram:
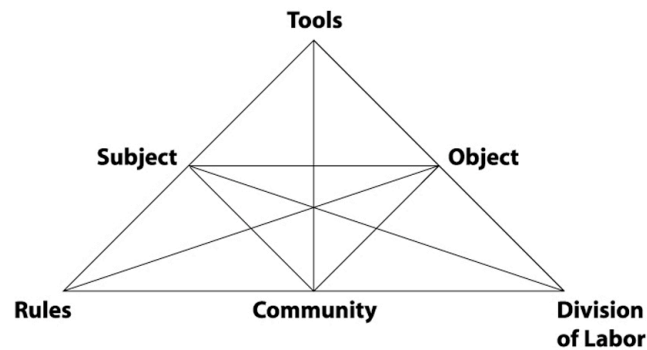
Figure 2: Model of an Activity System (Engestrom 1999)

Activity theory addresses complex features of human action and has been adopted by theorists in a variety of forms. None of the six dimensions is unproblematic; each is a multifaceted concept and characterizing them in great detail is beyond the scope of this paper. What is relevant here is that activity theory helps explain how artifacts and social organization mediate action (Kuutti and Nardi 1996). It is useful to imagine that the dimensions of AT provide a silhouette that needs to be filled in, rather than a detailed map of human activity. These dimensions have been used in the past as a framework for systematically investigating socio-technical systems that emerge with the use of computer-supported collaborative learning tools (Hewitt, Barab et al. 2004). In this paper, using the AT framework provides a common language and a structure for thinking about LPP and transformation of participation. If the activity triangle above represents the context of activity when a user first encounters Wikipedia, one can imagine the triangle twisting and bending over time as transformations in one dimension and then another stretch and pull the rest of the triangle. Because each segment of the triangle is connected

to the others, changes in one dimension affect the eventual character of the other dimensions as well.

To understand how users become part of the community, twenty-one Wikipedians were interviewed about their activities on the site. Interviewees were asked for stories about their engagement with the site and concrete examples of their activities. From these (often surprisingly consistent) stories, my collaborators and I constructed an understanding of how regulars in the Wikipedia community moved from peripheral to more central forms of participation.

Two rounds of interviews were conducted with a variety of community members from several different countries who were primarily editors on the English language site. For the first round, a purposeful sample of nine highly involved community members was collected by using communication channels frequented by active members. Five were conducted by telephone and four by email. In the second round during spring 2005, seven more interviews were conducted with active community members, all by telephone. In addition, interviews were conducted with two long-term, active readers who had not become regular contributors and three individuals who had been central participants, but had disengaged with the community either temporarily or permanently. Active readers were recruited through word of mouth and lists of "Missing Wikipedians" that are maintained by the community were used to recruit interviewees who had suspended their involvement in the community. One of the active Wikipedians responded to recruitment postings in both rounds of interviews, resulting in 21 total study participants.

Table 4: Study Participant Demographics (at Time of Interview)

	Participant	Approximate Time Active	Approximate Number of Edits (while logged in)
	Active Community Members		
	1	6 mos	399
	2	1 yr, 9 mos	5,381
	3	2 yrs, 6 mos	14,615
	4	8 mos	2,106
	5	7 mos	1,312
	6	1 yr, 6 mos	13,377
Round I	7	1 yr, 3 mos	15,072
	8	1 yr, 11 mos	2,190
	9	2 mos	3,664
	10	3 mos	132
	11	unknown	unknown
	12	unknown	unknown
	13	9 mos	2,909
	14	3 yrs, 6 mos	3,043
	15	2 yrs	7,116
	16	10 mos	4,689
	Active Readers		
	17	11 mos	10
	18	1 yr	unknown
	Former		
Round II	19	2 yrs, 3 mos	7,150
	20	1 yr, 1 mo	553
	21	10 mos	876

Each telephone interview lasted from 30 – 90 minutes and was designed to provide qualitative data about why the participants contributed to Wikipedia, how they had gotten started, how they perceived their role, and how their perception of Wikipedia and their participation in it had changed over the course of their engagement with the site. Most of the active Wikipedians reported near-daily activity on the site. One active member, Participant 11, reported regular, but casual (peripheral) activity on the site. On average, these participants had been active in Wikipedia for 15 and a half months at the time of the interviews; the duration of participants' activity ranged from two months to three-and-a-

half years (See Table 3). Former Wikipedians had been active an average of 16 and a half months at the time of their departure from the community. Note that, although number of edits often reveals highly active users, it is not a reliable indicator of activity. At least one participant reported making anonymous edits and others have spent significant amounts of time programming, planning, and dealing with Wikipedia-related work on other communication channels. Wikipedia had been established for over four years at the time the final interviews took place.

As explained in the previous section, activity theory provided an interpretive framework for understanding the different ways that interviewees' participation had been transformed over time. This framework guided the interpretation of common themes in interviewees experiences. As users moved from peripheral to full participation in Wikipedia, I found that their activity is transformed in many dimensions. The following sections use the language and structure of activity theory to organize and present the different ways that interviewees' participation changed as they became full-fledged members of the Wikipedia community.

Transformation of Subject: Goals and Identity

Whereas the object of the whole Wikipedia activity system remains unchanged over time, the subjects themselves change with respect to individual goals and identity. The notion of subject in the activity system is complex; for my purposes, subjects are defined as the participants in the Wikipedia community, each of whom has numerous characteristics that may change over time, including individual motivations, goals, and perceptions of self. Transformation of individuals' goals (which are different from the object of the activity *system*) and of users' self-perceived identities within the system are fundamentally linked to transformation of participation. Interviewees described a move from encyclopedia consumer to encyclopedia creator.

Novices: Finding Information and Editing What they Know

At the periphery of Wikipedia, novice users contribute by reading articles out of interest, noting mistakes or omissions, and correcting them. For the novice, the goal of participating in Wikipedia is often information gathering (using the site as an Encyclopedia). In passing, they identify problems and mistakes and fix them. Initial contributions seem to spring fortuitously from users' personal knowledge, frequently related to domains with which they feel comfortable and competent such as hobbies and personal interests:

> I saw a relatively weak article on [a South American writer]. I knew a lot about him, so I put together a stronger article on the topic. (Participant 6)

> I think the first thing I contributed was a page on [a musician] who was a post-punk rock group…for some reason it occurred to me that they didn't seem to have a page on it so I should write one. (Participant 5)

> I noticed how slim the [transportation]-related content was, so I started adding to it…My first contributions were just providing links to [transportation-related] historical societies' websites…It snowballed from there to writing new content myself. (Participant 9)

> I just looked up the article they had on bands that I'm a fan of, added a few sentences there, corrected a mistake, and pretty soon I was branching out into different areas that interested me. (Participant 2)

> I stumbled upon Wikipedia when searching for something else. I kept rechecking Wikipedia until I decided that it was definitely missing certain things and since I had an opportunity to contribute, why not do it? (Participant 8)

> One of the first things I looked up was [the country where I live], and I found that what was already there about [it], where I live…I thought, "Well that's wrong. I'll change that." And I thought, "What can I put to make it a bit longer, because it's short. And then it just sort of…I just got into the habit really." (Participant 3)

> Whenever I'm reading and I see a mistake, just like a spelling error, something that didn't quite make sense, I'd correct it… Half the time I'd read an article I'd fix it. (Participant 19)

Even as they contribute to the articles, new users tend to make only minor changes. Several of the participants reported a reluctance to make drastic changes when they first began contributing to Wikipedia:

> When I first started I was hesitant about doing a lot of structural changes. You know, I could go fix a comma here and there but I wouldn't necessarily edit the whole text of an article or move a page or change the way a particular disambiguation was done. (Participant 2)

> Early on, I was cautious about shaking up something I don't know much about. I was careful if an article seemed wrong, cautious about changing it. (Participant 6)

All the interviewees' first edits of Wikipedia involved topics about which they had some personal expertise. Initially, the goal of their activity on Wikipedia was to find information about their own interests and sometimes they fixed omissions or weaknesses. They saw themselves as consumers of the information provided on the site. It is important to note that the consumer plays an important role in supporting the object of the system: without information consumers, creating an encyclopedia is a meaningless act. Like in many online forums, readers, or lurkers, play an important role in constructing meaningful practice (Nonnecke and Preece 2000). As I will demonstrate in the next section, as they moved toward fuller participation, contributors to the site adopted a caretaker role with respect to some collection of articles. Over time, these collections grow. Eventually, Wikipedians identify with the community as a whole, adopt the goals of building a sound information resource, and see themselves as managers or creators.

Experts: Building Wikipedia

For experts, or "Wikipedians," Wikipedia as a whole becomes more important than any single article or set of articles. Whereas initial edits tend to be focused on correcting individual articles, once users become Wikipedians, their goals expand. Although they continue to improve the quality of the content in individual articles, their motivation

seems to become rooted in a concern for the quality of Wikipedia itself. They also become concerned with improving the community. In the move from novice to Wikipedian, goals broaden to include growing the community itself and improving the overall quality and character of the site.

It is important that Wikipedia is public, and that Wikipedians' work is available to anyone. Many Wikipedians perceive their work as contributing to a greater good, offering knowledge to the world at large. When commenting on why they contribute to Wikipedia, many Wikipedians recognized the project's overarching goals, the appeal of community, and perceived contributions to society:

> I really got inspired by the idea [of Wikipedia]. I'd say a lot of what hooked me was the community aspect and knowing that I was contributing something that was going to be around for a while…at the very least, I'll have done my part to make the whole package better and more accessible and more understandable, better links, more complete, whatever I happened to accomplish. (Participant 2)

> I contribute, I suppose, because I have something to say which might be of interest to other people…On the web generally, pages relating to the topics I know about are pretty dire in quality. Many are very inaccurate and there are entire topics missing completely. Wikipedia gives me the opportunity to fill some of the gap. I hope in a competent way and make a lasting contribution to knowledge. (Participant 1)

> To a writer, getting something "published" and reviewed in an environment that is more likely to correct your mistakes than reject your stuff might have a certain appeal. So when I do not write for a living, I write for Wikipedia. (Participant 8)

> It's a challenge to see how well I can put an article together on a subject…how you can express something clearly for people who do use this as an encyclopedia. How something you know about, how you can express that for other people to read it and for it to actually be helpful to them if they don't know anything about the subject. (Participant 3)

> I believe in the integrity of the project. I want to see it succeed, especially the articles people will look up. (Participant 6)

> I'd say that one of the great things about W and about free software is that they let people like me—and I'm sure there's lots of other people who

can't be involved in more formal learning areas for whatever reason, they can't afford it, they don't have the time because they're working—it lets other people learn. It, you know, frees up the opportunity to learn in a way that's really open for all people. (Participant 11)

It has a dedicated task and it's producing a product…at least with Wikipedia [versus Usenet and the like] you can convince yourself you're doing something to benefit mankind, you're moving the world ahead or something…I think, "What should I say here that will be of the maximum value to some guy who looks this up five years from now?" (Participant 5)

It feels good to create something of quality and it feels good to ban someone if they are a racist or something like that. It's a community coming together to make something that's highly valuable. (Participant 13)

Wikipedians seem to contribute because they believe in the product that the community produces. Kollock observes that motivation to contribute to online communities can spring from a variety of sources—the expectation of reciprocity from the community in the future, a sense of efficacy, and sustaining one's reputation—and none of them depend on altruism (Kollock and Smith 1999). Likewise, Donath remarks that altruism alone is unlikely to explain the millions of helpful interactions that happen online and proposes that establishing and sustaining one's identity is a far more likely motivator (Donath, Smith et al. 1998). It is interesting to note that, on Wikipedia, receiving credit as an individual author is nearly impossible due to the radical nature of collaboration; yet, a sense of individual efficacy and ownership remains. Ciffolilli asserts that reputation is established through number of edits (Ciffolilli 2003); however, I observed that, despite the barriers to claiming credit, Wikipedians described feelings of personal responsibility for the *quality* of their contributions to the site and its contents. They also often refer to "my" articles or "my" work as will be seen in the following sections. Almost all the active Wikipedians who were interviewed also use personal pages to establish an identity on the site and describe their contributions qualitatively.

The potential audience for Wikipedia articles is important to Wikipedians and the way they feel about their contributions. One participant recounted a story about recognizing

her work on a Wikipedia article about a particular musician in mainstream media reports when that musician died. Although the Wikipedia article was not quoted or cited, she believed that the journalist had used it as a source:

> I've seen evidence that other newspapers and magazines who were writing their obituaries on him used what information that I put out there. Obviously nobody's quoting it verbatim but just things in the way that…turns of phrase or the order that I put the facts in or certain obscure details that I knew and put in the article that aren't readily available in other online sources. And I see them used in magazine articles and it just gave me a warm feeling to know that I took my knowledge and put it out there for free and people were actually using it. (Participant 2)

Another described her feelings of pride when an original diagram she had created for Wikipedia was used and cited by a college professor:

> A professor used my diagram.... It was a PDF booklet of his lecture notes, and I saw my diagram, and he put my name there and said it come from Wikipedia, and I felt really felt appreciated. I felt like the hard work I put in, someone has benefited from it. Because you never know, you write these articles, and you never know if anyone actually reads them. So when you get a confirmation that they read it, and not only did they read it but they though it was good enough to knick it, that is makes you feel proud of what you've done. I feel sort of given something to humanity. That's why I edit Wikipedia really, it's the sort of thing that I've done something that will still be valid even after I'm dead. (Participant 15)

Because Wikipedians' goals are broader than assessing the quality of a particular article and fixing it, the scope of their activities extend beyond serendipitous editing. Most participants reported that the first thing they do when logging into Wikipedia is check their "watch list." Whenever a Wikipedia user is logged in and browsing articles, the option exists to "watch" that article. By clicking on the "watch" option, users add the article to their watch list, which is a page where recent editing activity is displayed for watched articles. With a watch list, Wikipedians can become caretakers of large sections of Wikipedia by monitoring changes to selected articles. In many cases, Wikipedians watch articles to which they have contributed so that they can review any changes.

Observing changes also enables Wikipedians to catch vandalism quickly (Viegas, Wattenberg et al. 2004). Watch lists are discussed further in the next section.

Transformation of Tools Use

Novices: How the Interface Helps

In the previous section, I identified novice goals on Wikipedia as locating information and fixing mistakes. The most obvious interface feature for novices is the search box, which allows users to locate articles by keyword. This enables users to find articles that interest them. Wikipedia also comes up in many Google searches. Many of the study participants' first encounter with Wikipedia was while researching a particular topic. Their searches brought them to a Wikipedia article and they could then use Wikipedia search feature to look up additional topics or click on links within that article to other, related Wikipedia articles.

> I adopted Google as my almost exclusive search engine and Google frequently turns up a Wikipedia link... In fact it often turns up more than one Wikipedia link. Also, I noticed that an awful lot of other responses include quotes from Wikipedia. (Participant 18)

> I would be searching for information on the Internet and I kept getting the same site over and over again and I hadn't really paid attention but the information was really good. So I believe I was looking up information on [a book]. I read the article and I noticed it didn't talk about the sequel which had just come out a couple years before. So I made that edit, added the information… That was my very first edit. That was my first time I edited the Wikipedia. (Participant 7)

Every page on Wikipedia (with the exception of the front page and a handful of other sensitive pages) includes an option to "Edit This Page." The ease of editing a page played an important part in allowing novices to make the initial transition from reader to editor.

> I didn't really understand when I started what it was about but saw that it said you start editing straight away and didn't even have to log in. And I thought, "Well that's strange, surely they don't mean that. I must give it a try just to see if it's true." When I found I could edit it , I was quite

surprised that it worked straight away. . . So I thought, "Let's see if they've got articles on any of the things that I know about." (Participant 3)

I looked at the web page and saw that it was lacking this information. And it said "edit this page." And most people think that web pages are plastic, that they don't change. It was just totally natural for me to click "edit this page" and change it. (Participant 7)

An important first step in drawing new users into editing and writing activities was effectively removing barriers to participation and allowing them to contribute their own knowledge to fill in a perceived gap or mistake in Wikipedia content. They felt that they had something to offer, something that would improve the quality of that particular article. The interface offered an easy way to make that contribution.

In addition to the "Edit This Page" function, users can also read a discussion page and the editing history of any article. None of the participants mentioned reading either the Discussion or page History before making their initial edits. It appears that these tools are not relevant to novice, peripheral participation but, as will be seen, become more relevant as users move toward full participation.

Wikipedians: How the Interface Helps

I identified Wikipedians' goals as maintaining Wikipedia—both as a community and as a reliable information resource. In general, the same set of tools is available to both novices and Wikipedians; however, Wikipedians' different goals and more sophisticated understanding of the site render more tools visible and relevant.

An example of tools awareness can be seen in interviewees descriptions of their daily activities in Wikipedia compared to their descriptions of initial experiences. Although none of the interviewees described initial encounters with Wikipedia that involved discussion pages or page histories, these features became deeply integrated into their routine activities on the site.

Discussion pages allow community members to confer about certain aspects of articles, whether it be an issue about including certain information, working toward a neutral point of view, asking for clarification, or simply requesting that someone with more knowledge about a particular aspect of the subject to add it. As a tool for knowledge building, the discussion capability affords consensus building:

> Well, for every article there's a talk page. On there, people will write, "I don't agree with what you've put about such and such, and I'm going to change it," something like that. And then sometimes they'll say, "You shouldn't have changed that and I'm going to change it back." And sometimes you get something that they call an edit war where people keep changing each other's contributions to it, so then it can get a bit fraught. But usually people will say, "Well what if I put such and such instead?" And someone else says, "Well, what about this?" And a few people might join in the argument…Usually they come to agreement. (Participant 3)

> [One discussion I'm in now is] mostly just trying to build consensus, deciding whether something should be in an article and if so, how it should be presented in a way that covered it factually and neutrally…it's a very casual discussion without much animosity, just acknowledging that there's controversy and we shouldn't be the ones to decide what's real and what's not. Just say, "this is what some sources claim, this is what other sources claim." (Participant 2)

The discussion pages, also referred to as "talk" pages, are a frequently used communication channel on Wikipedia. Although the study participants said that they had occasionally emailed other Wikipedians, almost all active Wikipedians stated that talk pages were their primary communication medium. Beyond discussion pages for articles, Wikipedia offers discussion pages linked to individual user pages and the Village Pump, the community area where Wikipedians discuss policies, general Wikipedia issues, and user help.

The most prominent "new" tool that Wikipedians use is the watchlist. The watchlist formalizes the surveillance of others' contributions. It alerts Wikipedians to changes on pages that interest them, and they can review the changes. Vandalism can be reverted,

and controversial changes can be addressed. According to interviewees, the watchlist becomes an important part of ritual activity in Wikipedia. Nearly all of the participants interviewed said that checking their watchlist is one of their primary tasks.

> Anything nontrivial I have on my watchlist, and I actually, at this point, about 1600 English language articles are on my watchlist. (Participant 6)

> I go look at the pages I've been editing through the watch list and see if anybody has sort of attacked them lately or done any modifications to them that … I might want to modify myself. (Participant 5)

> I watchlist almost everything I contribute... My latest article is on a [theater troupe], and no one seems to be touching that. More often my contributions do get changed, but the last few articles I've started from scratch haven't been changed. It varies. (Participant 16)

> My watch list right now includes 373 pages, but not all of them are complete articles; all of the images I have uploaded (all but one are my own work) are on my watch list just to make sure that nothing happens to them. The great majority of edits that I see are ones that constructively add to the articles, but I have found a couple of pages that were vandalized. With these pages on my watch list, I can spot the changes and quickly find the difference and revert any changes that are not appropriate. (Participant 9)

> I'll keep an eye on what other community members have contributed to the page I'm watching, and sometimes I catch vandalism or just mistakes that people add, and in that case, I fix it. For the most part, I just see that they've added new and interesting facts and if it needs polishing or copyediting to fit into the flow of what has come before, I'll do that. Usually I just look at, you know, just note what they've done, kind of think "Good job" and go on to whatever else. (Participant 2)

> I'm a watch list junkie…I have my watch list bookmarked, so I just click the watch list and it brings me right there. Basically I skim down to where I last checked it. Basically I look for the interesting pages, see if any of them have been edited. If they have, I look at the page differences, just to see what changed. (Participant 7)

> I've only got about 20 or 30 articles on my watch list, which would be mainly ones that, where I think other people might make controversial changes. And also my own user page in case somebody goes in and messes around with that…Just anywhere there's been a history of controversy. (Participant 3)

As they moved from the periphery into full community participation, these Wikipedians have assumed responsibility for maintaining the integrity of some set of articles. The watchlist is a tool they use to carry out this important task. Lists of recent changes and new pages also serve to alert Wikipedians to what other community members have contributed. These elements in the interface all provide Wikipedians tools for surveillance of the community. Rather than being faced with hundreds of thousands of articles to sift through in their efforts to maintain a quality resource, Wikipedians can focus on reviewing their personal watch list, recent changes and new articles. Several participants even noted that they use the random page function to pull up a random page and check it for errors or vandalism.

Transformed Perceptions of Community, Rules, and Division of Labor

Since perceptions of community, the rules that govern activity, and the division of labor overlap considerably, I present these three dimensions of activity in one section. In general, interviewees' novice experiences indicated little awareness of these three dimensions of activity on Wikipedia. It is only as individuals are drawn into the Wikipedia community that they begin to understand that Wikipedia *is* a community and begin to recognize the richness of community standards and roles.

Novices: Community? What Community?

In talking about their first experiences with Wikipedia, no interviewees mentioned interactions with other users. In contrast, they spoke at length about other users when describing their later and current activities as Wikipedians. It appears that, to novice participants, Wikipedia seems more like a *collection of articles* with random people adding information here and there than like a *collection of people* talking about, editing, and protecting their efforts to author good work.

Since they don't have an initially strong sense that a community exists on Wikipedia, novice users are likewise not aware of the roles associated with division of labor. Although most have already begun to move toward more central participation by shifting from the role of reader to editor, the possible roles they could play are still largely hidden. This can be contrasted with the communities that Lave and Wenger observed while developing the idea of legitimate peripheral participation. In case studies of communities of butchers, tailors, midwives, quartermasters, and recovering alcoholics, newcomers were aware of a community that they wished to join (Lave and Wenger 1991). They knew that they initially played a novice role and, although their knowledge of more advanced roles was likely incomplete and flawed, they could identify more senior members of the community whose activities they would someday emulate. In Wikipedia, a part of moving from the periphery toward fuller participation is becoming aware of the community that you are joining.

Full community members recognize that there are a host of rules and guidelines for Wikipedia use. On the periphery, however, the most important rules are articulated on the edit page where novice users are likely to encounter them. The edit page contains brief instructions that explain the instantaneous nature of Wikipedia edits and reminds editors to respect copyrighted material. The statement also informs users that there are places to experiment and places to learn more about wiki editing. After users begin to contribute more regularly, they begin to learn of other rules and guidelines. For example, there are policies outlining proper formatting and syntax. New users who are making minor edits are usually not aware of these policies because they don't need to know them for the changes they are making. As the scope of their edits increases, they learn about formatting conventions. In true LPP form, some users simply learn formatting syntax through observation by exploring the site or the help pages:

> And then after [starting to edit pages], the syntax for Wikipedia is very simple. At least for me. I have a degree in computer engineering…so picking up the syntax was very quick for me. (Participant 7)

Other users were coached by senior community members when they did not format their contributions according to convention:

> I didn't understand the markup language that you use to get the contributions into the correct form. I didn't know the conventions…And then people started sending me messages telling me where I was going wrong and so on. So I just gradually picked up how to do it. (Participant 3)

As users continued participating in peripheral activities, they not only became aware of the community but also were exposed to and learned the rules that guide the growth of Wikipedia.

Wikipedians: Members of the Tribe

Unlike novices, Wikipedians view their participation on the site as membership in a community. As I observed in the first part of this section, an important aspect of a community is the identity that individuals both establish within it and derive from it. The way that an individual presents himself is tied to his affiliations with particular communities, and, furthermore, with the roles he plays in them (Goffman 1959) (Cohen 1985). In Wikipedia, one of the main ways that individuals can establish an identity within the community is through the userpage.

At some point, novices decide to create an account on Wikipedia, which allows them to create a watchlist, track their own contributions, and maintain a consistent identity on the site. One interviewee relates that he was encouraged by others to establish an account:

> I started out as a "lurker," browsing articles, and then I made some anonymous contributions for about four months. After being encouraged by a couple other users, I created an account. (Participant 4)

When a user registers for a username, a userpage is automatically created. Wikipedians often use the userpage itself to provide some biographical information about themselves. All but one of the active Wikipedians who were interviewed included biographical or other information on their user pages. Many created elaborate resumes that included links

to articles they have worked on, to do lists, or lists of their interests. In addition, the discussion page that is associated with each userpage is called a "talk page," and serves as a main channel of communication among Wikipedians. The ninth user, who did not include biographical information on his userpage, used his talk page extensively.

Some of the rules that govern activity in Wikipedia remain constant whether one is participating on the periphery of the community or as an established member. These include maintaining a neutral point of view in the articles, following proper procedures for editing and adding pages, and syntax and formatting. The expanded activities and responsibilities of full community members require additional rules, mainly connected to treatment of other community members. Whereas all users are subject to community punishment (from chastisement to banning) if they act inappropriately, Wikipedians are expected to give new users some leeway. As one participant noted, "We have a policy of don't bite the newcomers and forgive and forget."

Another convention that is understood by Wikipedians but not by novices is that anonymous contributions are inherently suspect, so new users are encouraged to register and get usernames and to always sign their contributions to discussions. On the Wikipedia Policies and Guidelines page, two of the Behavior Guidelines include "Sign your posts on talk pages." Although anyone can edit articles and post on discussion pages without registering, this is considered bad form. Whereas the rules on the periphery tend to focus primarily on the technicality of editing an article, full community members are expected to adhere to certain understood elements of etiquette, including assuming good faith on the part of others, avoiding deletions and reverts if possible, politeness, signing discussions, working toward consensus, and other policies and guidelines that encourage cooperative behavior (Wikipedia).

In the previous section, I observed that novice users learn the rules and conventions for contributing both through observation and direct coaching from more knowledgeable others. Talk pages also provide one vehicle through which the community provides public recognition of good work on Wikipedia that can serve as a model for new users. Wikipedians post messages on others' user talk pages to commend individual contributions:

> In some ways you get recognized, you get some respect, recognition from your fellow…here's somebody who knows his stuff, who writes good articles and so on and so forth, and you feel happy when one of them puts a posting on your talk page. (Participant 5)

Wikipedians not only appreciate explicit accolades (See also (Kriplean, Beschastnikh et al. 2008) for a study of Wikipedia Barnstars, which are personal tokens of appreciation on the site), but also the indirect attention they are paid when others edit and improve their contributions. Diverse authorship can be used as a measure of article quality; diversity increases after an article is cited in the media (Lih 2004). One participant observed a similar effect when an article that he had written become the center of an editing frenzy after a related topic caught the attention of international media. He derived a great deal of satisfaction from others' efforts to improve upon his work:

> I got very lucky. I wrote an article on…[[a prison]] and after Abu Ghraib, that article exploded. It really exploded from what I had written, which consumed most of the article. Within a day, like 40 people had changed it. I'm like, 'What's going on?' Then I saw on the news – Abu Ghraib. And I'm like, 'Oh, that explains it.'
>
> Interviewer: And so you really followed that one –
>
> Yeah, ... the article improved pretty nicely. Everything that is in the news tends to improve pretty nicely. (Participant 7).

Another way that Wikipedians recognize exemplary work is the featured article. The review process for featured articles is more akin to traditional peer-review than the

standard freeform editing and discussion that takes place as most articles are written. Wikipedians nominate candidates for featured articles, the article is posted on a list of nominations where community members review the candidates and vote on whether or not to feature each article. If a Wikipedian objects to an article, he must provide specific, fixable criteria to explain his objection. Although anyone can edit the article, generally, the person who nominated the article then makes the requested corrections, resolving the objections, and the article is promoted to a featured article if there is a consensus in favor. A label appears at the top of the article identifying it as a featured article and a link to it appears on the Wikipedia main page. Ordinarily, featured articles remain on the main page for a day, but they retain featured article status indefinitely.

One interviewee described two important functions that the featured article plays in the community:

> [The featured article] gives us a specific set of articles that we can say, "Look, here is our best work." And so when people say, "How can this thing possibly work? How can it hope to rival an Encyclopedia Britannica?" And then we have this finite set of articles that we can say, "A-ha, look at this." That's very good in a PR respect. It also gives us a nice little something to put on the main page. It also works as kind of an incentive mechanism for people to write good articles. (Participant 7)

Another Wikipedian echoed the sentiment that the featured article serves as a public recognition of good work:

> Recently I've been working on the article… as a featured article candidate. If my article is accepted as a featured article, it will appear on the main page with a multi-paragraph excerpt and photo. Featured articles stay on the front page for a day, and then they're swapped for another, so I'm really just trying for bragging rights with this one. (Participant 9)

According to this analysis, the goal of the Wikipedian is maintaining the Wikipedia as a community and information resource. Although the division of labor in Wikipedia is always somewhat ambiguous, experienced Wikipedians support the community by

adopting a variety of roles. In some cases, they simply check various help pages and answer questions when they can. Other Wikipedians help resolve disputes by serving on an arbitration committee, which mediates extended conflicts that the community has been unable to resolve. Arbitrators are vested with the authority to ban individuals from certain sections of the site or for certain amounts of time. Some Wikipedians assume the role of system administrator. Administrators are not meant to hold privileged positions in the community. According to interviewees and to the Wikipedia site, obtaining administrator status is not difficult. It is available to any established and therefore trusted member of the community and provides access to functions such as removing vandalism from page histories, blocking IP addresses or ranges from editing, and editing secure pages such as the top page of the site.

While most of the participants stated that they continued to write and edit new articles, even as they expanded their activities, one said that he did very little of that, instead concentrating on "meta" tasks related to keeping the Wikipedia community productive. The main role that Wikipedians adopt seems to be that of a watchdog—monitoring community activities looking for opportunities to help and correct mistakes:

> Because I'm an administrator, I also keep any eye on the help desk and reference desk, which are places where people ask questions if they need help, and about one time in four I'll be able to answer a question that someone has asked and I'll pass that along. I'll answer it as best I can, point them in the right direction. And if I have time and feel like getting into more depth, I'll also look at the cleanup pages and see if there's anything that I can do there. (Participant 2)

> I act as a mediator for some controversial topics… trying to get extreme points of view and get an article out of it. It's amazing that we get good articles written…I just do work where something is needed and it interests me. (Participant 6)

> Starting in about January or February I kind of became, I like to call them "meta users." They don't touch the articles so much, because there's a lot more there than articles…A lot of people look up to me, respect my opinion and what I do there. (Participant 7)

One user provided an example of a sub-community within Wikipedia, whose members fulfill a particular need in the broader community:

> Then there are other people who've got different kinds of roles, who fall into different roles. For example, there's something called the Welcome Committee, so they're supposed to go in for people who have just signed on with an ID and to go to their Talk page and send them a message saying Welcome. (Participant 3)

Putting it All Together: Wikipedia, Information Literacy, and Learning

In the previous two sections, I provided detailed views of how Wikipedia is governed and what participation on the site is like for individuals who become community members. From these studies and the work of others, I have assembled a view of what it means to be "Wikipedia literate" and, moreover, how Wikipedia itself functions as an informal learning environment that emphasizes information literacy skills such as reflection on where information comes from and why we might believe some sources over others.

If we understand how Wikipedia works, what quality control mechanisms exist on the site, and what its policies are, it is possible to make informed judgments about when to use it as a source and how to determine whether or not information in it is likely to be reliable. One example of Wikipedia literacy involves the awareness of discussion and history pages. Each article on Wikipedia is paired with a discussion page where controversy involving its content can be discussed and consensus can be built and a history of edits. In my study of Wikipedia participation, I demonstrated how awareness of discussion pages is a distinguishing characteristic of becoming a Wikipedia community member. Consulting the discussion and history pages can be a useful way of ascertaining how much attention and editing has happened on a page and whether there are any outstanding controversies. Other researchers have used the practice of checking how much attention an article has received as the basis for visualization tools to surface this information: WikiDashboard overlays a graph of editing activity on the article itself so

that readers don't need to ferret out this information for themselves (Suh, Chi et al. 2008). Researchers have demonstrated that access to this kind of information increases readers' confidence in the reliability of information found on wiki articles (Kittur, Chi et al. 2008).

Another basic Wikipedia literacy involves understanding Wikipedia policy regarding citation and original research. Although topic-specific citation practices vary, Wikipedia is intended to be a secondary source and facts presented in the encyclopedia should be attributed to other information sources. As evinced in the story of William Connolley, citing appropriate sources is a critical policy for Wikipedia. Research has demonstrated that citation-related policy has become increasingly important in the Wikipedia community over time, as evidenced by increasing references to the policy (Beschastnikh, Kriplean et al. 2008). At the very least, readers should be aware that every article should have a bibliography if it has been reviewed and vetted via internal Wikipedia procedures.

Understanding Wikipedia (and other user-generated content) in order to develop strategies for assessing its information is one aspect of information literacy in the age of participatory media. As I noted in the introductory chapter, information literacy is a read/write proposition. Wikipedians are not just learning how Wikipedia works, they learn to collaboratively contribute to the construction of a public information resource. This trend is not unique to a handful of die-hard Wikipedians; Pew reported that in 2007, 64% of American youth were actively creating content to share on the Internet (Lenhart, Madden et al. 2007). For learning scientists, this is an exciting statistic, but what kinds of content creation might we expect to lead to learning? In my interviews, it became clear that writing for Wikipedia is a form of content production that exhibits many characteristics of learning activities as exemplified in the learning science literature and Wikipedians themselves described powerful learning experiences.

As they discuss the verifiability of claims in Wikipedia, editors engage in a form of discourse that includes making assertions, challenging assumptions, introducing support, and eventually either accepting or rejecting claims. Although Wikipedians are not in the business of scientific discovery, these kinds of discourse moves resemble knowledge building discourse as conceived by Scardamalia and Bereiter. Scardamalia and Bereiter suggest that by creating public repositories of knowledge where they collectively refine what is known in their community, students in classrooms can emulate the processes of scientists and take responsibility for their own learning and for the state of knowledge in their community. They describe a "second-order learning environment" in which learners continuously build on the efforts of their peers to advance the state of what is known by adopting a design mode of thinking about knowledge (Scardamalia and Bereiter 1996). Wikipedians engage in a similar process of advancing the state of knowledge locally among collaborators on specific articles; however, the norms and goals of Wikipedia differentiate it from knowledge building in some important ways. The goal of encyclopedia writing is verifying claims and agreeing on the presentation of what is known, not expanding what is known and coming to a common understanding of phenomena. This places much of the discourse of Wikipedians squarely in what Scardamalia and Bereiter characterize as a belief mode of thinking.

Although the policies that prohibit original research and emphasize verifiability on the site preclude Wikipedians from engaging in knowledge-building as envisioned by Scardamalia and Bereiter, the encyclopedia-writing endeavor is rife with opportunities to discuss where reliable information comes from and why we believe what we believe about the world. This makes it a potentially interesting venue for information literacy learning. Reflected one interviewee:

> 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 and perspectives that they wouldn't be otherwise.

Another feature of Wikipedians' experiences that intersects with the learning sciences literature was the importance of audience to the way editors think about their work on the site. In his essay on "Situating Constructionism," Seymour Papert observed that learning happens "especially felicitously in a context where the learner is consciously engaged in constructing a public entity" (Papert 1991). The publicness of the entity is very important for Wikipedians as I demonstrated in the section on participation in which interviewees explained that they think about their audience, how writing might be of service, and that they feel a sense of accomplishment when they know that others are reading, using and improving their work. Wikipedians have the sense that their work really matters to someone. Moreover, several interviewees explained that they see their work as having a value for themselves as learners:

> 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.

Wikipedians' experiences suggest that writing Wikipedia is a learning activity with some powerful characteristics including opportunities to reflect on the nature of information and knowledge. Involving students in user-generated content production as part of their formal educational experiences could be a way to not only capitalize on writing as a learning activity but also to investigate information literacy skills in the context of media consumption and production. What would it mean to create a Wikipedia-like writing experience as part of school work?

CHAPTER 4
SCIENCE ONLINE: WIKI TOOLS FOR THE CLASSROOM

A History of Wiki Tools in Education

The promise of wiki to support learning activities in formal education has been explored primarily in post-secondary contexts. In recent years, wikis have also been appearing more frequently in secondary schools (high schools). Publications on wikis in education range from descriptive efforts to characterize wiki learning activities and cultures, prescriptive efforts to establish guidelines for implementing wiki learning activities, and a few design reports that document technological innovations to support classroom use. To date, very little work has been done to measure learning outcomes explicitly and connect them with learners' wiki experiences.

The earliest documented uses of wiki in education were at the college level. In late 1997, researchers at Georgia Institute of Technology built the initial version of CoWeb, a variation on Ward Cunningham's original WikiWikiWeb, but implemented in Squeak Smalltalk (Leuf and Cunningham 2001). Since then, CoWeb has been refined and used to support hundreds of courses at Georgia Tech. Instead of designing activities for instructors, researchers primarily supported wiki use in courses by simply making it available and responding to instructors' needs. By observing the resultant profusion of wiki activity, researchers were able to characterize patterns of and barriers to adoption among instructors and students (Rick and Guzdial 2006). In some cases, a learning culture that emphasized individual accomplishment and competition presented a barrier

to adopting radically collaborative activities (Guzdial and Carroll 2002). Still, the extreme flexibility and lightweight nature of the technology also led to inventive and successful new uses of the wiki among many instructors (Guzdial, Rick et al. 2001). In some cases, instructors simply took advantage of the easily editable website to disseminate information, in other cases they used it as a place for individual peer review and critique, and in some cases instructors invented ways to use the wiki as a construction kit to engage students in collaborative, creative construction activities.

While wiki use was steadily becoming part of the standard academic toolkit for many Georgia Tech courses, researchers and instructors at other institutions also began experimenting with CoWeb and other flavors of wiki. Not surprisingly, many of the documented early explorations of wiki uses in higher education played out in computer science (CS) courses. The first wiki, Ward Cunningham's Portland Pattern Repository, was created to support the collection of computer programming design patterns (Leuf and Cunningham 2001), so it is not surprising that computer scientists were among the first to notice and appropriate wikis more broadly. In addition, technological resources and expertise in CS schools supported early adoption. At University of Colorado, CoWeb was adopted in 2001 to support Knowledge Building activities among students working on open source programming projects. Scharff found that students used the wiki extensively to coordinate their activities and adopted it as a space to construct group project deliverables. Furthermore, they used it far more frequently than the traditional and more familiar course mailing list (Scharff 2002). (For more examples of wiki uses in CS/Information Technology education, see (Bergin 2002) (Bower, Woo et al. 2006) (Brereton, Donovan et al. 2003) (O'Neill 2005)).

Over the past several years, Wikipedia has more broadly popularized the idea of wiki and brought it to the attention of educators. The number of wiki-in-education related projects and publications has increased dramatically: a search for the term "wiki" in the

Educational Resources Information Center (ERIC) returns one publication for 2003, two for 2004, three for 2005, thirteen for 2006, twenty-eight for 2007 and thirty-four for 2008. Educators have been quick to respond to the wiki trend. Experience reports and personal observations of wiki use in the classroom have also proliferated as teachers begin experimenting and sharing their practices (Mader 2006). As wiki use in education has become more visible, wikis have also begun appearing at secondary school levels around the world in subjects ranging from computer science to language arts, to social studies to physics. Easily accessible wiki and community hosting services that target school communities create easy opportunities for teachers to experiment with wiki writing assignments. (See pbwiki.com, schools.wikia.com for examples.)

With the move from wiki use in colleges and universities to secondary schools came an increased concern for understanding how structure and freedom can be balanced in learning activities. Lund and Smørdal describe wiki learning activities in a secondary school in Norway in which students in an English as a Foreign Language (EFL) class used MediaWiki to support collective Knowledge Building activities while practicing their language skills (Lund and Smordal 2006). In these EFL classes, they explicitly examine the role of the teacher in Knowledge Building activities and describe how teacher intervention and guidance support the collective construction of knowledge. They find that teacher intervention is mainly located outside the wiki through in-class comments and feedback and suggest that wiki tools for education could better facilitate teacher intervention in the online environment.

The relationship between teacher and student is a central issue for any educational research agenda. Research on novel technologies in the classroom often highlights the ways that teacher-student relationships are altered when new communication technologies become part of the learning context. Generally these changes are framed by researchers as beneficial to the student. From early work using chat in the 1980s (Batson,

Bruce et al. 1993) to recent work on Knowledge Building communities (Scardamalia and Smith 2002), technologies that shift control and responsibility from the teacher to the student have been understood as having a positive effect on learning. Still, teachers may not always be comfortable with that shift or understand how to best appropriate new technologies. As Lund and Smørdal point out, "an inherent part of being a teacher is to plan learning activities. The nature of these plans may be challenged by the emergent use of wikis as reported in the literature and as we have observed" (Lund and Smordal 2006) p43. Fortunately, wikis are also beginning to appear in teacher training and professional development.

Honegger describes how wikis are being adopted as part of teacher education at some German-speaking universities (Honegger 2005). In Alcona, Italy, TWiki was adopted to support teacher professional development in order to allow local teachers to share best practices and teaching materials. Da Lio et. al. studied teachers' uses of the site and share a familiar story of initially limited success due to technological and cultural barriers. They observe that "[c]ollaboration is not a current practice in Italian schools. The widespread individualistic approach to teaching makes the development of a collective sense difficult for professionals to even contemplate" (Da Lio, Fraboni et al. 2005) p86.

Despite the frequently encountered cultural barriers in the teaching community, maverick early adopters are becoming involved in wiki projects to support knowledge sharing among education professionals. Many proponents of the open education movement have embraced wiki as a platform to support the collaborative production and wide distribution of free educational materials. Projects like Curriki (www.curriki.org) and Wikimedia's Wikibooks (www.wikibooks.org) and Wikiversity (www.wikiversity.org) are taking advantage of the peer production model to create textbooks, course materials, curricula, classroom activities and other documents that can be used to organize educational activities.

Cultural barriers to adoption in various forms are frequently documented in studies of wiki use in education. Technological barriers to adoption are also sometimes noted although they are not cited as primary barriers in post-secondary, secondary and teacher education. Still, even in cases where a wiki-based community appears to be thriving, usability issues such as the lack of a WYSIWYG editor can limit participation (Wales 2006). What might one expect to find if wikis are used with still younger students? Usability issues become increasingly salient with younger users who are less experienced both as writers and as computer users. Désilets et. al. tested a custom wiki platform called The Lizzy Wiki with eight and nine year olds in French-speaking Canada (Desilets, Paquet et al. 2005). They found that usability issues associated with hyperlinking by far posed the most problems for the children and suggest that this is because the representation of hyperlinks in wikitext does not provide an adequate model of hypertext.

There has been little work done that explores technical modifications to wiki in response to observed cultural and technological barriers to successful adoption in formal education. For example, Wang and Turner developed wiki extensions to address characteristics of wiki they deemed "undesirable" in the classroom context, such as students having the ability to edit any page and a lack of private spaces for writing (Wang and Turner 2004); however, it is unclear that the undesirability of such features was determined through empirical investigations. Larusson and Alterman developed WikiPlayer as a representational tool to support wiki communities in a richer way than standard "Recent Changes" features and used it in classroom contexts to study the development of student work on a wiki although the tool was not developed explicitly to address education needs (Larusson and Alterman 2007).

In the next section, I present the design guidelines yielded by a pilot study that I conducted to understand the challenges of wiki use in classrooms.

Exploring the Need for New Wiki Classroom Tools: A Pilot Study

To familiarize myself with the potential challenges of researching wiki publishing and learning, in 2005, I conducted a semester-long pilot study. In this preliminary iteration, I sought to establish guidelines for design and to explore the relationship between wiki publishing and learning in a natural academic setting.

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 and Guzdial 2006). Participating students were informed of my intention to use their papers as content in a new public policy online resource for students. They used the wiki 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 had already been amply established . I set out to understand what barriers exist with respect to investigating students' perceptions of their potential audience, their process for writing and citing resources, and how interacting online influenced their learning. I aimed to answer three basic questions about students' experiences:

1. How does interacting with peers in a public wiki influence the content and tone of students' writing?
2. How does publishing an information resource for others affect the ways that students think about their written assignments?
3. What features do wikis need to support writing and publication activities in the context of formal education?

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. For this investigation, I conducted interviews

at three points in the semester to capture students' experiences and process throughout the activity of researching and composing their papers. The wiki also recorded each change that students made to their papers, bibliographies, evaluations of resources, and comments on peers' 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. I conducted interviews with twelve of the remaining students. I surveyed students at the beginning of the semester to establish demographic information such as year, GPA and gender. I 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 5: Description of Student Activity Online

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

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 4). 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. My most meaningful data came from interviews with the students and examination of their online interactions.

Students' Online Interactions Helped Improve their Writing

My first research question in the pilot study asked 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. I 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. I examined first and final drafts of students' essays alongside evaluations that were written by their peers to identify the kind and quantity of revisions students made based on feedback from their peers. I found that about 80% of students used peer evaluations to refine their papers (See Table 4). Of these, 90% addressed issues of argument form or content.

My 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 writing 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)

Perceptions of Audience Online

My second question asked how publishing in a public venue would influence students' experience of their writing assignment. I assumed that students would understand the website where they published their writing as a public place with a potential readership. I 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. I was 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 and 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 course wiki with an obscure domain name.

Because the public nature of the site was not apparent to students, 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 new 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.

Design Guidelines

One of the first challenges I encountered during the pilot study was that students did not perceive the resource that they were writing as public. The perception of publicness or privacy in a networked system is constructed by the user and may not be aligned with the actual privacy afforded to actions on the site. (Hudson and Bruckman 2005). This perception is constructed based on the users understanding of the medium, which can provide cues that help users construct realistic expectations. In this case, the wiki platform used by the students was CoWeb, which is a platform commonly used by classes across the university. The design of the site was not very polished or professional and it was hosted on a university server with an obscure domain name shared by many other course wikis. I concluded that these factors together provided cues that the site was not public. One design goal for the new site was to ***create a publishing venue that looked like a professional, public site to the students*** in order to encourage the perception of publicness.

Both the students and their professor complained that it was difficult to find things on the wiki. If students cannot find peers' comments or resources, they cannot learn from them. If teachers cannot find students' work, it becomes frustrating to use a wiki at all. When using a wiki with a large number of students, it is essential to provide features for organizing the inevitable information sprawl—the pilot study generated over 700 unique pages. The CoWeb platform does little to organize pages or depict relationships between

the kinds of pages that exist. I determined that, at a minimum, the new interface should ***standardize relationships among pages that with different kinds of information***, such as student articles/essays, the resources they use to support their writing, evaluations of those resources, and feedback and comments about their writing. In addition, it needed to ***organize users into classes*** so that teachers and peers could easily find one another's work.

One of the goals of the wiki publishing assignment was to bring about reflection about information sources. Students were asked to find and evaluate a variety of sources for their chosen topics and to cite these in the body of their essays. The wiki software did not support citation explicitly—students had to format and insert references by hand using wiki syntax. Moreover, it was difficult for students to know where to put their evaluations of sources. In order to better support scholarly citation practices among student writers, I concluded that the new wiki software should ***support citing explicitly*** as a part of the writing activity.

Finally, student privacy is a serious concern. Asking young people to publish their thoughts and work in a public venue may lead to productive learning experiences; however, there is a responsibility that educators bear to protect their students privacy and to educate young people about privacy and risk online. In the pilot study, I asked each student to choose a pseudonym. Unfortunately, this exacerbated the problem that students and the professor had in finding one another's work. For the professor in particular remembering 150 students' names is not easy—remembering 150 names and their associated pseudonyms is brutal. The system, then, needed to ***allow individuals with the proper permissions to see students' real identities while hiding it from the general public***.

Description of the System

Based on the design guidelines described above, I built a suite of tools to adapt the wiki platform MediaWiki for classroom use. MediaWiki is the open source software that Wikipedia runs on; I chose it from the many wiki platforms that were available because it already included some desirable features such as "discussion pages," which keep comments and feedback about student writing in the same place, and because it had a strong developer community. In addition it has a familiar visual design, which makes a MediaWiki site recognizable to students as a "real" public website rather than a school site.

In order to support critical use of information sources through careful citation, I built a bibliographic extension for MediaWiki called ReferenceTools. The initial version of ReferenceTools was constructed with Masters student Amruta Lonkar. I iterated on the code to create a classroom-ready prototype. The design of ReferenceTools was guided by examining features of commercial academic bibliographic tools and refined in consultation with a local high school science teacher. Usability tests were conducted to further improve user experience before in-situ field observations began.

Normally, when an author edits a page in MediaWiki, all the relevant citation information (author, title, etc) is entered into the text of the article using a special syntax in a reference tag in the wiki text, which is rendered as a footnote when the text is saved. For example, an author who is editing a page about British royalty would need to enter the following text into the body of the article in order to cite the book *Britain's Royal Families*:

```
<ref name="weir">{{cite book |last=Weir |first=Alison
|authorlink=Alison Weir (historian) |title=Britain's Royal
Families: The Complete Genealogy, Revised edition
|publisher=Random House |year=1996 |isbn=0712674489
|pages=pp. 272-276}}</ref>
```

The arcane syntax makes life difficult for newbies and oldtimers alike and raises the barrier for citing sources; furthermore, this system means that in MediaWiki, references are associated with only one article. Because I wanted to support explicit, critical reflection on information sources and because citation plays a central role in the social construction of knowledge in the sciences, I wanted references to be first-class, reusable objects in the system. I wanted students to build a shared bibliographic database as they wrote and ReferenceTools enables them to do just that.
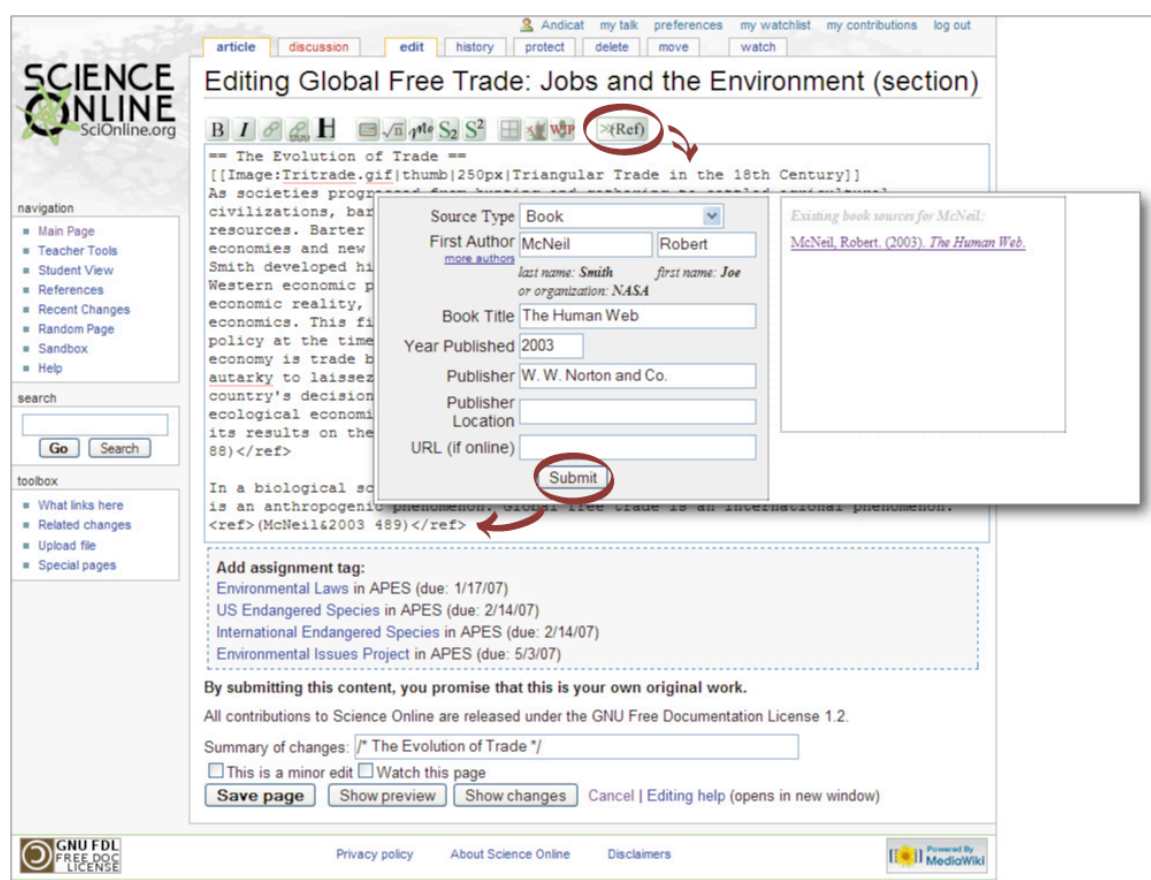
Figure 3: Using the Reference Tools MediaWiki extension to insert a reference

Using ReferenceTools, students enter their sources as they edit a wiki page. An "insert reference" button calls a separate data entry window where the relevant citation data can

be entered into a form. (See Figure 3.) When the student saves the reference (or selects an existing reference) a special reference tag is added to the wiki text. Upon saving, the tag is rendered as an in-text parenthetical reference and a list of works cited appears at the bottom of the page. It is important to note that references are saved in the database, so although each citation is initially associated with a specific article, the bibliography is shared across the wiki, so each information source need only be entered once and can be used to support multiple articles. If the reference tag is removed from all articles, the reference itself persists and can still be used. When a reference is entered into the database, a wiki page is automatically generated for that reference where its contents can be discussed or summarized. The reference page allows users to modify the reference information, see a history of all modifications, and revert changes if necessary. The reference page also provides a reverse citation index in that it lists all articles where the reference is currently cited.

In addition to ReferenceTools, I also created extensions to support classroom use: TeacherTools and StudentView. In my pilot study, I found that one of the aggravations associated with using wikis to support classroom work was information sprawl and a resulting inability of teachers and students to find one-another's work and understand who had done what. The TeacherTools extension provides teachers with a central place to manage their classes, students, and assignments. StudentView provides essentially the same functionality for students—it automatically groups together pages that describe their assignments in one place, and lists their classmates so that they can contact one another easily. In addition, teachers and students have access to the SendMessage extension, which allows them to place a message on the talk pages of all class members or any subset of class members at once.

Using this newly adapted version of MediaWiki, I launched a new wiki called *Science Online* in the fall of 2006 and I was prepared to begin researching wiki publication in the

classroom. As it turned out, participation in Science Online did not resemble participation on Wikipedia.

CHAPTER 5
WIKI ADOPTION IN THE HIGH SCHOOL CLASSROOM

What happened when my new wiki tools were adopted by teachers and students in high school classrooms? As it turned out, participation in the Science Online wiki was structured differently from Wikipedia, both in intent and in enactment. In this chapter I tell the stories of adoption in two different science classrooms at two different schools—one a highly ranked public school and one a private school. Naturally there were many differences in the ways that the two teachers and groups of students engaged with the site and with one another; however, in both cases, teachers assigned writing projects with similar constraints when it came to finding and citing sources. In this chapter, I will focus on describing the enactments themselves: the assignments, the teachers' attitudes toward the technology, the classroom culture, and how data was collected throughout these activities. In the following two chapters, Six and Seven, I will present my analysis of student citation practices and information literacy skills.

By inviting local science classes to write on *Science Online*, I set out to understand how the experience of participatory media can be used toward educational ends. My questions included:

- How do students make sense of and learn from creating public artifacts that have a readership beyond the classroom?
- What was their process for constructing wiki articles and what kind of engagement with science content did this process afford?

Furthermore, creating a public information resource is a not only a matter of writing down what one knows, but of remixing information, making decisions about what information to include and how to represent relationships with other information sources. I wanted to understand not only how students constructed wiki articles, but also:

- How do students find, assess and use information sources to inform the composition of an information resource for others?

And, finally, I was interested not only in the students' experiences, but in how the technology and activity was structured by the teacher.

- How did the use of wikis and production of user-generated content fit into teachers' goals and practices?

In order to find the field locations where my studies took place, I conducted a series of interviews with teachers both in the Atlanta area and elsewhere. My goal was both to educate myself about how a wiki writing activity might best fit into science classrooms and to identify potential collaborators. As I interviewed teachers about their experiences with Web technologies and about their practices with respect to written assignments, I also asked whether they would be interested in trying out a wiki in their classes. Interviewees for the teacher study were recruited by sending emails to the heads of science departments at area high schools and by sending email to teachers who used the Wikia high school collaborative writing site. I also used the snowball method of recruiting by asking teachers who agreed to be interviewed to refer me to others who might be interested. My criteria for selecting sites were twofold: teachers should be interested in working with me to develop assignments for use on the wiki and the schools themselves should be relatively well-ranked with good technology resources. My goal was to introduce a new technology in the classroom and I wanted to study how it was adopted by teachers and students; therefore I wanted to start out in a healthy, functioning

organization. In the end, two local science teachers expressed an interest in using the Science Online site as part of their classes. The stories of their involvement in the project are described in the sections below.

Data Sources

As described in the chapter on methods, my approach to data collection was to use mixed methods in order to understand students' learning experiences from several angles and help me act reliably as in interpreter of interview data. I combined interviews, observations, pre- and post- testing and quantitative data about students' editing activities on the site. The first study lasted approximately eight months, from October 2006-May 2007 and students wrote seven wiki assignments, which will be described in a later section. In order to collect denser process data, in the second study, I targeted one writing project as a context for data collection. The project lasted eleven weeks.

To help me understand how wiki writing assignments were presented to students, what the classroom culture was like, and how students interacted with one another, I attended classes as an observer. In the first study, I was present in the classroom on 49 days throughout the year. On 22 of these days, students used computers in class to work on wikis or other assignments; on the other days they were doing labs, other collaborative work, presenting material to the class or having more traditional lecture/discussion days. In the second study, students were not given time to work on wiki assignments during class, so I was present on 6 days when the assignment was introduced and discussed.

As described in Chapter Two, interviews with students consisted of three segments, unstructured, semi-structured, and a more structured segment in which students reconstructed their activities. During the reconstruction sessions, the interviewee reviewed the work he had done recently on the wiki together with me and reconstructed his process verbally, step by step and by demonstrating on the screen where possible.

This same process was used after pre- and post- tests. For search activities, students reenacted their searches and explained how they found sources and how they decided what to use.

In the first study, I conducted twenty-one interviews with fifteen of the nineteen participating students. These interviews were spaced out over the eight-month study. In the second study, I conducted interviews at much shorter intervals. I interviewed each of the fourteen participants at least once, most three times, which yielded thirty-six interviews. I also interviewed teachers periodically throughout the studies. In the first study, the teacher participated in four formal interviews; in the second, the teacher participated in three.

To assess student learning, I created document-based question pre- and post-tests that required students to use a set of information resources to answer a science-related question in essay form (See Appendix A). By observing differences in pre- and post-test sourcing practices, comparing these to students' writing practices on the wiki, and listening to students' accounts of their own sourcing practices, I intended to trace changes, if any, in students' use of science information resources over the course of the wiki assignments. In the first study, logistical complications prevented me from collecting complete post-test data; in the second study, I obtained both pre- and post-tests from nearly all students.

Finally, the wiki editing history records every edit that students make on the site. To understand basic levels of participation on the site, I examined editing histories for each of the participants. As noted in the section about my pilot study, editing trends alone are difficult to interpret—some students edit their texts primarily offline, others spend a great deal of effort playing with formatting and presentation—however, they can be helpful in broadly understanding how much activity happened on the wiki. Note that editing activity

for my two field studies with Science Online, as in the pilot study, was highly variable from one student to the next as evidenced by high standard deviations (see Table 5).

Table 6: Description of Student Activity Online

	Field Location One			Field Location Two
	10 students 30 weeks	**3 students 10 weeks (fall only)**	**6 students 16 weeks (spring only)**	**14 students 3 months**
Average number of edits *Standard deviation*	**301.10** *187.99*	**87.00** *59.92*	**199.17** *116.58*	**87.71** *19.43*
Average number of pages edited *Standard deviation*	**62.80** *17.04*	**21.33** *7.02*	**41.50** *15.98*	**40.15** *9.35*

Field Study Location I

When I met the teacher who would participate in my first field trial with Science Online, John Grant, he was teaching at a science magnet program but was about to switch to a new position in a new school. The public school where he would use Science Online, Rosedale High, is ranked one of the top schools in its district by test scores and graduation rates. John had been a scientist before he became an educator; he had begun a doctorate in biology and had completed all but his dissertation. He was extremely interested in using a wiki to support collaborative writing in his classes and had even tried to set up a wiki on his own but found that he didn't have access to the kind of technical infrastructure he needed. In the summer preceding the first field trial, he consulted with me to develop a basic research and writing assignment that would be published on Science Online as a recommended way of using Science Online for teachers. He also provided feedback for refining the interface for the teacher and citation tools I had built. I launched the site in time for the 2006/2007 school year and John's Advanced Placement Environmental Science (APES) students became the first users of the site.

APES was a year-long class. I began the study in fall semester with one section of 15 students; in spring, the teacher taught two sections of the class with 9 in each section. In spring, the students from the fall semester were split between the two sections and some of them dropped the class. Others joined John's class who had been with a different teacher. In total, 19 students both assented to participate and turned in signed consent forms from their parents. 10 of the study participants used the wiki for an entire school year; 3 used it in the first semester only, 6 used it in the second semester only. All the participants were either high school juniors or seniors.

Initially, I envisioned Science Online as a place for students to write what would traditionally be thought of as group research projects about science topics of their choice. Instead of writing a paper that dies on the teacher's desk, student research projects would become living documents and resources for others. Not surprisingly, when John adopted the site for his classes, he appropriated it in new and unexpected ways in order to balance curricular demands, time constraints, and personal teaching style. Rather than use the wiki to support one primary collaborative article-writing project and an introductory assignment as initially envisioned, he experimented over the course of the school year with seven varieties of discrete wiki assignments that varied in terms of length, collaboration, specific editing and sourcing requirements, and that were interleaved with different kinds of in-class activities. These assignments can be thought of as design iterations on wiki writing activities as the teacher adapted his expectations based on previous assignments. Excerpts of student writing can be found in Appendices B and C.

The assignments were:

Fall 2006

1. Create a User Page - October

This informal, individual assignment was designed by the researchers to be used as an introduction to the wiki. This was the only assignment that was not designed primarily by the teacher.

2. Biogeochemical Cycles Project - October

Students authored articles in groups of three. They created relatively short articles about a biogeochemical cycle and explained the information to the class in a 7-10 minute in-class presentation using the wiki as a visual aid.

3. Biomes Articles - November

Each student selected a biome from a list that was provided by the teacher and individually authored a wiki article about that biome. For this assignment, the teacher encouraged students to be creative and discuss where their biomes appeared in popular culture and literature in addition to providing information and images. During this project, some students began getting more creative and tried out advanced formatting techniques.

4. Human Population Dynamics - December

Each student selected a country or international organization and individually created an article that discussed its laws and cultural issues that affect human population growth. At the end of the wiki writing segment of the project, the class convened for an in-class debate about human population in which each represented the government or organization they had investigated.

Spring 2007

5. Environmental Laws - January

This was a short wiki assignment. Approximately 10 new students joined the class during the second semester. This individual assignment helped bring them up to speed. Each student created a short article that described a particular international, US, or state law that impacts the environment.

6. Endangered Species - February

Students found one American and one international threatened or endangered species of plant or animal and individually created an article about it. In order to facilitate studying for the end-of-year exam, the teacher asked if we could create a special template for making animal "trading cards." We created the template and added a "species box" button to the editing tool bar to make the template syntax easier for students to use.

7. Environmental Issues Project – March/April/May

The final project of the semester was longer and more involved than the previous ones. Each student selected a contemporary environmental issue to investigate in depth and had approximately six weeks to research the issue, assemble a bibliography, construct a wiki article, and prepare a presentation.

In the first semester, students were introduced to the wiki during the first week of October. John asked me to give a demonstration of how the wiki works and their first questions involved how to use the site to talk to one another: "Can we chat?" They created user pages during class and I demonstrated the use of features like the "talk page" to leave one another messages. Several students began playing with the site by editing one another's pages—some placed snarky comments on others' pages, but soon the transparency of the wiki medium became clear to the students as they learned that everyone could see who did what on the site.

Over the course of the school year, wiki activity varied widely from participant to participant. See Table 5 for numbers of edits per student. As the school year progressed, a story of wiki appropriation and resistance emerged from my observations and interviews. Most significantly, I discerned that the classroom context presented barriers to student collaboration. Although supporting collaboration is a defining characteristic of wiki, in the classroom, this affordance went largely unused.

Before the school year began, I had several discussions with John, the teacher, who was enthusiastic about the idea of using wiki to support collaborative writing activities in high schools. He was particularly positive about wiki in comparison to blogs, which were becoming popular among teachers in his school district, but which he felt were not well suited as a platform for student writing assignments. We initially discussed the possibility of two wiki writing assignments, but as noted, he chose to introduce seven wiki assignments over the course of the year. As the school year progressed, Mr. Grant observed that there was a mismatch between the affordances of the wiki toolkit and the demands of the school curriculum as he attempted to appropriate the tools ways that would support students in demonstrating proficiency on the Advanced Placement test at the end of the year.

One of the most notable features of the first-semester assignments was the collaboration. The first teacher-designed wiki assignment, Biogeochemical Cycles Project, was a project on which students collaborated in groups of three. Both students and teacher struggled with the collaborative aspects of the assignment. Students often worked in parallel during class and found that edit conflicts slowed their progress. In interviews, several students commented on the awkwardness of having to rely on other students to complete a project, regardless of the technology used to write. Because it was the first substantial assignment, students were not yet comfortable with the wiki. They had

difficulty recovering from errors and formatting their articles, which seemed to exacerbate their frustration with groupmates. Several students appealed to the teacher to grade them based on individual rather than collective effort.

Mr. Grant likewise had difficulty grading the collaborative assignment. He found parsing page histories laborious and uninformative and had difficulty understanding how each student had contributed to the collaboration. Although he had originally observed that the wiki would allow him to grade collaborative work more effectively, he found that it was too much work to understand patterns of collaboration and use them for assessment. After the Biogeochemical Cycles Project ended in October, the students were not asked to collaborate on articles again. They almost never touched one another's pages in later assignments.

In early interviews, students were positive about the wiki assignments but noted difficulty in uploading images, formatting and collaborating with other students. By the end of the semester, classroom observations indicate that most of the study participants had become proficient wiki editors. Many of them had begun using advanced formatting techniques by copying and pasting text from my user page. By December, early bugs caused by the reference extension had been mostly resolved and students only infrequently asked for assistance.

In the second semester, nine new students joined Mr. Grant's class; of these, five consented to participate in my study. Because half of his students were experienced wiki editors, the teacher provided less time for introduction to the wiki in the second semester. The user page assignment was not given and researchers gave less up-front instruction; that meant nine of the students received less instruction in using the wiki.

In the second semester, Mr. Grant became more emphatic about ways that the wiki was not quite synchronized with his needs as a teacher. Some of his concerns centered on the openness of the site. He became increasingly concerned that students might be writing things in a public place over which he had not had sufficient oversight. What if they were wrong? Design suggestions that emerged from these concerns included a privacy feature that would keep student work private until the students and the teacher had designated it as worthy of public consumption, possibly integrating it with a "rating" feature that could allow students and teachers to vote content into the public eye. He was apprehensive that students might write something publicly that would cause parents to complain. He frequently expressed concern that since students could see others' work, he could not ask several of them to write up the same topic to prepare for tests.

As he designed the second semester assignments, Mr. Grant also became increasingly concerned with designing ways of supporting the students in studying for the Advanced Placement (AP) exam at the end of the year, although he repeatedly explained to students that their learning goal was to understand scientific method and the content. Some students indicated that they believed their goal in taking the course was to pass the test and, by extension, place out of a science course when they began college. This tension became pronounced toward the end of the year, when arguments began to break out between the teacher and students about the goals of the class. The day after the exam, arguments erupted into open hostility.

Field Notes Excerpt, May 16, 2007

When the students come in, tension is already high because of the argument in the earlier section. John starts by immediately telling them that they do in

fact need to be there on Friday and starts arguing
        with Sylvia, Kelly, and even Carrie.[1]

        They start by telling him that the labs didn't help
        them on the test. He seems to interpret this as a
        criticism of his teaching. He tells them he highly
        doubts that is the case. Gary asks if he ever actually
        took the test. John kicks him out of class.

        Carrie observes that they thought that APES would be
        about things like saving the environment. She says
        over and over that she cried all night over the exam
        but tells him it wasn't his fault. Then she suggests
        they need to take practice tests and that is how the
        class should prepare them for the exam. Sylvia agrees
        and observes that they take 3 different practice exams
        in other classes.

It should be noted that at the beginning of the year, students seemed to have a very amicable relationship with John; he was the band coach and several of his band students were in the class. In my notes, I regularly noted that he joked around with students a lot and that he took pains to relate science material to issues they could identify with from their everyday lives. Furthermore, he took care to let them in on the teaching strategies he used and why he thought a particular activity was a useful one. I observed how this openness led to interesting discussions and even animosity over the course of the school year as students began to argue that the learning strategies he had them engage in were not directly related to test-taking skills.

John asked students to work on wiki assignments during class time about 20 times throughout the school year. Students had access to school computer resources in two different ways: in the classroom via laptops and in the media center via desktops. During the fall semester, when the students were given a day in class to work on their wiki assignments, they used laptops at their desks in the classroom. The school kept two

---

[1] Field notes and interview data have been anonymized.

laptop carts, for which teachers could sign up ahead of time and bring to the classroom at the designated hour. Often, when John brought in the cart, one or more laptops did not boot up properly or connect to the network and those students simply had to work on something else. The computing facilities for the school were outsourced, and a company representative was present on campus one day a week to deal with problems.

In the spring, John opted to take the students to the media center and use the desktops rather than use the laptop carts. All the students were able to find a working computer; however, this environment changed the dynamics of interaction significantly; students often spread out, or paired up and were not able to talk to one another as a group as they had in the classroom. Because the media center was large and often used by multiple classes at once, John was unable to keep close tabs on students as he had in the classroom.

The school wireless network was locked down so that only district-owned computers could gain access; student-, teacher- and, most frustrating for me, researcher-owned computers could not. Filters prevented students from accessing social network sites and using applications like instant messaging. At times, educational videos on YouTube to which John linked from his course page were not viewable in the classroom. On one occasion, he explained to me wryly that any technology that might allow students to communicate with one another was prohibited by the school.

Field Study Location II

The second study took place in spring semester, 2008. I had been in contact with the teacher, Elaine Baker, for two years. She had participated in my original teacher study

and had expressed an interest in using *Science Online* in her classes. Elaine held a PhD in biochemistry and taught honors science courses at a private school, Underwood Academy. I met with Elaine on several occasions to discuss wiki writing assignments. She informed her students early in the year that they would be doing a final research project on the biochemistry of human diseases, that they would be doing the projects on a website, and that a researcher would be visiting the class.

The biochemistry class took place in spring semester, 2008. The class was a year-long honors class in which the first, fall semester was spent on organic chemistry and the second, spring semester on biochemistry. That meant that the students had been in the class together for most of a school year before I met them and knew each other and their teacher well. In fact, the campus included both an elementary school and a high school, so some students may well have known each other for many years. I learned through my interviews that the class did not start out as an honors class, but the material proved to be so challenging that the school gave it honors status after the school year started. That meant these students had not applied for a place in the class as is customary for honors students and many remarked on how much more difficult it was than they had anticipated.

The students seemed to have the impression that I would study the quality of their writing, rather than their process or information use. On the days when the teacher introduced *Science Online* and the assignment, I was present in the classroom. When the website was demonstrated, the class responded with excitement and comments like "So this is like a science Wikipedia?" and "Wowww!" Another commented that the project was like doing "papers for the 21st century." One of the students asked me if I was researching whether they write better online than off to which I responded that I was sure they write well in either context, that I was not grading their writing, rather trying to

understand how they write. All fourteen students in the class returned assent forms and permission slips from their parents.

Like in the first study, students each created a personal userpage as their first assignment in order to become familiar with wiki editing conventions. Then they were assigned to choose a human disease that is caused by protein mutations and to create a comprehensive article about it for the science encyclopedia. They worked on individual articles, not in groups. The assignment was broken into three parts. First, students created a basic outline and preliminary set of resources. Second, they each worked on the section about the biochemistry of their diseases and uploaded images of the proteins involved, which they created using special software. Finally, the complete articles were due at the end of the semester. Elaine designed the wiki assignment herself with little intervention, except that she adopted the "create user page" assignment that I had developed as an introduction.

The students were never given time during class to work on the wiki assignment. On a few occasions, they went over the assignment and Elaine answered questions, but even help seeking activities mainly happened outside of class time when students sought out their teacher on their own.

Technology use at the private school was a radical departure from what I observed during my first study. Many students carried their own laptops, the wireless network was open and filters did not seem to impede use of instant messaging or social network applications like MySpace or Facebook. Students rarely used their laptops during class, but when they did, I observed them only taking notes and looking up information about the lecture content. It appeared to me as though students were both given and accepted a high level of responsibility for their use of class time and resources. One result of this difference between the two classrooms became clear on the second day I spent observing. When one

student attempted to use the reference tools that I had created, she was unable to do so because she only used Internet Explorer on a Mac; the MediaWiki formatting bar is not compatible with that particular browser/operating system combination. Within a minute she had downloaded and installed Firefox and was following along with the demonstration. In fact, there was barely any disturbance to the class at all aside from a dialog of a few seconds length. Because the students managed their own technology, the barrier to using technology in the classroom was reduced dramatically over the previous study where students and the teacher had no control over the technology they used at all.

The second enactment of Science Online was much more straightforward than the first. The teacher used it for one assignment and there appeared to be no discussion among the students about whether or not the assignment and the course were meeting their goals. In part, this may be due to the differences between honors and advanced placement courses. Many students in the first course reported that they were interested in getting college credit for the course and that the point of the course was to pass the test rather than learn to "do" science. For some, passing the AP exam would reduce the number of science classes they needed to take once they reached college. Most of the students in the second study reported that they intended to study science in college; many observed that having taken the course in high school would allow them to succeed when they took the college-level course. These students were not avoiding further science courses; they were preparing for them.

Design Modifications

Providing a description of the context in which studies played out is a critical component of ethnographic style work that seeks to understand practice in context. Because my work is also a design-based approach to research, another critical component is a description of the kinds of design modifications that were made while using a new technology in the field. In design-based research, the process of responding to perceived needs by

110

modifying the software serves both as a context for research and as formative evaluation. Instead of conducting research to assess the use and perception of different features, I simply watched and listened and tailored the site to the needs of students and teachers. It is worth noting that one effect of the strict regulation of technology in the public school was that I was unable to address technical needs "on the fly" because I did not have access to the network. I often hurried to a nearby coffeeshop between and after class observation sessions to address technology issues as quickly as possible.

Most of the tweaks that I made to the new wiki tools happened during the first enactment, in the public school. Many of the changes were simple bug fixes—students found countless ways to enter reference data in unanticipated ways and this frequently broke the references extension in the first few weeks of use.

Some design modifications were made at the request of the teacher, in order to better support the kinds of assignments he wished to create. For example, the list of references at the bottom of each page was initially designed to simply list all references in alphabetical order by authors' last names. Because the teacher wanted to easily see what kinds of references students were using to support their work, I added a link to sort references by type—journal, newspaper, website, etc. The teacher also wanted the students to be able to create pages with infoboxes with basic information about endangered species that could then be printed and used as a study aid. Although it is possible to use templates to create graphically consistent page elements, the syntax is difficult and involves understanding some concepts from programming such as inclusion and variables. To make it easier for students to create special endangered species information boxes, I made an endangered species template and included a special button on the edit page that inserted the include syntax for the new template into the body of any wiki page. Students then needed only to assign values like background colors, image file names, and relevant information in order to create the infobox page elements.

Other design modifications were made in response to observations of students' difficulties with wiki syntax. For example, students wanted to make a table of data but they struggled to create the requisite syntax. I created a wizard on the edit page that would prompt them for the number of desired table rows and columns and then create the wiki syntax for them and insert it into the page. Once again, all they needed to do was insert the actual content, and the formatting was taken care of. These modifications to the editing interface were necessary in part because of the lack of a compatible WYSIWYG editor for the version of MediaWiki that Science Online uses.

In the second study iteration, few changes were made to the software itself. Because the teacher basically used the same assignment as the final project in the first iteration, there was little need of new functionality and the software had been tested.

On a number of occasions teachers and students outside of my studies began editing on Science Online but none persisted very long, with the exception of a teacher education class at a local university. I suspect that some of this abandonment was due to a poor interface for teachers; a redesign of teachers' tools would be the next step for an improved version of Science Online.

CHAPTER 6
ASSESSING INFORMATION ON THE WEB

Assessing information plays a central role in the literature on information literacy. My research approach enabled me to construct a taxonomy of heuristics that students employed based on their explanations as they talked through their search procedures. In initial rounds of open and axial coding, I identified several categories of information assessment strategies that students used at various points throughout their assignments. Later, particularly with the denser process data I collected in my second study iteration, I was able to construct a more detailed view of students' process for constructing their wiki articles and connect their information seeking, assessment and use to their goals and understanding of the assignment. In this chapter, I will describe students' strategies for assessing information that surfaced in my initial rounds of coding; in the next, I will present the final piece of my grounded approach: a detailed explanation of process.

Literature on Information Seeking and Assessment

When it comes to understanding how people make use of information sources, researchers have taken cognitive, social and cultural views of practice. The literature on "documents models" uses a cognitive lens to understand how expert and novice readers make sense of information that comes from multiple resources (Britt, Rouet et al. 1994) (Britt and Aglinskas 2002) (Wineburg 1991) (Wineburg, Leinhardt et al. 1994) (Voss, Wiley et al. 2000). Britt and colleagues introduced the idea of documents models to explain readers' mental representations of information that comes from multiple sources. History education in particular has prompted researchers to examine these issues in detail because historians usually access their object of study indirectly. Historians cannot visit

the past themselves, so historical data generally come in the form of text, imagery, and other mediated representations of past events. The problem of becoming an adept historian is largely a process of becoming fluent in a set of disciplinary practices for assessing information and interpreting media. Britt et. al. developed the idea that readers who are making sense of multiple historical texts construct models of the documents they read at two levels: locally (features of a document and the information in it) and globally (how multiple documents relate to one another) (Britt, Rouet et al. 1994). They further suggested that students can be trained to notice the relevant features of documents and integrate these into the models they construct while reading. Based on research by Wineburg that identified expert historians' strategies for assessing pictorial and text-based information sources (see (Wineburg 1991)), Britt and colleagues developed tutoring software to support novice readers of history documents in adopting these expert practices as they read and construct models of multiple documents (Britt and Aglinskas 2002).

Stadler and Bromme have taken a similar approach to understanding how non-experts evaluate information they find on the Internet. They use the documents models framework to understand the process used by information seekers as they encounter informative media on the Web (Stadtler and Bromme 2007). They likewise developed a tutoring program that provides information seekers with a set of metacognitive prompts to encourage laypersons to reflect on important features of information sources (such as authorship and recency) and thereby build strong models of documents that integrate source information as they search for information online.

Information foraging theory was developed to explain information seeking and use as an ecological process in which information consumption is constantly balanced against fluctuations in the information environment in order to maximize gains of valuable information (Pirolli and Card 1999). This approach uses an economic approach derived

from studies in evolutionary biology to identify resource and opportunity costs associated with acquiring a piece of information and build a model of likely human behavior. For example, Pirolli and Card observed MBA students who searched for citations to support a research paper writing activity and found that they used a set of "filters" to discard sources that were likely to yield too little valuable information for the required investment of attention. These filters included the ease of accessibility, the length of the article, and other characteristics of the document. When chains of information sites are visited in succession by multiple information seekers, this suggests an optimal path with strong "information scent." This model was adapted to understanding information seeking behavior on the Web where it is relatively simple to identify sequences of clicks. If there is a strong "scent" linking one site to another, it is likely that individuals will follow a similar path. Pitgow and Pirolli and Chi et. al. developed algorithms to exploit this data to predict Web browsing behavior of information seekers (Pirolli and Pitkow 1999) (Chi, Pirolli et al. 2000).

Piagetian stage theory and information processing theory has also been used to understand how young people judge the credibility of information as they mature. Eastin argues that as young people become able to engage in more sophisticated information processing, they become more able to navigate complex information environments (Eastin 2008). The Limited Capacity Model (LCM) is an example of information processing theory that has been applied to media education research—if cognitive resources are limited, then complex information grounds such as websites with multiple advertisements and multiple messages should prove to yield reduced ability to judge information credibility cues. In fact, Eastin and colleagues found that this hypothesis was borne out in experimental studies of elementary school children's ability to judge the credibility of web sources (Eastin, Yang et al. 2006).

Many of the studies described above found that learners often overlook features of media such as authorship, subtext, or the social function. Other researchers have examined situations in which such metadata influence how learners engage with media in fundamental ways. The social functions and connotations of the media they encounter can deeply influence students' willingness to learn content. In *I Won't Learn from You and Other Thoughts on Creative Maladjustment*, Herbert Kohl describes some students' principled and steadfast refusal to learn from teachers and media that represent ideas counter to their sense of identity (Kohl 1994). For example, an African American student assiduously seeks out implications of racism or Western cultural hegemony in course materials and challenges their use. Understandably, racist or sexist language and assumptions can render novels, textbooks and other media unpalatable to some students. In such cases, learners' critical attentiveness to features of documents such as who wrote it, why it was written, and what impact it may have on their communities and identities demonstrates that information literacy goes beyond adopting some set of expert practices. Kohl's observations about students is consistent with Flower's suggestion that "literate acts… happen at the intersection of diverse goals, values and assumptions, where social roles interact with personal images of one's self and one's situation, where individual rhetorical agendas mix with highly conventional practices" (Flower 1994) p.19. In the circumstances that Kohl describes, information literacy involves not only adopting conventional practices in order to succeed in an academic community, but of protecting one's image of self and community.

Wertsch describes the differences between appropriation and learning in his study of history learning among Estonians (Wertsch, Stearns et al. 2000). Many Estonians learned from textbooks and other sanctioned media about the events that led to their country's assimilation into the Soviet Union in 1940. Despite the fact that they learned these accounts well and were able to reason in sophisticated ways about the history they had encountered in school, they did not believe these accounts. They learned, but did not

appropriate the content of state-sanctioned media because of the social function it played in legitimizing the assimilation of their nation into the Soviet Union. Instead of appropriating messages embedded in the media (which was tightly controlled), they instead appropriated illegal, often incomplete versions of events that were passed on informally through stories. Estonians' refusal to appropriate the state-sanctioned history is an example of critical consumption.

Critical consumption of information takes many formssome researchers have sought to distill assessment strategies into taxonomic descriptions of assessment heuristics. In open and axial coding of data from my two field studies, I likewise constructed a taxonomy of information assessment strategies used by students that complements and extends existing literature.

Heuristics for Assessing Information: A Taxonomy

Heuristics are rules of thumb or guidelines that people use to solve a known kind of problem. In the case of assessing information quality, there are different kinds of problems that students encounter. For example, relevance and credibility are two separate characteristics that a source may or may not exhibit strongly, both of which are important for judging its quality. Ascertaining the degree of relevance and credibility require different kinds of heuristics.

In my studies, student strategies for determining what information sources to use in support of academic writing assignments fell into four major categories (see also Table 6):

- Utility/Relevance
- Trustworthiness/Reliability
- Access
- Following the rules

Use of these strategies were apparent in both of the study iterations.

Table 7: Student Strategies for Selecting and Evaluating Science Information Sources

Category	Strategies Observed
Utility/Relevance	• "had what I was looking for" • based on google page rank • based on url name or title (not suffix) • presentation/readability • media was licensed for reuse
Trustworthiness	**Based on content characteristics** • subjective assessment/prior knowledge • cited other sources • consistency with other sources **Based on conditions of production** • authorial credentials • expert review • publisher/publication type (for example, url suffix .gov) • role of publication in science • activism/political agenda • number of editors/potential reviewers
Access	• ease of obtaining media
Following the Rules	• teacher-directed source use

Utility/Relevance

Students' search strategies often included dimensions of *utility*—did the sources have information they needed and was information presented in a way they could understand and use. Whether or not a source contains information relevant to the task at hand is a basic criterion for establishing its value. Research has demonstrated that students use a variety of heuristics to assess source relevance, sometimes even before they have seen

any content (Bilal 2001) (Agosto 2002). In the case of imagery, a few students explicitly described looking for sites in which media was licensed in a way that would allow them to reuse it in their own work. This criteria underscores the importance of media production as a component of literacy education. Although students were not meticulous about ensuring the licensing of imagery they used, some explained that they tended to use government sites and Wikipedia as a resource for imagery in particular, because these sources offered artwork and photographs they were allowed to reuse. Media production provided a reason for students to reflect on intellectual property and several classroom discussions about IP resulted from students' need to mix media.

When demonstrating their search strategies, nearly all the students used Google first to search for the topic of interest and, in the first iteration, some mentioned that they might also consult a textbook. In contrast to Wallace et al.'s 6th graders, students in my studies spent time "messing about" in the information space, getting a feel for what was available and looking for interesting links (Wallace, Kupperman et al. 2000). Also in contrast to earlier studies of information seeking among youth, constructing a search query was not difficult for these students (Fidel, Davies et al. 1999) (Wallace, Kupperman et al. 2000; Jones 2002). Some mentioned that they sometimes redid their search with different terms after learning more about a topic, but none described using query refinement as a regular strategy for increasing the relevance or utility of a given set of search results. Instead of assuming their queries were unsuitable, they seemed to assume that there must be a better place to look for information. For example, if they were unable to find something they wanted through Google, some students reported that they would likely have better results in a more specialized database, such as an index of peer-reviewed publications. Other students described finding peer-reviewed articles that were too specific and wished that there were more general information available. Both of these explanations for suboptimal search results revealed that students understand the limitations of both general Internet

search and specialized scientific journals. In order to determine what sources might be useful as they searched, they frequently used Google page rank as a proxy for relevance.

> Well, mostly, just with like prior knowledge. Like, after I read those books I went online and since that was the first thing that came up it's obviously relevant. – Paige

> Here we go. Wikipedia… Usually Wikipedia is what I end up clicking on when I'm looking for broad information about something because it is usually really good about throwing everything out there. But I would look through this, find the answers that I needed and then go to another source if I wasn't able to find everything… I'd probably come back here [Google results] and I always look towards the top because I feel these are probably the most relevant ones. I don't know, I've been told that's how they organize it. – Ella

> Then I'd be like, "well. cool. Click on the first one." That's what I would have done naturally, because it has the most hits…
> *Interviewer*: OK so did you go to any of the other links that came up in Google?
> Not really… well, I did go to Wikipedia, just to like understand what [the topic] was, but I didn't really use that as a source because he said we couldn't. – Carrie

Utility and relevance-related heuristics were important for these students in assessing the value of a given resource, particularly in the early stages of search when students were looking to understand the object of study. I repeatedly heard that Wikipedia was a favored source early in the research process because it "has the basic information," despite the fact that, as I will demonstrate in the next chapter, students had inconsistent models of how the site works and whether or not it is a reliable source and despite the fact that, in some assignments, they were not allowed to cite it.

Trustworthiness

At the core of our research on information literacy is the question of how learners understand the reliability of information they encounter while doing research. The answer to this question is bound both to the task that learners are completing when they search

for information, and to their models of how media is produced and published. In my studies, the task itself was one of information production.

Two broad categories of strategies for evaluating information reliability emerged from open coding of interview transcripts:

- Based on characteristics of content

- Based on conditions of production

In other words, students sometimes looked at features of the content itself to decide whether or not to trust it and at other times leveraged their understanding of publication to decide whether a source was reliable based on how it was created.

Students used a variety of strategies to establish whether or not the content of a resource had "trustworthy" characteristics. Some students described "getting a sense" of whether a resource was trustworthy based on their prior knowledge. More concretely, students mentioned characteristics like citing other sources and whether or not the content aligned with most other sources said.

> The fact that they listed their resources made me feel better about using them as a resource – Paige

> Wikipedia can, I don't know. It can be influenced by different people obviously, what's in the articles. But if I can find that it's solidly backed up by a reference, you know then I trust it for the most part. – Amanda

> I sometimes look for other sites to make sure that they say the same thing. – Susan

None of the students mentioned potential failure modes for these strategies. For example, the idea that a publication might itself cite bad sources or that multiple sources could fall victim to the same misinformation did not enter into students' discussion of these heuristics.

Other strategies for evaluating reliability revealed glimpses of the models students hold of how publication works. Generally people do not reflect on epistemological issues or publication models when they are seeking information to fill a need; however, different understandings of how information production is regulated give rise to different heuristics for evaluating reliability. For example, in traditional models of publication, authors wield institutional accreditation like degrees and positions held as markers of expertise that lend authority to their publications. In traditional scientific publication, an elite group of experts act to achieve editorial consensus about what ideas will be propagated by their community. In this "gate keeper" model of publication, it makes sense to use authors' accreditation and/or employer as markers of a documents' reliability. Most students reported using heuristics consistent with traditional publishing models, such as authorship and publisher, to evaluate documents based on the conditions of production.

> I understand that you have to have—you can just have any random website. It's better and you're going to have more credit if you're taking, you know, peer-reviewed sources or you're taking sources that have more credit than just a third grader's website, as far as stuff like that goes... I mean Wikipedia still isn't my first source. It'll be the thing that I go to if I want to get a brief summary of something, but if I want to dig into it, I'd rather go to a .gov site or a peer reviewed, you know, just because I don't know if the person that's writing the wiki is, you know like I said, a third grader or if it's an actual scientist with a doctor, so it's—to me Wikipedia still doesn't have as much credibility as other websites could. – Carrie

> Like government sites mostly. .gov .edu Something that seems like it's a knowledgeable person publishing. Not just like, a normal mind. – Susan

> Well, anybody can write on Google, not anyone can write on government sites. – Anne

> Science journals and peer-reviewed articles can be more reliable than blogs or Wikipedia—nothing against that—but how anyone can just throw in ideas. But the science journals are just coming from actual scientists and people involved in that field of study. – Ella

> You want to get the people who are scientists and really know what they're talking about. You know, there's noone, there's no extreme genius checking Wikipedia and making sure everything's right about it. You know, it's *people* doing it. – Jaime

Students tended to describe blogs, Wikipedia, and random websites they encountered in Google as one "type" of source that could be contrasted with peer-reviewed or primary sources. The primary reason for this distinction seemed based on the question of authorship. Who wrote it? They placed a lot of emphasis on the role of individual authors and their credentials. Students' grasp of the publishing models behind the sources and the ways that information is systematically groomed and prepared seemed more tenuous.

Part of the difficulty in assessing the reliability of documents returned by a Google search is the potentially dramatic heterogeneity of publication models that gave rise to the individual documents. In particular, students tended to dichotomize Wikipedia and scientific journals; however, few students had a clear idea of how Wikipedia is produced. A handful of students suggested that information in Wikipedia was subject to some kind of oversight, but some applied traditional heuristics to explain why they believed it might be a reliable source:

> For some reason with Wikipedia I always imagine that it's like really educated people writing these articles and I know it's probably not. – Amanda

> Like in Wikipedia and scientific journals the wonderful thing is, you get all this peer review from others who are at the top of their fields so if something's wrong, they're going to know that because they have that independent knowledge. – Reagan

In the cases above, the students describe some possible heuristics for deciding whether to trust Wikipedia content based, again, on authorship; however, these heuristics are applied globally, to the site as a whole. In the case of Wikipedia, where content quality varies

across and even within articles, conclusions about content reliability need to be made locally, based on local indicators that the content has been groomed and is under surveillance. Students consistently misconstrued the mechanisms by which Wikipedia operates and the features that are available to the general public for editing and reviewing content on the site:

> [On Science Online,] you can see who authored it if you go through the history. Maybe you can do that on Wikipedia, I'm not a member so I don't know. –Reagan

> I don't know how exactly Wikipedia works but it seems like it's kind of easy that, if you wanted to like, mislead someone—don't they have like editors there or something that go through it? – Brian

> I think they have, like, some kind of administration, because when you look at some things, it will say, 'This needs to be cited,' or 'This section needs to be linked and/or have more detail.' I think that there is someone who is regulating to some extent. – Diane

Only a few students explained that they believed Wikipedia has a process for ensuring quality that is distinct from traditional publishing mechanisms:

> Like, somebody could come in and mess it all up or push in the wrong direction and even just by accident, you know, put the wrong information on there, but I feel that—I mean I don't know how many people are monitoring it all the time to keep those kind of things from happening but I imagine they do a pretty good job. – Gary

> Well, I think that Wikipedia is more established since it's got more, there are more people on Wikipedia, I think I would probably trust it more than {our website}. But I think that as you get more people on SciOnline it would definitely be more reliable since it's just for like science people. – Paige

> Wikipedia, it's like, known that it possibly could be wrong but so many people read it that they can correct it that it kind of like checks, it's like checks and balances. – Alli

One theme that was notably absent from most students' discussions of source reliability in their web searched was the idea of authorial bias or political agenda. When they described their pre- and post- test experiences, which asked them to use four specific documents, students were more inclined to comment on potential bias that stems from the agendas of publishers and authors:

> I noticed there was one by Fox and of course different news stations, they're slanted politically… I think the graph was by an environmentalist study or whatever so obviously that's going to be slanted toward save-the-eagles or whatever. – Anne

> The news sites are a lot of times very opinionated or very much specific on something—trying to get a small point across. And a lot of times they're not very well related to the whole big issue. – Alex

> You see that these three are all journals and this one's just a news report and news reports can be biased, well I guess journals can be biased too, but when you think news and like, Fox vs CNN. Fox is definitely a more conservative spin I think, and CNN—well that's getting into it really deeply.
> Interviewer: So when you say that's getting into it really deeply, what do you   mean?
> Well like, we didn't really analyze the source. Like I know CNN, I think they have the more liberal viewpoint? Like with the War in Iraq you'd say it was bad and then Fox usually has a more conservative spin being like, it's worthwhile and this is kind of the conservative side of it. And you think of environmentalists as being more liberal in their viewpoints—well this one's insulting the environmentalists and being more conservative and saying that all they want is power and stuff. – Erin

> [Document 3] was the only one that was going against what the others were saying so I decided to look at the author. It was from Fox News so I was like, ok that's a news website so it's not always accurate, it might reflect bias and to me I detected a little bit of bias in it because it talked about the environmentalist's "ill-gotten authority" so to me it seemed like this person was a little bit more biased towards—really I guess they didn't' like environmentalists is what I'm trying to get at. So that's probably why I discredit-I didn't discredit, but I didn't give as much validity. – Jerry

> Well of course it's the scientists I guess that perform the experiments and come out with the research but I guess like now it seems that a lot of it can be slanted with media. And then we get the information through the media and so the media has a lot of power as far as that. Because you know, they

can change wording or maybe give more credit to one scientist than another who may not deserve that much credit. So I guess it really depends on who you are and how far you're looking to read in between the lines as far as the media is concerned. Because if you only go to one source, you know and you go to a very conservative newspaper to read, then you're only going to have conservative views, but if you're willing to look at both conservative and liberal papers then you're likely to have more rounded opinions. – Brian

One student described a heuristic for reliability that indicated he held a sophisticated understanding of the role of publishing in the scientific enterprise. He suggested that scientists' need to secure funding could create problems in interpreting their publications:

And if you look at—if you're talking about credible sources, you have to not just rely on scientists that are backed by say the World Wildlife Fund, you also have to look at scientists, you know, that are not backed by environmental—because, I guess it's kind of off topic, but kind of with the global warming, I think a lot of the problem is that scientists know who they're backed by. So like all too often, if you're backed by say like an oil company, your results are going to be more favorable of the oil. But if you're backed by environmentalist group, I think your results are going to be more likely to come out the way environmentalists would like it to. – Brian

Although I do not expect students to actively reflect on such issues while searching for information to satisfy their academic needs and personal curiosity, one of the goals of an information literate society is a common understanding of how information is produced. I suggest that with more accurate models of how information is produced and regulated, teachers and students can develop increasingly sophisticated strategies for using the information they encounter online and elsewhere. In the next chapter, I explore the ways that participating in the production of an online information resource can give students leverage for understanding publication models online.

<u>Access</u>

Access naturally played an important role in determining what information sources students use: if they can't access it, they can't use it. In a few cases students reported finding abstracts but failing to locate full-text articles online. However, most students were able to find a large number of potential sources and ease of access played a role in determining what resources students used. Although textbooks surfaced as a resource for many of the students in the first study and some students reported visiting the library, all of the students in both studies reported using Internet search as their dominant strategy for learning about science topics and ease of access was a recurrent theme.

> The thing is, pretty much everything I find out about is on the Internet. Newspapers and magazines and all are available but it's just a lot easier, because you can find pretty much the same stuff but a lot more of it on the Internet. –Alex

> Like with the articles we're finding, it's so easy we can find those online cause otherwise we'd have to go to some special access thing. You know what I mean. I mean it's just so much more convenient. – Erin

> As a tenth grader I seriously only went to Google or Wikipedia and even though we know Wikipedia is not like 100% accurate because people can change it, we still use it. Just cause it's so easily accessible I guess. – Becca

In most cases, students reported finding an abundance of resources by performing a simple Google search. In general, they did not find it difficult to procure information. On the contrary, so much information was available to them that they often used what was easiest, rather than employing the heuristics for reliability described in sections above. Without the rules described in the next section, which required them to find traditional peer-reviewed sources, some students reported that the information they found in more openly accessible publication venues would have sufficed.

> So a lot of my peer reviewed articles dealt with like, nitrogen leeching, soil and stuff like that... I thought that didn't really help, having to find all those sources. We had to find like 10 or 11 sources. And then, but I thought that using like website sources was a lot easier. Like the

government sources and then some companies have put together really good websites. – Sylvia

Most students in the first iteration study talked about using textbooks to support their research and some students in the second iteration described trips to the library to seek help from the school librarian; however, the vast majority of sources that students used could be accessed online. Some students reflected on their own role in creating an accessible source, even as they commented on the accessibility of other sources. In the second study iteration, some students noted that they were doing others a service by collecting information and making it more accessible through the science online site, thus improving experiences of other web searchers.

Accessibility is a significant issue for educational materials and science information in particular, but concern with accessibility is a much broader concern. In fact, accessibility is a concern not just for librarians and educators; proponents of the free culture movement are also interested in promoting wider, freer access to information sources. The Wikipedia model on which Science Online was based was started with a vision for freeing the world's knowledge for use by all of humanity. Visions of novel forms of education and production in a networked world depend on easy availability of resources to the creative minds who seek to produce novel content, software, and other goods (See (Benkler 2006)).

Rules

The rules governing text production in academic environments set school writing apart from other kinds of writing. Students write to meet a set of grading criteria that will be applied by a teacher who is generally thought to already know about what the students have written; there is little need for them to think about communicating a message or educating a reader. Students in my studies used classroom rules and familiar academic

norms to assess the quality of their sources. Although they modified their practices to meet the needs of a broader readership on the Internet, meeting the standards set by their teacher was a real concern when it came to finding and using information sources. This duality of purpose will be discussed in more detail in the next chapter.

In addition to understanding why students used the sources they used in this assignment, these quotes provide a glimpse of a larger set of rules to which these students have been exposed. Data from several students indicate that they have been influenced by an abstinence approach to new media sources like Wikipedia. For these students, following the rules means avoiding Wikipedia altogether. Other students reported that their teachers encouraged them to read it but not cite it, that they believed they could only use it *if* they cite it, and still others had heard it is a great source. Teachers' messages were somewhat mixed; however, most students seemed cautious about using Wikipedia.

In this chapter, I have described the kinds of heuristics that students employed as they sought out information online and elsewhere. These heuristics were identified through the process of open and axial coding of data; however these codes describe *what* students did with little insight as to *why* they did what they did. In the next chapter, I will examine the process of composition in more depth and connect students' understanding of their task, their goals, and their strategies for success to their ideas about information production and use.

CHAPTER 7

CITING AND WRITING:

GENRE AND AUDIENCE IN THE CLASSROOM

In Chapter One, I introduced the concept and history of information literacy and observed that educational standards for information literacy frequently include dimensions of critical consumption, but generally do not focus on participation in the creation of information sources. For example, I discussed the ACRL's widely accepted five standards for information literacy that are frequently adopted by information schools who train educators ((ACRL) 2000). To date, much of the literature on information literacy has focused on skills represented by the ACRL's five standards, which emphasize critical consumption–search, evaluation and use. My studies contribute to this literature by suggesting that new forms of media and new publication models give rise to new ways of participating in and learning about information. In this chapter, I examine how students engaged in different aspects of information literacy as they completed wiki publishing activities. My grounded analysis suggests that the concepts of *audience* and *genre* play critical roles in students' performance of information literacy in the wiki publishing context.

Genre and Schooling

Education is frequently described as enculturation—becoming able to act skillfully within a community of practice and contribute to its goals. Many ideas about how people learn focus on sustaining and reproducing the valued (and valuable) practices of communities

in the next generation of its membership. From midwives, tailors, and quartermasters (Lave and Wenger 1991) to would-be scientists, engineers, and mathematicians (Kolodner, Gray et al. 2003) (Renninger, Shumar et al. 2004) (Scardamalia and Bereiter 1996), to historians and journalists (Wiley and Voss 1996; Hatfield and Shaffer 2006), the literature on human learning is full of examples of encouraging learners to "think like a," "act like a," or "see themselves as a."

This ground is theoretically well trodden. Legitimate peripheral participation provides a way of thinking about the kinds of activities that learners might engage in to become central members of a community of practice (Lave and Wenger 1991) . Cognitive apprenticeship appropriates the apprenticeship model of learning for cognitive activities and examines the ways that teachers can model and coach students as they adopt expert ways of thinking as well as doing (Collins, Brown et al. 1989). Schaffer and Resnick's thick authenticity includes disciplinary authenticity as a desirable feature of learning activities, meaning that learning activities ideally involve tools, strategies and outcomes that are characteristic of the discipline being learned (Shaffer and Resnick 1999). Theorizing about processes of enculturation and how to use these processes to bring about desirable learning outcomes in formal education has come a long way and has yielded useful yardsticks for the design of new educational environments. These studies break from the tradition of examining processes of enculturation and instead focus on a case where a disruption in practice created opportunities for learning.

Genre is one way that community practices become reified and recognized and are sustained as membership changes over time. The study of genre has a long and nuanced history. In this analysis, I adopt the post-structuralist view that genre cannot be understood apart from the situations in which texts are produced. Genre describes both form and communicative purpose. It describes not only the form of the written artifact itself—"novel," "syllabus," "business memo"—but also the demands of a particular

rhetorical situation. Genres are kinds of texts, but, furthermore, they are kinds of social actions within a particular community (Flower 1994) (Miller 1984).

As it becomes a stable and identifiable feature of a discourse community, a genre becomes a tool that members use to shape their participation. In his examination of the experimental report in science, Bazerman observes that "writers find in existing models the solution to the recurring rhetorical problems of writing science. As these solutions become familiar, accepted, and molded through repeated use, they gain institutional force. Thus though genre emerges out of contexts, it becomes part of the context for future works" (Bazerman 1988) (p.8). Bazerman argues that the adoption of a genre by an individual scientist is a critical appropriation, that genre is always interpreted and used in a particular situation by a particular individual. Still, as social constructs, genres imply consistency, mutual intelligibility and evaluative standards. By structuring discourse, the genre of the experimental report, for example, both frees scientists from some of the rhetorical burden implied in the communication of experimental findings, but it also becomes a powerful constraint by establishing rhetorical expectations that can only be satisfied by engaging in certain practices. In other words, although scientific reports are literature that distill, simplify and at times even misrepresent the activity of the laboratory (Knorr-Cetina 1981) , certain practices of the scientific trade are embedded within the genre. Thus the genre becomes a powerful instrument of stability within the scientific community.

It would make sense from this perspective that students should become adept at producing specific genres in order to practice participating in the disciplinary discourse communities they will someday join. Although school genres are never quite like the genres of the professional world, in the best case they serve as a jumping off point—a place to practice (Barab, Duffy et al. 2000). Russell describes the role of school genres as a kind of mediator between the activity system of school and the activity systems of the

professional world: "A classroom genre is a translation of some professional genre, a way of changing its direction (motive) from that of the research lab or professional application to a pedagogical use…" (Russell 1997) (p.16). By participating in the production of professional-like genres in a school environment, learners can begin to orient themselves toward (or, as Russell points out, away from) the practices of a professional community.

There are several examples of innovative projects that reproduce the rhetorical situations of a particular profession to create a bridge between educational writing contexts and disciplinary modes of thinking and communicating. These projects often include the design of innovative new media. Hatfield and Schaffer's *science.net*, for example, builds on the idea of "epistemic frames," or ways of knowing and thinking (Shaffer 2006), to create an environment where students learn to think and write like a science journalist (Hatfield and Shaffer 2006). *Science.net* uses special software designed to introduce learners to journalistic writing by including structural cues in the form of markup tags like lead{}, body{} and jump_line{}. The software used on the *science.net* site encourages students to engage with science content by structuring their writing experiences around two important elements of journalistic writing: *writing to formula* and *writing as a watchdog*. Explain Hatfield and Shaffer, students in the class that used the site "engaged in the practice of writing to formula, which involves developing journalistic skills and knowledge such as writing story leads and using inverted pyramid story models. These profession-specific writing structures are part of the highly formulaic writing that differentiates journalistic writing from other genres" (Hatfield and Shaffer 2006) p.237. In this case, the writing technology was intended to help learners think like a journalist.

Scardamalia and Bereiter's Knowledge Forum (and its predecessor, CSILE) was similarly designed to support modes of discourse among learners that resemble that of scientists. The "knowledge building" discourse of science provided the model for an

innovative way of thinking about formal education and the design of classroom activities and software. Their goal was to encourage learners to take responsibility for examining and furthering the knowledge of their class, much like scientists do (Scardamalia and Bereiter 1996). Knowledge Forum is a kind of discussion forum that structures students' discourse in part by asking them to reflect upon and label their contributions with labels such as "my theory," "I need to understand," "a better theory," and the like. When a student creates a note that they believe makes a particularly sound contribution to the knowledge of the class, she can submit it for review and, if published, it becomes marked as such in the software. By creating learning contexts in which students work toward publishable notes, knowledge building activities on Knowledge Forum approximate the rhetorical contexts in which scientists create and communicate about new knowledge. Knowledge Forum notes don't look much like scientific publications in form, but they satisfy a similar social purpose and allow students to perform similar social actions through writing. Scardamalia and Bereiter recognize that simply reproducing scientific genres like lab reports are not sufficient to bring about scientific thinking: "it is not likely that imitation of surface forms can produce the radical restructuring necessary to turn schools into real knowledge-building communities" (Scardamalia and Bereiter 1996). Instead, they try to create a set of rhetorical demands and social supports to get students thinking like scientists.

Although genres and the situations in which they are produced are sometimes simplified or replicated for pedagogical purposes, genres are not straightforward recipes for successful communication. Genres change. People are agents who bring with them motives and interpretations that affect their appropriation of genre as a tool for structuring interactions. Miller explores how genre facilitates social action and connects individual agency with cultural convention (Miller 1984). She explains that although they represent recurrent rhetorical situations and patterns of language use, genres are not permanent immutable features of discourse, but evolve and are adapted to new

circumstances. There is a constant dialogic interplay between the micro-level at which individuals and groups produce texts and the macro-level at which genres represent the structure of social discourse. For Russell, this is a reason to educate young people not only to reproduce genre forms but to enact genre reflectively and critically, so that genre can become a tool through which they can assert themselves. Bazerman too notes that schools should not think in terms of "simple genres that must be slavishly followed, that we must give students an appropriate set of cookie cutters for their anticipated careers, but rather that the student must understand and rethink the rhetorical choices embedded in each generic habit to master the genre" (Bazerman 1988) p.8.

Genres don't stay the same. Genres change over time because people experience new kinds of rhetorical needs. When and how genres change is an interesting question with implications for studying genre in education. Bolter and Grusin examine how meaning is communicated differently when messages from one media are repurposed and represented in another and articulate this process as *remediation* (Bolter and Grusin 2000). Orlikowski and Yates have used the notion of *genre repertoire* to examine how communicative practices change over time in organizations and how individuals repurpose genres as new situations create new rhetorical demands (Orlikowski and Yates 1994). Similarly, I position new media as a potentially disruptive element in schools.

Transforming the Research Paper Genre with New Media

I will base much of the analysis in this chapter on data from the second enactment of Science Online in the private school setting because my data is much denser and provides a more complete picture of students' writing process than data from the first enactment. However, data from the first study was also instrumental in supporting my analysis of student activities, in particular where these activities concern search and assessment practices. When the assignment was introduced, the students in general appeared enthusiastic and excited and seemed to anticipate what it meant to write on a wiki.

However, in interviews, it became apparent that when they approached the task, this new context for researching and writing about science created confusion. The students recognized that it had a different purpose than a traditional paper and weren't sure what exactly the results of their efforts should look like:

> I was like, 'Mom. I'm getting something published on the Web!' I was really excited. I didn't know it was going to be like this though. I didn't know it was going to be a webpage. I thought we were going to write like a research paper… [but] it's not really going to be like a paper, it's just going to be like—I don't even know how to describe it. It's like a paper but not a formal paper. Cause we're doing research and everything, it's just not. – Becca

> I think it's really interesting that it's like [Wikipedia], it's really cool. I like it a lot and like, instead of writing a regular paper, that's what it's for and I think I like this better than just sitting down and writing a regular paper... I'm a little confused because originally it was a research paper and now it's online. – Erin

> I actually thought we were going to, like, be writing a paper… I have no idea where we are going with this. I think we are just making a web site for other people to use… I like that a lot better than actually having to sit down and write a research paper that has to be so-and-so amount of paragraphs, so-and-so amount of words. This is kind of, like, you can get your point across and you can do it in the way you want to do it. – Jamie

> It's kind of almost like writing a paper. – Jana

> When I normally do a paper, it is just like only my teacher is going to see it, and if I let my mom proofread or my dad or something like that. It's like a more intense form of a paper. – Lisa

These students felt that the familiar scholastic genre "research paper" did not satisfy the rhetorical demands of writing a publicly accessible article about a science topic on a wiki. When the "research paper" went online, it became somehow different. There was a new audience. The form and communicative purpose had changed, it was no longer a genre that they were skillful in producing. So how did they proceed? As I coded interview data to understand the process students used to write their wiki articles, I found that they

attended to two distinct communicative goals as they assembled their understanding of what kind of written artifact they ought to produce:

- Meet assessment criteria (doing school)
- Provide a public resource (publishing)

Over the course of the two-and-a-half month assignment, the students moved between these goals as they progressed in the construction of their wiki pages. These two communicative purposes are not separate ways that students engaged with the task of writing a science article, rather, they represent two rhetorical situations in which students needed to act simultaneously. Each of these goals alone implies the production of different genres in terms of both form and communicative purpose, and students used different rhetorical strategies to inform different phases of their writing as they moved between the two goals. Still, in the end, the students' writing efforts yielded a single written artifact, not two. They reconstructed the genre of "research paper" in a way that satisfied the new rhetorical demands that were imposed by the public nature of the assignment.

To examine this process in detail, and to understand where learning opportunities are situated in this process, I break the process of constructing a "research paper" as enacted by these students into three sets of tasks: *finding content, crafting content,* and *sourcing content*. Students moved between these iteratively, not sequentially, and used different strategies as they switched between tasks and goals and as they gained expertise about their topics. The three kinds of tasks are interdependent, they inform one another. See Table 7 for some high level strategies for each goal and each set of tasks. In the next sections I will work from the data to demonstrate how students reconstructed the "research paper" in the context of this framework.
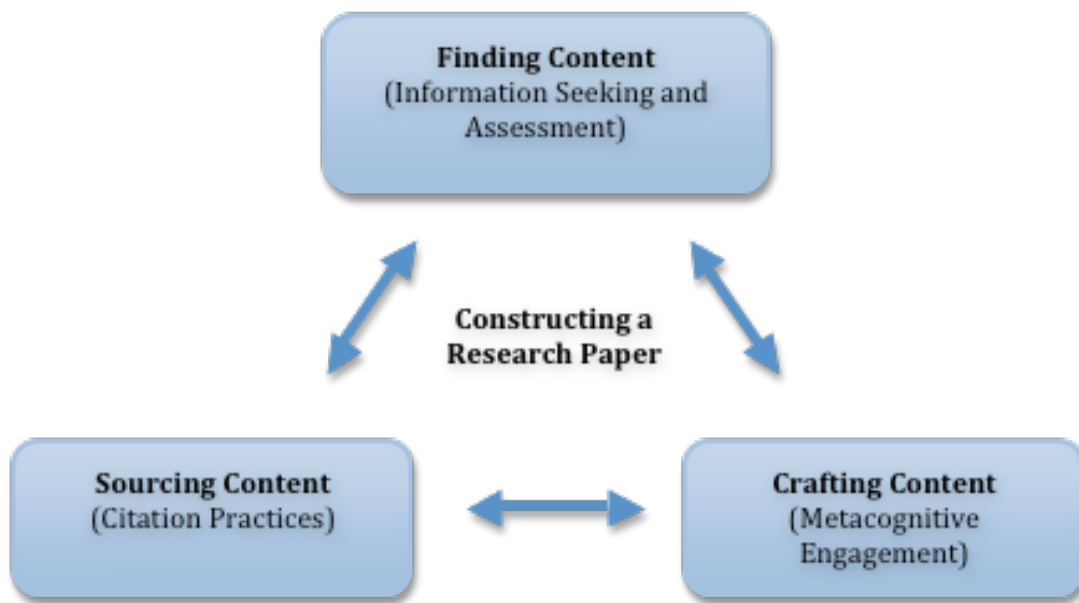
Figure 4: Constructing a Research Paper

Table 8: Student Strategies for Meeting Two Rhetorical Goals

	Goal 1: Meet Assessment Criteria	**Goal 2: Provide a Public Resource**
Crafting Content	• Follow directions • Look to other students • Apply conventions from other classes • Seek feedback	• Simplify scientific language • Invoke an audience • Use existing sources as a model • Reflect on own experiences as a reader
Finding Content	• Follow directions • Apply conventions from other classes • Invoke the teacher	• Use "regular" search habits

Sourcing Content	• Look to other students
	• Apply conventions from other classes
	• Seek feedback
		• Same strategies, different purposes:
		  o Ensure credibility
		  o Defer responsibility

Goal 1: Meeting Assessment Criteria

Writing assignments are often an assessment vehicle; students not only learn about something but also demonstrate what they know by writing about it. The students in my studies were doing school work. They were assigned the task of writing a science article about a human disease and found themselves in the familiar rhetorical situation of producing a text that would be used by their teacher to assess their learning. In later sections, I will demonstrate how they used not only explicit directions from their teacher, but also imported experiences of writing in scholastic genres from other classes to decide how to meet assessment criteria. To understand how to write this assignment successfully, they both followed directions and used their understanding of how writing assignments serve an assessment function in the system of schooling in which they were required to act.

Many of students' decisions about how to proceed in their research and writing were guided by their perceptions of what the teacher wanted. Yet, when they were asked directly in interviews throughout the project, not one of the students reported that they understood what grading criteria their teacher would use.

> It's been difficult, not horrible, because we don't really know exactly what our requirements are. We're kind of just given, you know, a rough sense of what we need to do. – Jana

> She hasn't done like, you need to have your introduction done, you need to have like an outline handed in. Like every other research paper I've had to write, that's what it's been like and this has not been like that at all. – Becca

> The one thing I don't like about the way we've had this set up is that I don't feel like I have a really good grasp of what the whole thing's going to look like when it's all done… So, you know, it's hard to figure out how to do it. – Jamie

> I don't really know. She hasn't given us a rubric or anything yet. I'm not sure. – April

We haven't even seen a rubric… so I don't know if it's based on the actual English part of it and how well we defend our topic or if it's just—I don't know. To be honest with you, I don't know. – Jerry

This meant that students had to find indirect ways to define the rhetorical constraints associated with meeting assessment criteria for the assignment. The strategies that we will identify in the interview data are applying conventions from other classes, invoking the teacher, calibrating with other students' work, and seeking feedback.

Although the students reported that the assignment was unstructured, Dr. Baker gave the students some direct instructions. First, on the day that *Science Online* was introduced, she explained what a primary resource is, how science publication works, and gave explicit instructions on how to find peer-reviewed journal articles on indexes like PubMed, a digital library run by the US National Library of Medicine, and Galileo, Georgia's state virtual library. Second, while demonstrating for the students how to edit the wiki, Dr. Baker made up a sample outline for an article. Many students referred to her outline as they began the task of organizing their articles. Finally, she structured their writing process by imposing three due dates: early on they were required to choose a disease topic and post a draft outline as well as one relevant peer-reviewed source; about half-way through they were required to post an image of a relevant protein and write a draft of the section on the biochemistry of the disease; the final due date included instructions to cite three peer-reviewed journal sources and five websites. Individual students also sought out feedback from Dr. Baker as the assignment progressed and received explicit directions in one-on-one sessions.

Goal 2: Providing a Public Resource

Because their writing also functioned as a contribution to an online information resource, the students also found themselves needing to act in another kind of rhetorical situation:

informing an unknown readership. In my 2005 pilot study, students either did not understand or did not buy into the idea that their work would be viewed by the public, although they were editing a public wiki (Forte and Bruckman 2006). In this study, students accepted that their work would be available for the public to see and use. In both study iterations, at least one student found that when she searched for her topic on Google, it returned her own wiki page in progress. In interviews, some expressed apprehension about the idea that their work was available for the world, whereas others were excited by the idea, but all understood the public nature of the work.

> It's like 'oh my gosh, I have a huge responsibility now' even if nobody actually uses this. It's still there, somebody *could* use it so everything has to be exactly right and I want to put as much information on here as possible. – Reagan

> I don't know if I would do something like this without having an assignment for it.
> INT: So explain what you mean by that?
> I just mean, I wouldn't—like I don't think I see myself as a blogger or someone who puts up stuff on the Internet.
> INT: Why not?
> I don't know. It's just weird to put your stuff so like everyone can see it. Like everyone in the world can see it. It's just weird. I guess some people are like, yeah, I want everyone to notice me, but I'm like, ummmm. – Diane

> I think it's so cool! ...I think it's great! Cause it's just like Wikipedia except *you* can do it. So I think it's really good. – Julia

> I'm not going to lie. I'm sure I'll never know this but if I find out like someone uses my information, like some little kid for their research? I'm going to be like, yeah, that was me! I did that research! But I'm sure I would like never be able to know if someone actually used it. – Becca

> Like, I'm the person that hates to be on stage and stuff like that. I don't like any kind of attention. But for this I don't care if someone looks at my work.
> INT: You don't care if someone looks at your work or you don't think they are?
> Well, I'm sure someone probably has and I don't know, but I really, to me it wouldn't matter. As long as I don't make a fool of myself. – Hans

> I kind of like writing it online, but it is kind of weird, because I have never done anything like that before. It is kind of weird just thinking that other people are going to see this, possibly. That is so weird to me. — Lisa

All of the students seemed well aware that their work was public and described writing strategies that indicated they were reflecting on their readership and how best to inform them. The writing strategies we will identify in interview data in the next sections include invoking an audience, simplifying scientific language, and using existing resources as a model.

Balancing these Goals in Practice

Because they needed to produce one text, students had to balance the two rhetorical goals that they experienced, *meeting assessment criteria* and *providing a public resource,* as they composed their wiki articles. How did this translate into concrete strategies for writing? How did they figure out what to do when they weren't sure what it meant to write a research paper to inform the public? In the next three sections, I will situate students' reconstruction of the research paper genre in their actual writing strategies by examining how the two rhetorical goals informed *writing and organizing content*, *information seeking,* and *citation* tasks as they carried out their wiki writing assignments.

Crafting Content

Students felt unsure about what exactly their teacher was looking for or how they would be graded. As they described their actual writing process, students revealed a few different criteria for deciding how closely they were approximating the teachers' expectations. First, because the writing was done on a wiki, which is a public writing venue, it was possible to look to one other's work for cues:

> I looked at other people's pages and just kind of got an idea of what I needed to put on there and stuff. — Lina

I just came up with the topics. It was just kind of general stuff I guess. I looked at other people's and saw what they've done and I was like, oh, ok, yeah, that's a good one. – Sarah

I went to like 5 or 6 pages just to see if it was like under another category if it was like "image" or if it was on their actual page and if it was on their actual page I would text them-cause Alli, I think Alli's is linked to another page and I think Lina has it actually on her page and I knew it was her page and I was like how did you get it up there? – Becca

I like to see how they like organize theirs or like how long theirs were. INT: And did you do that before you started writing or? R: I did it after I wrote it. I was just making sure that mine was a good length. – April

I looked at my friend Erin's paper to see, like, how she had, like, organized it and written it. And so after that, I am like, okay. So I got a good general idea of what length it should be, like, what type of words to use, because she always gets really good grades in class - is, like, perfect - so I am like, okay, I need to structure something like this, so then I wrote mine. – Jerry

I heard some other people have really intense stuff on their sites, like Erin. So I have to add some more information to it. – Lisa

Students did not simply come up with standards for written work on their own, they used the open nature of the wiki medium to begin constructing a shared understanding of what kind of written artifact might satisfy the demands of the assignment. By looking at one another's work as they progressed, they were able to build this interpretation collectively and to gauge their work and process against others'. The wiki medium allowed students to see aspects of article production that helped them calibrate their own work. For example, the referencing tools in Science Online allowed students to see others' citations as they worked. When a student is entering a citation and types in an author or title, the wiki offers a list of matching sources that have already been entered. So students could see if others had used information from the same sources:

When you do the reference and you type it in, it will [show] you other things from there. So when you start typing in Mayo on the side it shows up. So I saw I think Erin's thing came up as Mayo Clinic and that was the title of hers. And then once you start typing in more information it goes away so I just happened to notice it as I was typing that in that other

people have used the same site… It was nice—at first I was having trouble with figuring out how to put stuff—how to get like the reference stuff in like what it's supposed to look like when I type it in. So you can click edit on somebody else's and see what it looks like and you know so I kind of figured it out that way. – Jaime

In addition, it was possible to use information from the wiki editing history to understand if they were keeping up with other students:

I wanted to see if I did it at the same time as everyone else. I did. I wanted to see the history of who's updated lately. – Hans

As they wrote, students balanced the need to write something that would earn them a good grade with a sense of responsibility toward their readership. I have already observed that students were aware of the fact that their writing was visible for the public to view and use. As they wrote, this awareness led them to use writing strategies like simplifying their language, evoking an audience, and using models in order to write and organize their text for public consumption. One student observed that "it's not like we're just doing a paper that we return and get a grade on and it's over with, this is still going to be used for something bigger than just, like, a grade" (Jana).

How did students organize their texts to ensure that it was readable and informative and served a purpose beyond the grade? Students described a variety of strategies that helped them create texts that would be useful and interesting for readers. One recurrent strategy was to explicitly invoke an audience with specific characteristics like background knowledge and interests. Often, students' invoked audience resembled themselves, but they also considered that many readers would not have the advantage of having taken honors biochemistry and may have less background knowledge.

What do people want to know about bipolar disorder? That's kind of like what I was thinking about. Like what would I be interested in if I was trying to look at one of these sites? And I wouldn't say I'd be really

interested in the biochemistry but since it has to be included, it shall be included. I mean, you want to know what happens when you have this disease, so I included symptoms. Or how do you fix this? Is it treatable? Can you live with this disease? – Sara

If I was researching—which I am technically researching—then I'd want to know what it was, what it looks like—like what are the signs, symptoms, treatment, diagnosis, things like that. And so that's how I got my subtitles. – Julia

If you started off the first paragraph with the structure of the amyloid beta protein in Alzheimer's, people would be like, 'Wait, what are you talking about? You know, what is Alzheimer's? Is it devastating [unintell]?' And so that is why I start out with statistics, symptoms, just in case, you know, someone is really ignorant and does not know what it is. – Kimberly

I don't want it to be too vague and just—I don't know how to say it—free from information. I'm trying to go a little bit of detail but not so much that it gets too wordy and people don't want to necessarily read through all that. – Jana

I know when I go on web pages and see that I don't understand the first couple of lines I just like go back and pick another web page. So I put the stuff that people are less likely to know about in the bottom. – Alli

In addition to organizing their texts to serve the needs of an imagined readership, another strategy that students used to design their wiki articles was using other sources as a model. Students were selective about what they took from other sites, and frequently reported that they had only patterned their articles after the parts that seemed interesting or useful.

On a lot of the other websites it was broken down into like treatment, diagnose and like all that kind of stuff. Yeah, like, there—treatment, prognosis and everything. So I figured well, that's how they do it and people seem to get to that easily I just might as well do it like that too. – Lina

I looked at how it was broken down on other websites like because we had to get sources. So I combined a bunch of like—I looked at—you'd go to one website and they'd have different categories for what they talked about. So I kind of picked the ones I thought would be the best suited to like cover all of it and I just did those. – Erin

145

> I was looking at other sources and how they kind of went about explaining the disease and mimicked that a little bit. So that is what I did. – Kimberly

A number of students used the encyclopedia model as established by Wikipedia to guide their efforts and either emulated or explicitly attempted to improve upon it to add value to *Science Online*.

> I kind of see how it's going to go like with all the information under subheadings. I'm guessing it's going to be something like that, and not just like one huge paper with like, transition sentences. Is it going to have—is it? Oh this is crazy. I guess what I'm thinking about it is it's going to be like Wikipedia. – Becca

> I was writing the bio-chem part of it, and I didn't know some of the words so what I wanted to do—so on Wikipedia, if there is like a word you don't know, it will tell you like, the definition. I wanted to try to do that. – Becca

> I think Wikipedia's just so general. Like you can't really get the little details that like, are really important. And like when—in our case, we each have our own thing and our topics are so specific that you have down every detail about it and that would be helpful for people. – Lina

> This is going to be a really good article, because I mean, in the Wikipedia one— not that I quote from that—but the Wikipedia one does not go into any detail regarding the biochemistry, I do not think. Or it did not go into enough that I thought, 'Oh, I understand this.' So this will be even better. That is the aim. – Julia

The kinds of writing strategies described up to now were about selecting information and organizing wiki articles to serve the purpose of informing the general public about science. When it came to actually composing the text of their articles, students also had to decide how to serve the two goals of earning a grade and providing a resource. A common strategy for writing a public resource was to simplify the scientific language they were reading in journal articles in order to make the ideas accessible to a wider readership:

I want it to be, I guess, readable for everyone. Cause like some of the articles I've been finding on PubMed, I have no idea what they're saying. So I want to be just more understandable. – Jana

So I mean, I had to take words and I mean, I wanted to make it readable for people too, because I knew other people were going to look at this, so I was not going to use, like, huge words, just kind of make it simple. – Lina

I think this kind of does a good job of bringing it down from the scientific community so that it can be understood by the general public to some degree. – Hans

I had to go back and define everything in terms of, like, what it was exactly and break it down to a very, like - I do not want to say a lower level, but I mean truly it was, like, a lower level - so that took a lot of work, because I had to go back for the vocabulary. At first I was just taking stuff and putting it into my own words, but I could not do that. I actually had to go back and do the vocab, look up everything, what it meant. – Jerry

The articles I found had those words in it, and I was like, "Wow, I really don't know what that word means. Maybe people won't either." So, like, I figured if I'm going to put it in my paper, and I need to probably know what it means just in case someone was like, "What does this mean?" – Becca

One student admitted that she felt she did not understand everything she wrote about, and expressed concern that it would not be understandable for her readers either.

If you looked at some of the stuff I put on there, I do not really understand what it says completely, and I do not know if other people understand what it says either. I do not know. It is kind of weird to me. So I mean, hopefully they understand what I meant by what I said… I mean, I tried to pick the really smart stuff and make it more normal. – Lisa

Simplifying scientific language is hard work. In order to re-express the ideas from scientific journal articles, these students needed to engage deeply with the scientific content and understand it thoroughly. One student noted that 40% of his effort "was collecting information. 60% was actually trying to understand what on earth are we talking about." (Jerry). Having a "real" audience brought about natural opportunities for engagement with science content by creating an authentic need for students to work with

scientific ideas and, as I will demonstrate in later sections, by creating a sense of responsibility among students to get things right and express themselves well. For these students, the communicative goal of providing a public science resource meant becoming enough of an expert on their science topic to mediate between the language of the scientific community and laypersons like themselves.

The strategy of simplifying scientific language was frequently aligned with the goal of earning a grade as well. As one student noted, the teacher would know if they simply restated things they didn't understand, "I know if I put really, really intense stuff about it, she will know. She would not understand how I knew that, so I tried to take all the really big information and just scale it down to where I could actually understand." (Lisa) In addition to serving as a kind of watchdog, the teacher reinforced students' sense of audience throughout the assignment. She had anticipated the learning value of having students write for a real audience, this was one of her motivations for participating in the research and she reminded them periodically to think about the fact that their writing would be public.

It is worth noting that, at times, students felt they had to make a choice between the goal of providing a public resource and earning a grade. When this issue was raised by students, they tended to describe earning the grade as a primary motivation.

> I think about, like, what she wants and then in the back of my mind I'm like I hope someone uses this because I'm like helping someone with their project. – Erin

> I want it to be understandable, but I don't want it to be so simple that it looks like I didn't but enough like time or thought into it. – Jana

> Well, 'causes', I was like, well, if someone was to look at this, it would be like 'causes of the disease', like, and then I was, like, well, maybe they will not understand that, and then Dr. Baker was like, 'Well, you are supposed to find the etiology of the disease.' I was like, 'Okay, I am going to use the word 'etiology'.' – Lina

I kind of have reorganized mine to fit a paper format compared to, like, what you might find on Wikipedia, just because I think that is the way she wanted it to go is, like, a term paper-type issue... like, whenever I do something with Wikipedia, it seems like they will always have, like, just a little blurb right at the beginning of something if you just need information, like, right away. And this seems more like someone is going to have to sit here and read. If they want to know about schizophrenia, they are going to have to read what I wrote in terms of symptoms and statistics like that, compared to just 'a schizophrenic person is this.' This is, I guess, in more detail than I would expect if I was just trying to get a quick answer. – Hans

This is evidence that, although students are taking into account unknown audiences and writing to provide a useful science resource, they are still doing schoolwork. Whatever other goals they may adopt, they are here to earn a grade. Their writing process is about adapting the "research paper" to the novel conditions of publication. In the next sections, I will examine how tasks associated with information seeking and citation, also important aspects of producing a research paper, are experienced differently by the students when they need to take into account the unfamiliar rhetorical demands of publishing.

Finding Content

Students have more than one way of thinking about information and where to find it. I found that they change their tactics many times even within a seemingly single context like completing a homework assignment. They used different strategies depending on their level of knowledge about the topic, what goals they were attending to, and where they were in the assignment, all of which changed fluidly throughout the study. This is consistent with literature on information seeking that underscores the iterative nature of information seeking as a process (Wallace et al 2000).

All of the students described doing general searches on Google as they began learning about their topic. Early in the process, many students described using web resources like Wikipedia, Mayo Clinic, and other websites to inform themselves, get background

information, and formulate better search queries. These findings confirmed data from the first study that suggested students refine their search process iteratively. Their criteria for identifying good sources to learn from tended to revolve around accessibility, whether the source had helpful information, and whether it "looked professional."

First I started on just a basic Google search.
INT: Can you show me literally what you did and talk through? {typing} I started just researching protein-based diseases and from there they gave a list of like, Alzheimers and stuff like that and some of those were already taken by other students. And so that's how I found Lou Gehrig's disease and then I went to the evil Wikipedia… So first I did Wikipedia, then I tried to kind of get away from that. – Jana

Oh. I went to Google first, Google's my bread and butter. So I just did Google-I probably spelled [the disease] wrong the first time I did it… {looks at search results} Wikipedia's number two so I was golden.
INT: So why do you use Wikipedia?
Cause it's so user friendly. I mean, I love this little box here. Like little outline format so I can jump right to it… And then I think after I did this, got some kind of idea, realized that it wasn't always as severe as [in the movies], I went back and I think I searched for the involved enzymes. – Hans

I went online like next, like that night or something and found like the background information on it.
INT: So how did you do that?
I just went to Google.
INT: Can you show me what you would do?
Alright yeah… {searches on Google and clicks on Wikipedia} This is where I read about it before I actually was like, that's what I'm going to do.
INT: Ok so how did you decide to chose that link. How did you decide to click on that?
Cause Wikipedia is like something I've been using since Freshman year and it's the first link… People, when they hear "research paper" they immediately go to Google and Wikipedia. – Becca

Google. I always go to Google first, it's like my best friend. And then I would just type in Alzheimers Disease. Just to find general sites. And the first one I saw was this one and it seems really professional.
INT: alz.org?
Yeah… I went to this one and I went to Wikipedia. For secondary sources, I love Wikipedia also. {Clicks on Wikipedia} Yeah I went to this one.

150

They just give you like a good definition. A good foundation for it. – Kimberly

Conflict around Wikipedia arose recurrently as students described their information seeking efforts. Wikipedia holds a central place in these students' general information seeking habits, and they likened *Science Online* to a "science Wikipedia," which made it a natural place to look for information; however, they had received mixed messages from teachers about the appropriateness of using Wikipedia in school. Some students described being told not to use Wikipedia at all, some described being told it was fine, still others were advised to use it only in conjunction with other sources. Three of the fourteen avoided Wikipedia altogether and most of the others indicated that they used it despite the fact that it is taboo. This confusion is consistent with findings from my first study iteration, described in the previous chapter, in which students also frequently turned to Wikipedia but had poor understandings of how it works (see (Forte and Bruckman 2008)). Some students suggested that they would not or should not "use" Wikipedia, yet when they described their actual actions it was frequently one of the first places they went to begin reading about the topic.

> INT: {Looking at search results} Ok, so you're looking at your results. What do you [click on]?
> Ok well, probably not Wikipedia. Well, sometimes Wikipedia's good but sometimes it isn't.
> INT: So can you explain why you would or wouldn't?
> Cause Wikipedia, anyone can edit it so you don't necessarily know if it's good or not but it can be helpful if you're starting off. Just to look at like—this has categories and just talks about it.
> INT: So did you look at Wikipedia?
> I did. Yeah, I looked at it at first. – Diane

> INT: Can you show me [what you did to search]?
> Yeah. {whispers to interviewer} I looked on Wikipedia.
> INT: {laughs, whispers into the recorder} She looked on Wikipedia.
> Apparently we are not allowed to. {looks at the Wikipedia article} So wow, look at this. This is what it is. Symptoms, lots to write about there. Diagnosis. Pathology. And then this stuff that I don't really want to know about. Therapy.

INT: Ok, so you are acting like you shouldn't have looked at Wikipedia. I think we're not allowed to… I mean even my previous school teachers would be like don't use Wikipedia to search science. – Julia

I started yesterday looking for the primary protein that's involved in like causing and it's like, Glutin, G L U T I N, I guess that is how you pronounce it. So I typed it on Wikipedia… In English or in history or in papers like that I never use—or I never can cite Wikipedia—we are not allowed to do it. However, I do use Wikipedia for my own knowledge, like even if I can't use it in my work cited I am still going to read it. Okay you know, let's say there is a book. So you are reading this, there is a book and you don't understand at all what it is talking about. So I will type it in on Wikipedia and I will sit there and I will read it and I will say okay this is what this person is thinking about and then I can start to bounce off that idea. So once I bounce off that idea I start getting ideas in my own head so then I will go try to find primary sources to help me incorporate that. – Jerry

{Looking at search results} I skipped Wikipedia because usually teachers tell you not to use Wikipedia as like a source. Typically if I'm just like interested about something, that's where I'll go cause it has like everything, but they always tell you to like steer clear of Wikipedia for things.
INT: (later) So you said that most teachers don't want you to use Wikipedia as a resource. Did you look at Wikipedia at all?
I actually didn't because there was so much other stuff on there about it but you know, if I was looking for something more complicated or they didn't have anything or if I wasn't trying to do it for a research paper. If it was just for, you know, doing my homework and I don't know what something is or what something means or what they're talking about? And you're not going to quote or cite or anything like that, you just want to know, that's where I would go. – Jamie

Teachers kind of discourage us from using Wikipedia. So I don't really use it unless I have to look for something really basic, if I'm like starting on a whole new topic and I just want to get like the basic overview, then I'll use Wikipedia for that. – April

I use Wikipedia all the time. You know, they tell you we're not supposed to use it technically because, like, Underwood says it's not a very good source 'cause anyone can get on there. But for quick things, it's really good. – Erin

One student noted that she would apply the same standards to Science Online:

You can't really trust a student's work for—I mean if you were just trying to understand it then maybe I would use something like this [Science

152

> Online] myself, just if it was like just personal curiosity but for school stuff, every kind of school thing is going to need a primary source. – Jamie

Although students had to start off by looking up information, information seeking was not just a first step. Students searched for information again and again throughout the assignment and their strategies and criteria were tied to the rhetorical goals that would be met by writing and citation tasks. For example, in the previous section, I described how students invoked unknown audiences to help them write for the purpose of providing a resource. This affected the kind of information seeking strategies they adopted. If students wanted to write in a way that was compelling and understandable to the general public, they needed information sources that provided them with compelling and understandable material from which to write. Likewise, if they wanted to write from sources that would meet their citation requirement of three peer-reviewed journals, they needed to find sources that met these criteria. As the assignment progressed, I saw that students used different strategies to meet these needs. These changing goals help explain the inconsistency I saw when students claimed they do not use Wikipedia yet demonstrated that they use it all the time. Using Wikipedia to learn and hone one's ability to search and using it as a citation are two different tasks associated with two different goals.

Once they had an idea of what they needed to know, students switched to the websites PubMed and Galileo as instructed by their teacher to inform the writing of the biochemistry sections of their wiki pages and to obtain the necessary peer-reviewed sources. In the second round of interviews, students were in the middle of writing the biochemistry sections of their pages and tended to talk about finding primary or peer-reviewed sources from which to draw material. They described how they supplemented their use of peer-reviewed sources with websites and other sources. If they couldn't find

what they needed, or didn't understand something, they returned to the "regular" Internet to find fill knowledge gaps.

> I went through the PubMed thing and a lot of them that said it had something on it, I either couldn't open it for some reason or when I went to Galileo they didn't have it. So then I just went to the regular Internet and did some research there. That's where I found the information about like mutations, and what amino acids are switched and things like that. – Jana

> To find most of the sources I went under like the PubMed, I went to Galileo, and looked at those articles… and then I would try to go to Google which I still need to do, but the bio-chem part of it was just easy enough to find articles from like Galileo.
> INT: So, what do you mean when you say you still need to go to Google?
> Just to maybe find the more basic information like, how do you diagnose it? What's the treatment? Just something I wouldn't need to spend like two and a half hours researching. Because bio-chem, like, not only do I have to research, but then I have to read all and understand it and be able to put it in like into the thing. – Becca

> It got very specific when they were talking about the exact genome, the hla-dq -1102 and it just talked in a language that I wasn't familiar with. And like everything I had to Google. Or medical dictionary it. Or find some help from someone, it just seemed like every—every—I couldn't just go through it. It was a lot of work just to become familiar with the information that I gathered. – Jerry

> We had to use, like, primary journals and stuff like that, and, like, Underwood is connected to a lot of, like, JournalQuest programs so you can, get in and move out into, like, a university's access to journals, medical journals and stuff like that. So I used pretty much all of those… for this specific part, like, for the stuff that we are doing right now, that is kind of, like, what you have to use. But I mean, for all the basic stuff that, like, I have been looking at and stuff like that, I have used, like -- I don't know -- like E-Medicine Health Online or something like that. – Sara

As they searched for information to meet the assessment criteria for the assignment, some students invoked the teacher mentally or sought out her help and approval.

> If it didn't look like I could open the web page and have Dr. Baker look at it, I wouldn't use it just because I felt like if it didn't look legit then it probably shouldn't be used.

INT: So, when you say open up the website and have Dr. Baker look at it? Like if I had been in front of her and she was reading it, would I think that she would think it was okay? – Hans

She told us how to go in there and find which ones were good and I had to check with her a couple times cause I kind of like, I freak out about that kind of thing. – Erin

I could not find anything on PubMed, and I was really struggling, and the librarian and I - she is, like, one of my good friends in the library, so she always helps me out - and she goes, 'Well, can you use this web site?' I said, 'I have no idea. I know just Dr. Baker told us Galileo, PubMed,' and that was all, like, I am operating off of… and then I actually caught Dr. Baker on a Tuesday going to pick up her kid, and she said that was fine, so I just kept going, going, and going. – Jerry

Sourcing Content

Citation played different roles for students depending on the communicative goal they were trying to meet. As evidenced in the previous section, students were concerned about whether their information sources met the teachers' criteria for the required peer-reviewed source citations. In addition, they were required to cite five "good" web sources. In order to earn a good grade, they needed to conform to these requirements, but because they were providing a public resource, they also were concerned about the responsibility they had as authors. For these students, citation was not only a requirement, it also played a role in supporting the legitimacy of their wiki as a public information resource.

To decide when and what resources to cite to meet assessment criteria, students not only used Dr. Baker's instructions, they also frequently invoked rules about citation that they had learned in other classes and from other teachers in other scholarly writing contexts. Again, genre is visible as a prominent feature of their academic lives. They drew on a history of academic experiences that had shaped their writing practices in ways that helped them define and satisfy the criteria for successful citation.

I know that, in my American Studies class, they said was if it is a fact or if it is a direct quote or if it is paraphrasing, that is when you cite it. I guess that is when you cite stuff—when it is not something that you are saying, that someone else is saying. I do not know if it is the same for science articles, but that is what it is for history. – Diane

In English or in history or in papers like that I never use or I never can cite Wikipedia, we are not allowed to do it.
INT: (later) So would you let students cite it?
Probably not… just because of the culture that I have been exposed to here at Underwood. They won't let us—you know, it's kind of like a parenting thing. You know you grow up with your parents and they tell you not to do X, Y, and Z so you know just part of—you know, you pass it on to your kids. So the teachers tell us not to do it, so then if I was a teacher I would probably pass it onto the next students that I would have. So probably not just because they tainted my mind, they got me. A little brainwashing thing. – Jerry

They just tell us, like, how to cite things, like if you are going to take something directly from your source, it has to be put in quotations and you have to state where you are taking it from—like I stated the lab I took it from and then wrote about it. I mean, I remember all through middle school and ninth grade—maybe last year, too—they take papers that you wrote, and they put them in this thing called, like, Red Letter or something and it scans your paper to make sure you did not copy and plagiarize and, like, all this stuff. And so it just kind of becomes a thing, like, you know not to do it. You are not going to do it. – Lina

Decisions about when to cite were often related to avoiding plagiarism and staying out of trouble. This aspect of citation took on particular importance to the students since they knew their work would be available to the public.

It is scary that it is the first thing that comes up on Google, because if I have not referenced anything correctly, if what I am doing is incorrect anyway, then I could get into trouble. – Julia

In terms of like, other people's work, this is one big thing I went to the librarian about, because in all the information or journals that I had is that, like a big "C"—copyright information that says, 'Do not—' Here, I will show it to you, actually, because I was really scared. I said, 'I do not want to get, like, in trouble for, like, having some kind of legal action against me!' …and so I asked the librarian what do I do in terms of, like, getting this for usage, and then she just told me as long as I am not claiming it as

my own work, and the EBSCO publishing for the specific things has, like, a certain citation format. – Jerry

Clearly, students' citation performances were designed in large part to satisfy the requirements of their teacher and to follow the conventions of school writing. But what role did citation play, if any, in supporting the goal of providing a public resource? We demonstrated in an earlier section that, because their work was public, students felt a responsibility to their readership. They repeatedly expressed concern about the fact that they were contributing to a real science resource and that they had an increased responsibility to get things right. Students recognized that publication can be a powerful tool, and that it also implied responsibility.

> Because you are being monitored by so many people and people are using your work as well. I mean people can misuse that power and write—but I don't want to do that.
> INT: What do you mean, people can misuse that power?
> People know that other children are going to look at their work and use it. So they could write down a load of rubbish and find it funny when people believe them. Do you know what I mean? Write their own opinions, not necessarily for fun but if they strongly believe in an opinion that isn't supported by many other people and they have full freedom to express themselves on something like SciOnline. - Julia

> I mean like anybody can access it. So it puts more pressure on you to make sure that what you're putting on the web is true and accurate information because other people could be reading it and could access that for their website or something like that. So it could be like an upward spiral if everyone has true information then everybody will keep getting true information, but if one person has false information and the next person uses that, uses that—then you just have a downward spiral and no-one really knows what's true. – Sara

> I guess it is weird that people can actually use my work, and so that is why I was going to Doc Baker to make sure that things were okay, because I did not want to put, like, faulty or poor information up on the Internet. – Jerry

Several students mentioned that their work would be suspect because they had no credentials. Said one student, "If someone was searching and trying to learn about

anemia? I know that I'm going to have my facts right because I'm doing it, but how would they know that I do? I'm just a high school student, I don't know anything about it." (Jamie) Citation played an important role in their writing by legitimizing their contribution to a public information resource. Through citation, they felt they not only satisfied their assignment requirements, but also satisfied the responsibility to their readership to provide a sound and useful resource.

> I have no credibility behind my name, I'm a student still. But all the work that I was—all the information I put up had sources, had everything, had a credible background to it. So I think if it's going to be so open for other people to use, your work should be credible. You just don't want to lead people wrong. – Jerry

> If it was me and I was writing a research paper and I found something like this, I would probably look at the references and go to them and use that for information. Like if I was writing a paper on anemia and I came across this I would probably say okay they used this article a lot, I would click on it and I'd find that article and use it myself. That's the way I would use it because you can't really trust a student's work. – Jamie

> I think the information is pretty accurate, because most of my sources were very good, so I think [people] can use it as a general source. I guess it would be better for them to look at the sources that I got it from. – Diane

> I mean, I got it from somewhere else, so I have no problem. And it says it everywhere, like, it is right by where I wrote something, it would say the name. So I mean, I have no problem doing that. I do not feel bad if it is wrong. Yeah, it is not really mine, it is more like I am putting it out there, making it easier to access. So I really do not feel bad. It is not like I did the research. – Alli

When viewed through the lens of genre, it makes sense that citation practices are closely linked to the form and communicative purpose of a written artifact. Citation is a critical component of enacting scholarly genres. The writing environment itself also played a role in supporting citation as an activity. Students in both the initial and the second study suggested that they did not like having to cite things. Extra citations means extra work: "I have lots of sources. That is going to be a pain because that means I am going to have

lots of work citeds." (Jerry) Citation is onerous in part because of detailed formatting conventions and the need to follow guidelines (APA, MLA, Chicago Manual of Style) that don't have meaning for students. As I noted in Chapter 4, Science Online was built to make the task of citation easier. In both rounds of classroom studies, students remarked on the utility of the citation tool in formatting and saving references:

> I like the reference thing, that's the greatest! So like, you can just put in your information and you don't have to know how to format it. It actually formats it for you. – Heather

> It's just hard to figure out how to do it and after that it's ok. It's cool how it all kind of like puts itself together. You like kind of put stuff in and then all this extra stuff comes up like that box down there, that you're like "oh that's cool" it just kind of like did that by itself. – Carrie

CHAPTER 8
CONCLUSIONS AND FUTURE DIRECTIONS:
INFORMATION LITERACY IN A READ/WRITE WORLD

In this dissertation, I have described research that examines information literacy from several perspectives. First, I argued that new systems of information production are made possible by social media and this brings about two critical information literacy needs: first, to understand these systems in order to assess their products and, second, to become adept participants in the construction of public information spaces. I then focused on a popular example of a new publishing system, Wikipedia, and presented research that explains how the site is governed and what kinds of experiences Wikipedians have as they join the community. In addition to providing an account of how Wikipedia works as a system of publication, this research suggested that participating in article production can be a transformative experience, which is aligned with theoretical insight from the learning sciences. Moreover, the nature of these experiences indicates that Wikipedians have opportunities to learn important literacy skills associated with assessing and producing information. I then turned my attention to the classroom and described three iterations of design-based research, in which I explored the use of wikis to support publication activities and information literacy learning in formal educational contexts.

My findings suggest that using social media like wikis to alter the form and purpose of school writing to create a public information resource can bring about opportunities for reflection and learning. These opportunities include transforming the value of citation, creating a need to engage deeply with content, and providing both a need and a

foundation for assessing information resources. In this final chapter, I will briefly highlight the main points of my findings related to genre and audience in the classroom and then discuss the implications of this work for understanding how wiki supported students and teachers in the context of classroom writing and where future design and research directions might lead. I close with a vision of an amended understanding of information literacy for a world filled with participatory forms of media.

Genre and Information Literacy

My work takes a somewhat unorthodox view of information literacy by suggesting that participating in the construction of information resources for others is a critical aspect of literacy and, moreover, can yield interesting opportunities for reflection and learning. In particular, I illustrated how information literacy skills related to finding, assessing, and using information sources in school is tied in practice to the rhetorical purposes of students' work as they reconstructed the "research paper" genre for a public audience. The idea behind genre reconstruction as a way of thinking about what happens when students write online is not new—many genre theorists have pointed out that genres are never quite duplicated, they are always appropriated by a particular author in a particular context. I have elaborated on this perspective to examine information literacy learning in the context of reconstructing the research paper genre when it becomes a public information resource. From interview data and observations I reconstructed students' process for constructing their "research papers"/wiki articles and found that their performance of genre was revealed in three sets of tasks: finding, sourcing and crafting content; all of these performances were influenced by their understanding of audience and communicative purpose, and shaped by the tools they had at their disposal. Note that it is not the act of reconstructing that is critical to the kinds of reflection that I hoped to see; rather, it is the kind of communicative purpose that was introduced. Contributing to a public information resource not only created the context for designing a science text, but

also created opportunities to "see into" the process of publication and motivated different—arguably more authentic—ways of thinking about citation than students reported when they talked about citing to meet assessment criteria.

Finding Content

As students switched between the goal of creating a public resource and addressing assessment requirements, they used different strategies to find information. On the one hand, they followed teachers' directions and school conventions to meet assessment criteria. On the other hand, they used their "usual" strategies of looking on Wikipedia, searching with Google, and consulting reference sites to fill knowledge gaps and find supporting information for their science texts. Students' strategies for finding and assessing the information they encountered as they constructed their wiki articles sometimes included heuristics drawn from their own experiences as information producers. Some students also used their experiences as consumers to invoke an audience and guide their selection of information as they assessed search results (I would want to see information like this). Others explained properties of information sources they found online in relationship to the one they were building themselves (I guess Wikipedia is like Science Online). Features of media such as licensing and the number of potential editors, which I have not encountered in the literature on youth information seeking behavior, became salient as students sought information to support their writing. These strategies suggest that transforming the communicative purpose of the research paper from an assessment instrument to a public information resource plays a role in setting the context for finding and assessing information.

Crafting Content

As students crafted the content of their research papers, they naturally took into account the purpose their papers would serve. On the one hand, they needed to meet the standards

162

set out by their teacher. Because they imagined that they would need to hold readers' attention, explain things to younger or potentially less educated readers, and meet readers' information needs, they also found themselves writing to mediate between a scientific community and a lay community. In order to do this, they needed to engage with science content deeply by questioning what things really meant as they reworded complex ideas and by asking themselves, what do people need to know in order to understand or be interested in this topic?

Sourcing Content

I also found that the dual rhetorical goals of satisfying assessment requirements and creating a public information resource created different reasons for citation. Citation as a school exercise meant fulfilling a set of pre-defined requirements: I used the sources my teacher told me to use. Citation as a part of writing an information resource meant something altogether different: If I cite this, then people will know that the information is good. In some cases students wanted to defer responsibility since they themselves were not experts. By including references to what scientists wrote, they strengthened their own work both by increasing its perceived legitimacy and by protecting both their readers from wrong information and themselves from culpability for providing wrong information. If the sources were good, they didn't need to worry about misinformation.

Wiki as a Place for Developing Collective Practice

The wiki writing environment itself played an important role in defining the ways that students made sense of the publishing assignment. First, like many forms of social media, wikis have a low barrier for entry—it's easy to get started. Students don't need to learn about client/server models or otherwise become network savvy before they begin

publishing on a wiki. For Wikipedians, this is particularly important because easily making small changes is the key to participating peripherally in the community and learning to write like a Wikipedian. Second, transparency proved to be an important characteristic of a wiki because newcomers can see discussion and edit histories and the wiki markup produced by more advanced editors. This provides models of good work and allowed students to come to a shared understanding of what their written assignment should look like. They used the transparent nature of the tool to come to a collective understanding of genre.

In the preceding chapter, I demonstrated how the introduction of a second rhetorical purpose to the traditional research paper—informing an unknown audience—created a need for students to use multiple strategies for information seeking, use and creation throughout the writing process. This suggests that participating in the construction of an information resource in formal education can bring about the kinds of reflection and learning that I observed in Wikipedia editors' accounts of their activities, although it happened in a different way. In particular, addressing a perceived audience with real information needs played a critical role in bringing about reflection on writing practices like citation. The medium in which students were asked to construct their texts also played a critical role. A wiki is unlike a word processor in important ways. Like Orlikowski and Yates' office workers whose communicative practices were influenced by the capabilities of email as a medium (Orlikowski and Yates 1994), the writing practices of students in my studies were influenced by the capabilities of the extended MediaWiki installation as a medium.

The first time I heard a student express the sentiment that "I thought we would be writing a research paper, but now it's on a wiki," I was confused by this focus on the tool. If the students believed they would be writing a research paper, it seemed perfectly reasonable to write one using a wiki instead of a word processor. But, in fact, I soon realized they

were talking not just about the tool, but about everything the tool made possible—the communicative purpose and form of their assignment had clearly changed from a research paper into something else and the wiki was an integral part of that shift in genre. The introduction of a new writing tool accompanied a new audience and a new purpose for their writing.

Changing tools and the ways they are used in order to challenge oneself is not uncommon in creative worlds such as art and music where creative individuals often aspire to genre breaking. In his book, *Art Worlds,* the sociologist Howard Becker describes conventions that allow individuals to cooperate and communicate around the production of art (Becker 1982). Becker observes that "conventions make collective activity simpler and less costly in time, energy, and other resources; but they do not make unconventional work impossible, only more costly and difficult" (p. 35). Becker also suggests that conventions are often embedded in the tools that people use to produce creative works. Just as camera lenses, paintbrushes, word processors or wikis can embody familiar conventions, they can also structure production in ways that run counter to the social, technical and cultural conventions of a community.

In both of my high school classroom studies, I observed ways that the openness and transparency of wiki as a collaborative medium ran counter to the culture of individual assessment that is common in American education. In the first field study at the public school, this led to challenges for the teacher, who grew increasingly concerned about his students' work being seen by others, about the need for him to assess the students individually, and about covering all the topics required by the curriculum. In the second iteration at the private school, the teacher seemed less concerned about her students' work being public, but did not wish to create a collaborative project despite the affordances of wiki for supporting collaborative writing.

Teachers' hesitations about collaborative work and their struggles with assessing collaboration on a wiki present an interesting opportunity for designers. Could an elegant design solution allow teachers to more easily assess individual contributions to a collaborative writing effort? In interviews, one teacher suggested that a simple visualization such as a pie chart that attributed a percentage of authorship to each student would be useful in assessing contributions. But is word count or edit count a reasonable proxy for understanding the contribution of an author? What of structural changes to a document, revising an argument, or creating original artwork? These are potentially powerful indicators of engagement and learning, but how can such contributions be surfaced in an interface? Creating interfaces that reveal salient characteristics of groupwork is an interesting research and design problem for the future.

Despite the fact that teachers did not structure assignments as collaborative efforts, the transparency of the medium proved critical for students as they coped with the unfamiliar aspects of the wiki writing assignment. Although the students generally did not collaborate on text production, I observed that the wiki supported them in coming to a collective understanding of what their writing should be like. As students struggled to come to a new, common understanding of their writing goals, I described how they used affordances of the wiki such as page histories and the shared citation database to see into the process and product of their peers' writing efforts. This suggests that wikis and other collaborative tools can be designed in ways that allow individuals to "see into" the productive processes of their peers. This social function of wiki transparency is related to the concept of modeling in the literature on cognitive apprenticeship (Collins, Brown et al. 1989) and legitimate peripheral participation (Lave and Wenger 1991), which stress the importance of giving novices access to expert models. In the case of the classroom, students were not emulating expert practice as much as they were looking to one another to establish a set of shared practices. Designing for transparent process could help not only in the context of coming to a shared understanding of genre that I have described

166

here, but also circumstances when newcomers seek to understand and emulate the established practices of a community such as when newcomers join the Wikipedia community.

Another challenge for designers is to surface features of process that are interesting and critical to learners, and some of these features may be social information rather than characteristics of the artifact. For example, in *Science Online,* some students used the shared citation database to decide what information sources are acceptable and viewed editing histories and articles of their peers—but *which* peers did they pay attention to? Interviewees often mentioned looking to the best students to gauge their own performance. In a small, physically co-located class, where all the authors are known to one another, looking to the best students as models is a source of support for less accomplished and confident writers. But what happens when students are not as well known to one another or when individuals who do not know one another come together online? Reputation systems in wikis and other collaborative production environments may play a critical role in supporting process transparency. Further research on such tools would be a useful addition to the literature.

Information Literacy Revised

Young people are creating plenty of media for others to consume. In 2007, Pew reported that 69% of young people were creating and sharing media online (Pew 2007)—this trend is inspirational from the perspective of learning scientists for whom media creation offers a powerful context for learning. Moreover, it signals a gap in the literature on information literacy. Information literacy has been primarily defined as a set of skills related to finding and using information, very little attention has been played to the role of the public in creating information resources for others or the kinds of skills that might be involved in becoming adept contributors. Grudin has suggested that young people in

167

particular are in a position of increasing responsibility with respect to assessing information as information environments become less mediated by authority figures and the "parental controls come off" (Grudin 2007). My work suggests that taking responsibility for information production activities in online environments is a valuable addition to our standards for information literacy and can give young people a starting point for reflecting on where information comes from. Moreover, it provides opportunities for learning both information literacy skills and reflecting on content knowledge.

In teaching and understanding how information is produced, traditional economic models of publishing are often taken for granted. New economic models create new targets for education. An example of this is peer production as described by Benkler—this is a form of content production that doesn't follow the traditional economic publishing model and relies on a workforce that is able to recognize opportunities for creation and adapt quickly to new working groups, largely leveraging the potential of networked technologies to support creation and collaboration (Benkler 2006). I suggest that without radical shifts in the ways that teachers, librarians and other information professionals view information literacy and the ways that information is produced, students will be underprepared to understand and contribute within such economic models. Furthermore, there is a strong connection between peer production as a new economic model, the free culture movement/intellectual property law reform, and education. Not only do new forms of production signal a need for new competencies, but access to media and permission to reuse it is a critical need in creative classes. Intellectual property and licensing issues became salient for students as they searched for imagery and sounds to appropriate in their own work.

The question of how editing experiences affect participants in the wild remains open. Certainly it is difficult to imagine that Wikipedians engage in the kind of work that they

do without developing more sophisticated skills and knowledge about issues like intellectual property and heuristics for identifying credible sources; however, it is also possible that without the guidance of a formal classroom environment, opportunities for such reflection come too seldom to be considered part and parcel of the Wikipedia experience. Further studies of information literacy learning and participatory media "in the wild" would complement the classroom work that has been presented in this document.

Learning how to produce traditional scholastic genres well can be an excellent learning experience for students; however, school genres can also shield students from important intellectual work. I have demonstrated here how popularization of participatory media signals an unprecedented opportunity to engage young people in real intellectual work that matters outside the classroom. Introducing new media can be a genre breaker; moreover, it can lead to critical engagement with content in particular when students need to invoke unknown audiences and reflect on how to present material in order to inform their readership. Producing an information resource for others can provide a vantage point from which to reflect on where information comes from. When orchestrated carefully, with the right technological supports, school work can become rich with new opportunities for reflection and impact when learning goes public. I have presented here a vision of wiki not as a staging ground for producing texts for the edification of students, but as a canvas on which students themselves can engage in the intellectual work of publication and knowledge production.

REFERENCES

ACRL (2000). Information Literacy Competency Standards for Higher Education, American Library Association.

Agosto, D. (2002). "A model of young people's decision-making in using the Web." *Library and Information Science Research* **24**: 311-341.

Applebee, A. N. (1984). "Writing and Reasoning." *Review of Educational Research* **54**(4): 577-596.

Barab, S. A., T. M. Duffy, et al. (2000). From Practice Fields to Communities of Practice. *Theoretical Foundations of Learning Environments*. D. Jonassen and S. Land, Eds., Lawrence Erlbaum Associates**: 25-55.

Batson, T., C. Bruce, et al. (1993). The Origins of Enfi. *Network-based classrooms: promises and realities*New York, Cambridge University Press**: 87-112.

Bazerman, C. (1988). *Shaping Written Knowledge: The Genre and Activity of the Experimental Article in Science*, University of Wisconsin Press.

Becker, H. (1982). *Art Worlds*. Berkeley, University of California Press.

Bell, P. (2004). "On the theoretical breadth of design-based research in education." *Educational Psychologist* **39**(4): 243-253.

Benkler, Y. (2006). *The Wealth of Networks*. New Haven, Yale University Press.

Bereiter, C. and M. Scardamalia (1987). *The Psychology of Written Composition*. Hillsdale, NJ, Lawrence Erlbaum Associates.

Bergin, J. (2002). *Teaching on the wiki web*. Proceedings of 7th annual conference on Innovation and technology in computer science education ITiCSE. 195-195.

Beschastnikh, I., T. Kriplean, et al. (2008). *Wikipedian Self-governance in Action: motivating the policy lens*. Proceedings of International Conference on Weblogs and Social Media, AAAI Press.

Bilal, D. (2001). "Children's use of the Yahooligans! search engine. II. Cognitive and physical behaviors on research tasks." *Journal of the American Society for Information Science and Technology* **52**(2): 118-136.

Blumenfeld, P., E. Soloway, et al. (1991). "Motivating Project-Based Learning: Sustaining the doing, supporting the doing." *Educational Psychologist* **26**(3): 369-398.

Bolter, J. D. and R. Grusin (2000). *Remediation: Understanding New Media*. Cambridge, MIT Press.

Bos, N. and J. Krajcik (1998). *Students' awareness of audience in web-published science writing*. Proceedings of American Educational Research Association.

Bower, M., K. Woo, et al. (2006). *Wiki Pedagogy: A Tale of Two Wikis*. Proceedings of International Conference on Information Technology Based Higher Education and Training. 191-202.

Brereton, M., J. Donovan, et al. (2003). *Talking about watching: using the video card game and wiki-web technology to engage IT students in developing observational skills*. Proceedings of fifth Australasian conference on Computing education. 195-207.

Britt, M., J. Rouet, et al. (1994). Learning from History Texts: from causal analysis to argument models, Lawrence Erlbaum Associates**:** 47-84.

Britt, M. A. and C. Aglinskas (2002). "Improving Students' Ability to Identify and User Source Information." *Cognition and Instruction* **20**(4): 485-522.

Britton, J., N. Burgess, et al. (1975). *The Development of Writing Abilities*. London, Macmillan.

Brown, A. L. (1992). "Design Experiments: Theoretical and Methodological Challenges in Creating Complex Interventions in Classroom Settings." *Journal of the Learning Sciences* **2**(2): 141-178.

Bruckman, A. (1998). "Community Support for Constructionist Learning." *Computer Supported Collaborative Work: The Journal of Collaborative Computing* **7**: 47-86.

Bryant, S., A. Forte, et al. (2005). *Becoming Wikipedian: transformation of participation in a collaborative online encyclopedia*. Proceedings of Group: International Conference on Supporting Groupwork.

Buckingham, D. (1998). "Media Education in the UK: Moving beyond protectionism." *Journal of Communication* **48**(1): 33-43.

Buckingham, D. (2003). *Media Education: Literacy, Learning, and Contemporary Culture*. London, Polity Press.

Burke, M. and R. Kraut (2008). *Mopping up: Modeling Wikipedia promotion decisions*. Proceedings of CSCW, San Diego, CA. 27-36.

Burke, M. and R. Kraut (2008). *Taking up the mop: identifying future Wikipedia administrators*. Proceedings of ACM Conference on Human Factos in Computing Systems (CHI), Florence, Italy. 3441-3446.

Butler, B., E. Joyce, et al. (2008). *Don't look now, but we've created a bureaucracy: the nature and roles of policies and rules in Wikipedia*. Proceedings of ACM Conference on Human Factors in Computing Systems (CHI), Florence, Italy. 1101-1110.

Castronova, E. (2005). *Synthetic Worlds. The Business and Culture of Online Games*. Chicago, University of Chicago Press.

Chi, E., P. Pirolli, et al. (2000). *The scent of a site: a system for analyzing and predicting information scent, usage, and usability of a Web site*. Proceedings of ACM Conference on Human Factors in Computing Systems, The Hague, Netherlands. 161-168.

Chistiansen, E. and B. Nardi (1996). Tamed by a Rose: Computers as Tools in Human Activity, MIT Press**:** 175-198.

Ciffolilli, A. (2003). "Phantom authority, self-selective recruitment and retention of members in virtual communities: The case of Wikipedia." *First Monday* **8**(12).

Cohen, A. (1985). *The Symbolic Construction of Community*, Ellis Horwood.

Cohen, M. and M. Riel (1989). "The Effect of Distant Audiences on Students' Writing." *American Educational Research Journal* **26**(2): 143-159.

Cohen, N. (2007). "A History Department Bans Citing Wikipedia as a Research Source." *New York Times*.

Collins, A. (1992). Towards a design science of education. *New directions in educational technology*. E. Scanlon and T. O'Shea, Eds. Berlin, Springer**:** 15-22.

Collins, A., J. S. Brown, et al. (1989). Cognitive Apprenticeship: Teaching the Crafts of Reading, Writing, and Mathematics. *Knowing, Learning, and Instruction*. R. Glaser and L. B. Resnick, Eds., Erlbaum**:** 453-494.

Da Lio, E., L. Fraboni, et al. (2005). *TWiki-based facilitation in a newly formed academic community of practice*. Proceedings of WikiSym. 85-97.

Dervin, B. (2000). Chaos, Order, and Sense-Making: A proposed theory for information design *Information Design*. R. E. Jacobson, Ed. Cambridge, MIT Press.

Desilets, A., S. Paquet, et al. (2005). *Are Wikis Usable?* Proceedings of WikiSym. 3-15.

Donath, J. S., M. Smith, et al. (1998). Identity and Deception in the Virtual Community, Routledge**:** 29-59.

Eastin, M. (2008). Toward a cognitive developmental approach to youth perceptions of credibility. *Ditigal Media, Youth, and Credibility*. M. Metzger and A. Flanagin, Eds. Cambridge, MIT Press.

Eastin, M., M.-S. Yang, et al. (2006). "Children of the net: an empirical exploration into the evaluation of Internet content." *Journal of Broadcasting and Electronic Media* **50**: 211-230.

Ellis, J., A. Bruckman, et al. (1999). *Children and Elders Sharing Stories: Lessons from Two Online Oral History Projects*. Proceedings of Computer Supported Collaborative Learning. 151-158.

Emig, J. (1977). "Writing as a mode of learning." *College Composition and Communication* **28**: 122-127.

Emigh, W. and S. Herring (2005). *Collaborative Authoring on the Web: A Genre Analysis of Online Encyclopedias*. Proceedings of Hawai'i International Conference on System Sciences.

Encyclopedia Britannica, I. (2006). Fatally Flawed: refuting the recent study on encyclopedic accuracy by the journal Nature. Secondary Fatally Flawed: refuting the recent study on encyclopedic accuracy by the journal Nature. Secondary Encyclopedia Britannica, I. Place Published. http://corporate.britannica.com/britannica_nature_response.pdf.

Engestrom, Y., R. Miettinen, et al. (1999). Activity theory and individual and social transformation, Cambridge University Press**:** 19-38.

Ericsson, K. and H. Simon (1993). *Protocol analysis; Verbal reports as data*. Cambridge, MIT Press.

Fidel, R., R. Davies, et al. (1999). "A Visit to the Information Mall: Web Searching Behavior of High School Students." *Journal of the American Society for Information Science* **50**(1): 24-37.

Flower, L. (1994). *The Construction of Negotiated Meaning: A Social Cognitive Theory of Writing*, Southern Illinois University Press.

Forte, A. and A. Bruckman (2006). *From Wikipedia to the Classroom: Exploring online publication and learning*. Proceedings of International Conference of the Learning Sciences, Bloomington, Indiana. 182-188.

Forte, A. and A. Bruckman (2007). *Constructing text: wiki as a toolkit for (collaborative?) learning*. Proceedings of International Symposium on Wikis (WikiSym), Montreal, Canada. 31-42.

Forte, A. and A. Bruckman (2008). *Information literacy in the age of Wikipedia. In Symposium on learning and research in the Web 2.0 era: opportunities for research (Organized by James Slotta)*. Proceedings of International Conference of the Learning Sciences, Utrecht, Netherlands. 237-244.

Forte, A. and A. Bruckman (2008). *Scaling consensus: increasing decentralization in Wikipedia governance*. Proceedings of Hawaiian International Conference of Systems Sciences (HICSS), Big Island, Hawaii.

Forte, A., V. Larco, et al. (2009). "Decentralization in Wikipedia Governance." *Journal of Management Information Systems*.

Foundation. "WikiMedia Foundation Site." Retrieved March 15, 2009, from http://wikimediafoundation.org/wiki/Home.

Fox, S. (2005). Health Information Online. Secondary Health Information Online. Secondary Fox, S. Place Published.

Garfinkel, H. (1967). *Studies in Ethnomethodology*. Englewood Cliffs, NJ, Prentice-Hall.

Geertz, C. (1983). Thick Description: toward an interpretive theory of culture. *The Interpretation of Cultures* New York, Basic Books**:** 3-32.

Giles, J. (2005). "Internet encyclopaedias go head to head." *Nature* **438**.

Glaser, B. and A. Strauss (1967). *The Discovery of Grounded Theory: strategies for qualitative research*. New Brunswick, Transaction Publishers.

Goffman, E. (1959). *The Presentation of Self in Everyday Life*. Garden City, New York, Doubleday Anchor.

Grinter, R. (1998). *Recomposition: Putting it all back together again*. Proceedings of Computer-Supported Cooperative Work. 393-402.

Grudin, J. (2007). "Living without parental controls: the future of HCI." *Interactions* **14**(3): 48-52.

Guzdial, M. and K. Carroll (2002). *Explaining the Lack of Dialogue in Computer-Supported Collaborative Learning*. Proceedings of Computer Supported Collaborative Learning. 418-424.

Guzdial, M., J. Rick, et al. (2001). "Beyond adoption to invention: Teacher-created collaborative activities in higher education." *Journal of the Learning Sciences* **10**(3): 265-279.

Hatfield, D. and D. Shaffer (2006). *Press play: Designing an epistemic game engine for journalism*. Proceedings of International Conference of Learning Sciences. 236-242.

Hewitt, J., S. Barab, et al. (2004). An Exploration of Community in a Knowledge Forum Classroom: An Activity System Analysis**:** 210-238.

Honegger, B. D. (2005). *Wikis - a Rapidly Growing Phenomenon in the German-Speaking School Community*. Proceedings of WikiSym. 113-116.

Hudson, J. M. and A. Bruckman (2005). *Using Empirical Data to Reason about Internet Research Ethics*. Proceedings of European Conference on Computer-Supported Cooperative Work.

Ito, M. (2008). Mobilizing the Imagination of Everyday Play: The Case of Japanese Media Mixes. *International Handbook of Children, Media, and Culture*. S. Livingstone and K. Drotner, Eds. London, Sage Publications.

Jenkins, H. (2006). *Convergence Culture: where old and new media collide*. New York, New York University Press.

Jones, B. (2002). "Recommendations for implemening internet inquiry projects." *Journal of Educational Technology Systems* **30**(3): 20.

Kafai, Y. and M. Bates (1997). "Internet Web-searching instruction in the elementary classroom: building a foundation for information literacy." *School Library Media Quarterly* **25**(2): 8.

Kittur, A. (2007). *Power of the few vs wisdom of the crowd: Wikipedia and the rise of the bourgeoisie*. Proceedings of Alt.CHI, San Jose, CA.

Kittur, A., E. Chi, et al. (2008). *Can you ever trust a wiki? Impacting perceived trustworthiness in Wikipedia*. Proceedings of CSCW, San Diego.

Kittur, A. and R. Kraut (2008). *Harnessing the wisdom of crowds in Wikipedia: quality through coordination*. Proceedings of CSCW, San Diego, CA.

Kittur, A., B. Suh, et al. (2007). *He says, she says: Conflict and coordination in Wikipedia*. Proceedings of CHI, San Jose, CA.

Klein, P. (2000). "Elementary students' strategies for writing-to-learn in science." *Cognition and Instruction* **18**(3): 317-348.

Knorr-Cetina, K. (1981). *The Manufacture of Knowledge: An essay on the constructivist and contextual nature of science*. Oxford, Pergamon.

Kohl, H. (1994). *I Won't Learn from You: and other thoughts on creative maladjustment*. New York, The New Press.

Kollock, P. and M. Smith (1999). The economies of online cooperation: gifts and public goods in cyberspace. *Communities in Cyberspace*. M. Smith and P. Kollock, Eds. New York, NY, Routledge**:** 220-239.

Kolodner, J. (1993). *Case-Based Reasoning*. San Francisco, CA, Morgan Kaufman.

Kolodner, J., J. Gray, et al. (2003). "Promoting transfer through case-based reasoning: rituals and practices in Learning by Design classrooms." *Cognitive Science Quarterly* **3**: 183-232.

Kriplean, T., I. Beschastnikh, et al. (2008). *Articulations of wikiwork: uncovering valued work in Wikipedia through barnstars*. Proceedings of Computer Supported Cooperative Work (CSCW), San Diego.

Kriplean, T., I. Beschastnikh, et al. (2007). *Community, Consensus, Coercion, Control: CS*W or how policy mediates mass participation*. Proceedings of GROUP: ACM Conference on Supporting Group Work, Sanibel Island, FL.

Kuiper, E., M. Volman, et al. (2005). "The Web as an Information Resource in K-12 Education: Strategies for Supporting Students in Searching and Processing Information." *Review of Educational Research* **75**(3): 285-328.

Kuutti, K. and B. Nardi (1996). Activity Thoery as a Potential Framework for Human-Computer Interaction ResearchCambridge, MIT Press**:** 17-44.

Lamberty, K. and J. Kolodner (2003). "Exploring Digital Quilt Design Using Manipulatives as a Math Learning Tool."

Larusson, J. and R. Alterman (2007). *Tracking online collaborative work as representational practice: analysis and tool*. Proceedings of Communities and Technologies, Lansing, MI. 245-264.

Lave, J. and E. Wenger (1991). *Situated Learning: legitimate peripheral participation*. Cambridge, Cambridge University Press.

Leavis, F. and D. Thompson (1933). *Culture and Environment: The Training of Critical Awareness*. London, Chatto and Windus.

Lenhart, A., M. Madden, et al. (2007). Teen Content Creators. Secondary Teen Content Creators. Secondary Lenhart, A., M. Madden, et al. Place Published. http://pewresearch.org/pubs/670/teen-content-creators.

Leuf, B. and W. Cunningham (2001). *The Wiki Way*. Boston, Addison-Wesley.

Lih, A. (2004). *Wikipedia as Participatory Journalism: Reliable Sources? Metrics for evaluating collaborative media as a news resource*. Proceedings of Fifth International Symposium on Online Journalism.

Livingstone, S. (2002). *Young People and New Media: Childhood and the Changing Media Environment*, Sage.

Livingstone, S. and M. Bovill (2001). *Children and their Changing Media Environment: A European Comparative Study*, Lawrence Erlbaum.

Lund, A. and O. Smordal (2006). *Is there a Space for the Teacher in a Wiki?* Proceedings of WikiSym. 37-46.

Mader, S. (2006). Using Wiki in Education.

Masterman, L. (1985). *Teaching the Media*. London, Routledge.

Miller, C. (1984). "Genre as social action." *Quarterly Journal of Speech* **70**: 151-166.

Millner, A. (2008). *Supporting children as they program to make physical and virtual objects interact*. Proceedings of Interaction Design and Children, Evanston, Illinois.

Morningstar, C. and F. Farmer (1990). *The Lessons of Lucasflim's Habitat*. Proceedings of First Annual International Conference on Cyberspace.

Nardi, B. (1996). Activity Theory and Human-Computer Interaction, MIT Press**:** 7-16.

Nonnecke, B. and J. Preece (2000). *Lurker demographics: counting the silent*. Proceedings of Conference on human factors in computing systems. 73-80.

Norman, D. A. (1988). *The Design of Everyday Things*, Doubleday.

O'Neill, M. (2005). *Automated use of a Wiki for collaborative lecture notes*. Proceedings of 36th SIGCSE technical symposium on Computer science education. 267-271.

Olanoff, L. (2007). *Librarian: 'Just say no to Wikipedia'*. Proceedings of The Express-Times.

Orlikowski, W. and J. Yates (1994). "Genre repertoire: the structuring of communicative practices in organizations." *Administrative Science Quarterly* **39**(4): 541-575.

Ostrom, E. (1990). *Governing the Commons: The evolution of institutions for collective action*. Cambridge, Cambridge University Press.

Ostrom, E. (2000). "Collective action and the evolution of the social norms." *Journal of Economic Perspectives* **14**(3): 137-158.

Owusu-Ansah, E. K. (2005). "Debating Definitions of Information Literacy: Enough is enough!" *Library Review* **54**(6): 8.

Papert, S. (1980). Mindstorms: Children, Computers and Powerful Ideas, Basic Books.

Papert, S. (1991). Situating Constructionism. I. Harel and S. Papert, Eds., Ablex Pub. Corp.**:** 1-11.

Peppler, K. and Y. Kafai (2007). "From SuperGoo to Scratch: Exploring creative digital media production in informal learning." *Learning, Media and Technology* **32**(2): 17.

Piaget, J. (1950). *The Psychology of Intelligence*, Routledge.

Pirolli, P. and S. Card (1999). "Information Foraging." *Psychological Review* **106**(4): 32.

Pirolli, P. and J. Pitkow (1999). "Distributions of surfers' paths through the World Wide Web: Empirical characterizations." *World Wide Web* **2**(1-2): 16.

Preece, J. (2004). "Etiquette, empathy and trust in communities of practice: stepping-stones to social capital." *Journal of Universal Computer Science* **10**(3): 194-202.

Renninger, K. A., W. Shumar, et al. (2004). The centrality of culture and community to participant learning at and with The Math Forum, Cambridge University Press**:** 181-209.

Resnick, M., A. Bruckman, et al. (1998). Constructional Design: Creating New Construction Kits for Kids, Morgan Kaufmann.

Rick, J. and M. Guzdial (2006). "Situating CoWeb: A Scholarship of Application." *International Journal of Computer-Supported Collaborative Learning* **1**(1).

Riel, M. (1985). "The Computer Chronicles Newswire: A functional learning environment for acquiring literacy skills." *Journal of Educational Computing Research* **1**(3): 317-337.

Russell, D. (1997). "Rethinking genre in school and society." *Written Communication* **14**(4): 504 - 554.

Scardamalia, M. and C. Bereiter (1996). Computer Support for Knowledge-Building Communities. *CSCL: Theory and Practice of an Emerging Paradigm*. T. Koschmann, Ed. Mahwah, NJ, Lawrence Erlbaum Associates**:** 249-268.

Scardamalia, M. and C. Bereiter (1996). "Student Communities for the Advancement of Knowledge." *Communications of the ACM* **39**(4): 36-37.

Scardamalia, M. and B. Smith (2002). Collective cognitive responsibility for the advancement of knowledge**:** 67-98.

Scharff, E. D. (2002). Open Source: A Conceptual Framework for Collaborative Artifact and Knowledge Construction, University of Colorado.

Schutz, A. (1967). *The Phenomenology of the Social World*, Northwestern University Press.

Seidman, I. (1998). *Interviewing as qualitative research*, Teachers College Press.

Shaffer, D. (2006). "Epistemic frames for epistemic games." *Computers and Education* **46**(3): 223-234.

Shaffer, D. W. and M. Resnick (1999). "Thick Authenticity: New Media and Authentic Learning." *Journal of Interactive Learning Research* **10**(2): 195-215.

Songer, N. (1996). "Exploring Learning Opportunities in Network-Enhanced Classrooms: A case of kids as global scientists." *Journal of the Learning Scieces* **5**(4): 297-327.

Spinellis, D. and L. Panagiotis (2008). "The collaborative organization of knowledge." *Communications of the ACM* **51**(8): 5.

Stadtler, M. and R. Bromme (2007). "Dealing with multiple documents on the WWW: The role of metacognition in the formation of documents models." *International Journal of Computer-Supported Collaborative Learning* **2**: 191-210.

Strauss, A. (1987). *Qualitative Analysis for Social Scientists*. Cambridge, Cambridge University Press.

Strauss, A. and J. Corbin (1998). *Basics of Qualitative Research: techniques and procedures for developing grounded theory*. London, Sage.

Suchman, L. A. (1987). *Plans and Situated Actions: The Problem of Human-Computer Communication*, Cambridge University Press.

Suh, B., E. Chi, et al. (2008). *Lifting the veil: improving accountability and social transparency in Wikipedia with WikiDashboard*. Proceedings of ACM Conference on Human Factors in Computing Systems (CHI), Florence, Italy.

Viegas, F., M. Wattenberg, et al. (2004). *Studying cooperation and conflict between authors with history flow visualizations*. Proceedings of CHI 2004. 575-582.

Viegas, F., M. Wattenberg, et al. (2007). *Talk before you type: coordination in Wikipedia*. Proceedings of Hawai'ian International Conference on System Sciences.

Viegas, F., M. Wattenberg, et al. (2007). *The Hidden Order of Wikipedia*. Proceedings of HCII.

Voss, J., J. Wiley, et al. (2000). A Case Study of Developing Historical Understanding via Instruction; the importace of integrating text components and constructing arguments, New York University Press**:** 375-389.

Wales, J. (2006). *Opening Remarks*. Proceedings of Wikimania.

Wallace, R. M., J. Kupperman, et al. (2000). "Science on the Web: Students Online in a Sixth-Grade Classroom." *Journal of the Learning Scieces* **9**(1): 75-104.

Wang and D. Turner (2004). *Extending the wiki paradigm for use in the classroom*. Proceedings of International Conference on Information Technology: Coding and Computing. 255-259.

Weber, M. (1966). *Basic Concepts in Sociology*, Citadel Press.

Wenger, E. (1998). *Communities of practice: Learning, meaning, and identity*, Cambridge Univeristy Press.

Wertsch, J. V., P. N. Stearns, et al. (2000). Is It Possible to Teach Beliefs, as Well as Knowledge about History?, New York University Press**: 38-50.

Wikipedia. "Wikipedia: Policies and Guidelines." Retrieved 4-24-2008, from http://en.wikipedia.org/wiki/Wikipedia:Policies_and_guidelines.

Wilensky, U. (2001). *Emergent Entities and Emergent Processes: constructing emergence through multi-agent programming*. Proceedings of Annual Conference of the American Educational Research Association.

Wiley, J. and J. Voss (1996). "The effects of 'playing historian' on learning in history." *Applied Cognitive Psychology* **10**: 63-72.

Wineburg, S. (1991). "Historical Problem Solving: a study of the cognitive processes used in the evaluation of documentary and pictorial evidence." *Journal of Educational Psychology* **83**(1): 73-87.

Wineburg, S., G. Leinhardt, et al. (1994). The Cognitive Representation of Historical Texts**: 85-136.

Winner, L. (1986). Do artifacts have politics?, University of Chicago Press**: 19-39.

Zagal, J. P. (2008). *The Game Ontology Project: supporting learning while construbuting authentically to game studies*. Proceedings of International Conference of the Learning Sciences, Utrecht, Netherlands.

Zurkowski, P. (1974). The Information Service Environment Relationships and Priorities. Secondary The Information Service Environment Relationships and Priorities. Secondary Zurkowski, P. Place Published.

Appendix A – Pre and Post Document-Based Questions

Read the following document excerpts, then explain the relationship between power lines and childhood cancers such as leukemia. Justify your explanations using the readings.

Document 1

Schüz J., Grigat J.P., Brinkmann K, and Michaelis J. (2001). Residential magnetic fields as a risk factor for childhood acute leukemia: results from a German population-based case-control study. *International Journal of Cancer*; Vol. 91, Issue 5, p. 728-35

Our objective was to investigate whether exposure to residential magnetic fields such as those associated with high voltage power lines increases a child's risk of leukemia. The study population consisted of 847 cases and 2,127 controls. Our data provide evidence for a weak association between childhood leukemia and exposure to residential power-frequency magnetic fields. When we restrict the analysis to children who lived in a single home between date of birth and the study date, the association is even more pronounced. When we examine the data for children aged 4 years or younger and children aged 5 years or older, we observe a pattern similar to that in our previous studies: the risk is highest for younger children. An explanation for this association remains unclear.

Document 2

Data   from:
Draper, G., Vincent, T., Kroll, M.E., and Swanson, J. (2005). "Childhood cancer in relation to distance from high voltage power lines in England and Wales: a case-control study" *British Medical Journal*. Vol. 330, no. 7503, p. 1290.

Relatice Risk of Leukemia
Based on Cases of 29,081 Children
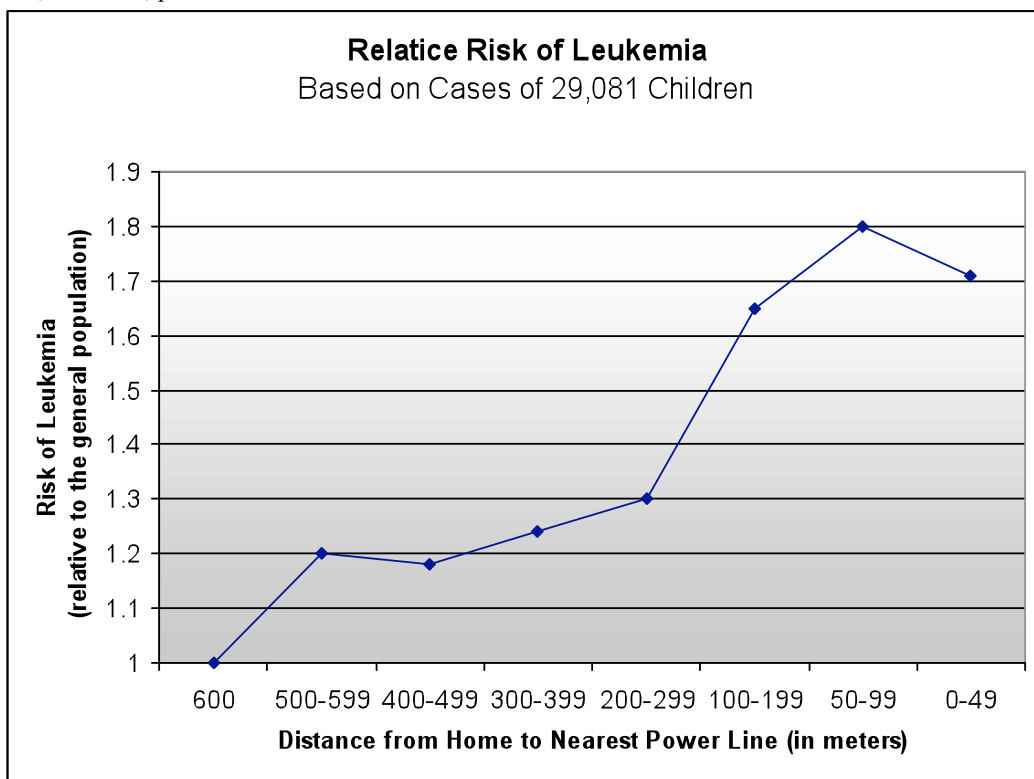
Document 3

Power Lines Don't Cause Leukemia, Study Concludes
by Gina Kolata
New York Times (July 3, 1997)

For the last 18 years, the debate over whether power lines cause cancer has been passionate and sometimes furious. People are terrified of radiation, said Dr. Charles Stevens, a neurobiologist at the Salk Institute in San Diego. "You can't see it and it comes through the walls of the house." Add to that the fear that "it does terrible things to children," and you have a substance that "taps into our primal fears," he said. Some say the debates show how hard it is to dispel the public's fears of a threat that has never been demonstrated but that seems terrifying. Now a new study has found no evidence that electric power lines cause leukemia in children, researchers said Wednesday.

Document 4

National Research Council (1997). *Possible Health Effects of Exposure to Residential Electric and Magnetic Fields*. Washington DC: National Academy Press.

Magnetic fields measured in the home after the diagnosis of disease in a resident have not been found to be associated with high incidence of childhood leukemia or other cancers. However, the link between electro-magnetic fields from high voltage power lines and childhood leukemia is statistically significant (unlikely to have arisen from chance).

How can we accept the statistical link between proximity to high voltage power lines and leukemia while also stating our overall conclusion that residential electric and magnetic fields have not been shown to be hazardous? One reason is that high voltage power lines correlate with many other factors such as the age of a home, housing density, and neighborhood traffic density. Homes close to high voltage wires are often associated with other factors that may be causing the increased rates of leukemia.

Read the following document excerpts, then explain the relationship between DDT and bird populations. Justify your explanation using the readings.

Document 1

Henny, C.J. and Bennett, J.K. (1990). "Comparison of breaking strength and shell thickness as evaluators of white-faced ibis eggshell quality." *Environmental Toxicology and Chemistry*. Vol. 9, no. 6, pp. 797-805.

A 1986 field study was conducted of white-faced ibis that had a history of reproductive failure correlated with elevated egg concentrations of DDE. DDE is a substance that is produced over time when DDT breaks down. Eggs from 80 nests (one egg per nest) were tested for shell strength and thickness. Egg contents were analyzed for DDT and DDE. DDE-DDT concentrations in the eggs ranged from none detected to 29 ppm. Shell thickness and shell strength decreased as levels of DDE increased. Negative correlation was found at -0.60, -0.61, respectively. Shell strength deteriorated at a faster rate than shell thickness.

Document 2

Nygaard T. and Gjershaug J.O. (2001). "The Effects of Low Levels of Pollutants on the Reproduction of Golden Eagles in Western Norway." *Ecotoxicology*, Vol. 10, no. 5, October 2001, pp. 285-290.

Data from a 26 year study of Golden Eagles in western Norway. Data was collected between 1973 and 1999.

Figure 1: The relation between eggshell thickness and DDE levels in individual eggs of golden eagles collected during the study.
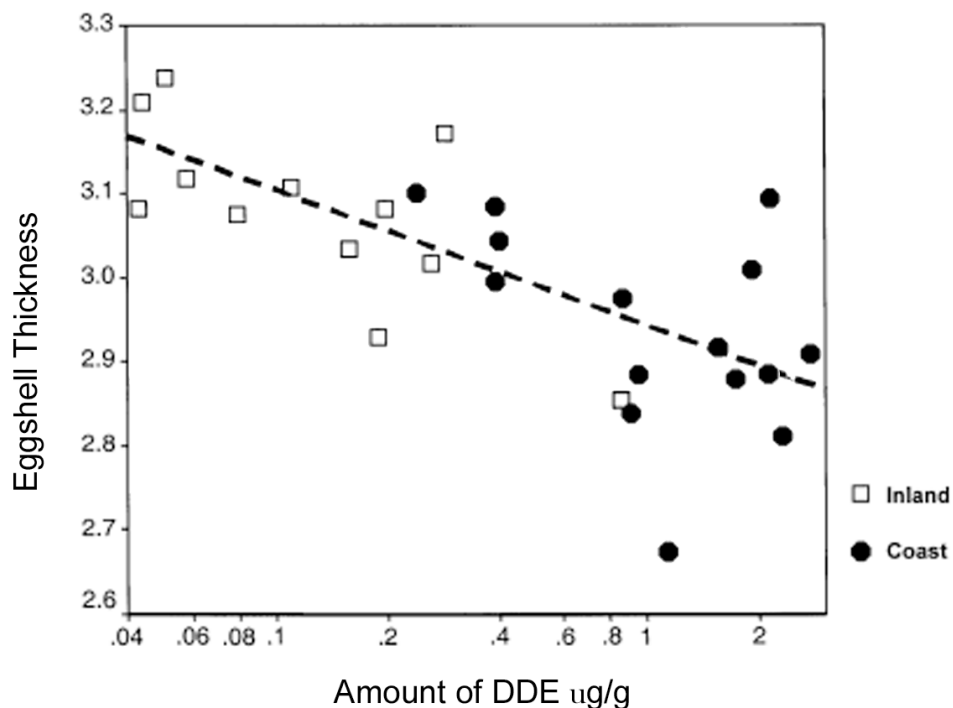
Document 3
Bald Eagle-DDT Myth Still Flying High
FoxNews.com (July 6, 2006)
by Steven J. Milloy

In recent reports, the Associated Press has erroneously blamed DDT for the eagles' near demise. In fact, A 1984 National Wildlife Federation publication listed hunting, power line electrocution, collisions in flight and poisoning from eating ducks containing lead shot as the leading causes of eagle deaths.

One of the most notorious DDT "factoids" is that it thinned bird egg shells. But a 1970 study published in *Pesticides Monitoring Journal* reported that DDT residues in bird egg shells were not correlated with thinning. Numerous other feeding studies on caged birds indicate that DDT isn't associated with egg shell thinning.

Why was banning DDT so important to environmentalists?

Charles Wurster, a senior scientist for the Environmental Defense Fund – the activist group that led the charge against DDT – told the *Seattle Times* (Oct. 5, 1969) that, "If the environmentalists win on DDT, they will achieve a level of authority they have never had before. In a sense, much more is at stake than DDT."

Banning DDT wasn't about birds. It was about power. The sooner the record on DDT is set straight, the sooner the environmentalists' ill-gotten "authority" will be seen for what it is.

Document 4
Buck, J. (1999). "Changes in Productivity and Environmental Contaminants in Bald Eagles Nesting Along the Lower Columbia River." *Report from the US Fish and Wildlife Service Oregon State Fish and Wildlife Office*

Bald eagle reproduction in the Pacific Northwest has greatly increased since DDT was banned. Bald eagle productivity in certain areas, however, remains low primarily due to the lingering impacts of organochlorines like DDT and DDE (a breakdown product of DDT). Organochlorines in water and sediment can build up in the fatty tissues of organisms living in the river. Fish and birds that eat these organisms gradually build up, or bioaccumulate, organochlorines in their tissues. Because removal of organochlorines from the body is a very slow process, bald eagles and other predators bioaccumulate the compounds over time as they eat prey from the river. The bioaccumulation process often results in problems for predators at the top of the food chain.

Appendix B – Sample of Student Writing, Iteration I

article   discussion   edit   history   protect   delete   move   watch

SCIENCE ONLINE
SciOnline.org

Global Free Trade: Jobs and the Environment

Refresh References

navigation
- Main Page
- Teacher Tools
- Student View
- References
- Recent Changes
- Random Page
- Sandbox
- Help

search

Go   Search

toolbox
- What links here
- Related changes
- Upload file
- Special pages
- Printable version
- Permanent link

Contents [hide]

1 The Evolution of Trade
2 Differing Views of Free Trade
   2.1 Macroeconomics
   2.2 Jobs and Unemployment
   2.3 International vs. Domestic Distribution of Wealth
   2.4 International Agreements Dealing with Free Trade
      2.4.1 World Trade Organization
      2.4.2 North American Free Trade Agreement
      2.4.3 Central American Free Trade Agreement
3 Environmental Ramifications of Free Trade
   3.1 Transfer of Invasive or Destructive Species
   3.2 Dominance of Genetically Modified Crops
   3.3 Resource Use
   3.4 Carbon Dioxide Emission from Free Trade and its Effect on Global Warming
   3.5 Trade Imbalance
   3.6 Tuna-Dolphin Case
   3.7 Shrimp-Turtle Case
4 Related concepts
5 Citations of Pictures

The Evolution of Trade

[edit]

As societies progressed from hunting and gathering to settled agricultural civilizations, barter developed between societies as a profitable exchange of resources. Barter eventually evolved into large scale trading with standardized economies and new transport technologies. During the mid Eighteenth century, Adam Smith developed his economic theory, Capitalism, which sets the foundation for Western economic policy for the next three centuries. Considering this current economic reality, environmentalists have formed a new field called ecological economics. This field deals with how environmental conditions interact with economic policy at the time. Currently in the 21st Century, the heart of the globalized economy is trade between nations. As a result, policies of trade ranging from autarky to laissez-faire free trade are available for a country to pursue. A country's decision on trade policy enters in with economics, and consequently ecological economics, to create an fascinating interplay between trade

Triangular Trade in the 18th Century

Contents
  1 The Evolution of Trade
  2 Differing Views of Free Trade
     2.1 Macroeconomics
     2.2 Jobs and Unemployment
     2.3 International vs. Domestic Distribution of Wealth
     2.4 International Agreements Dealing with Free Trade
        2.4.1 World Trade Organization
        2.4.2 North American Free Trade Agreement
        2.4.3 Central American Free Trade Agreement
  3 Environmental Ramifications of Free Trade
     3.1 Transfer of Invasive or Destructive Species
     3.2 Dominance of Genetically Modified Crops
     3.3 Resource Use

The Evolution of Trade

As societies progressed from hunting and gathering to settled agricultural civilizations, barter developed between societies as a profitable exchange of resources. Barter eventually evolved into large scale trading with standardized economies and new transport technologies. During the mid Eighteenth century, Adam Smith developed his economic theory, Capitalism, which sets the foundation for Western economic policy for the next three centuries. Considering this current economic reality, environmentalists have formed a new field called ecological economics. This field deals with how environmental conditions interact with economic policy at the time. Currently in the 21st Century, the heart of the globalized economy is trade between nations. As a result, policies of trade ranging from autarky to laissez-faire free trade are available for a country to pursue. A country's decision on trade policy enters in with economics, and consequently ecological economics, to create an fascinating interplay between trade policy and its results on the ecological and anthropological environment. (Cunningham, 2001)

In a biological scope, this phenomenon is limited to Homo sapiens and free trade is an anthropogenic phenomenon. Global free trade is an international phenomenon. (McNeil, 2003)

Appendix C – Sample of Student Writing, Iteration II

A Quick Blast to the Past

Alzheimer's disease was first discovered in 1907 by scientist, Alois Alzheimer. The diagnosis began when Alzheimer was notified that a fifty-year old woman had been suffering from severe cognitive malfunctions that dealt with memory, speech, and interaction. After the woman had died, Alzheimer conducted an autopsy on her brain by using the silver stain technique which allowed Alzheimer to identify neurons. During the process, Alzheimer noticed strange formations which today are called senile plaques. Alzheimer's unusual finding within the woman's brain were later diagnosed as Alzheimer's disease. Even with this discovery, Alzheimer's was not a common term used during the early 20th century and did not become fully noticed until the science world exploded in the 1970s.