Students’ awareness of audience in web-published science writing

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Students’ awareness of audience in Web-published science writing

It has been recognized for at least a decade that the Internet holds promise as a writing space, promising rich interactions among a variety of participants and for a variety of audiences. First-generation research established that writing for an Internet audience could be motivating for students, could break down the walls of the classroom and provide for new interactions between geographically distant participants (Cohen & Riel, 1989; Harasim, 1990). This paper will add to our knowledge about students writing in this new publishing space by examining how students adapt (or fail to adapt) their writing process when publishing on the World-Wide Web for an outside audience or respondents.

This research began with the premise that student writing in science could become a more meaningful and authentic task by publishing student work on the World-Wide Web for an outside audience of readers. Calls for more meaningful, contextualized, situated (Lave & Wenger, 1991) or authentic (Newmann, 1991) learning periodically resurface in educational circles, and in writing-instruction research (Hull, 1989; Ede, 1984) in particular. Writing for an audience is sometimes recommended as a method for making school writing tasks more authentic. Writing, after all, is an act of communication, and communication implies an audience. Despite this, audience is often not a component of classroom writing tasks. ReinSTATING the role of the audience is recommended as a reaction to overly product-centered approaches to teaching writing, and a way to teach ‘real-world’ writing (Ede, 1984). The default audience for most student work, the classroom teacher, may be inauthentic in that the teacher already knows most of the material being communicated, and may not respond to writing in the same way that an audience interested in learning from the writing’s content would.

At least three pedagogical models have been recommended for bringing the audience back into the task of composition. Some rhetoric models advocate having students write for a make-believe audience, and helping them analyze this audience, perhaps by creating lists of audience characteristics on a chalkboard. A second model for creating audience for student work is to have students become an ‘audience’ for each other by creating a discourse community of peers within a classroom (Hull, 1989; Rafoth, 1988; Scardamalia & Bereiter,
1994). In these types of models, students learn disciplinary communication by enculturation—by being part of a group with shared standards and ways of communicating.

A third method, which encompasses this research, is to arrange for readers outside the classroom to act as audience and respondents for student writing (Cohen & Riel, 1989; Redd-Boyd & Slater, 1989). For example, international penpals might be an authentic audience for students writing personal essays (Cohen & Riel, 1989), and professional scientists may be an authentic audience for student work in science. An authentic audience of readers for student writing may have a variety of benefits. An authentic audience may seem more real to students than a pretend audience constructed for a classroom task and therefore more motivating; students may use a variety of social-cognitive inferences in response to a new audience that may affect or improve their writing.

The recent explosion of access and capability in telecommunications technologies has seemed a natural fit with this last attempt to make classroom writing more authentic by arranging for new audiences for student work. The web makes publication for a local, national, or worldwide audience easier than any previous media. Interactive features such as submittable forms also make it possible to solicit immediate feedback on student writing from readers anywhere on the web. Since students can also use the web for their own research, the web provides an understandable media for students to publish within. What remains to be seen is whether these capabilities can be exploited in ways that make writing tasks more motivating for students, or that lead students to produce better-quality work due to audience-related inferences.

**Previous research on writing for an audience**

Overall, previous research on students' writing for an audience has seen mixed success in bringing about observable changes in student writing or motivation. Redd-Boyd and Slater (1989) found that undergraduates were more interested and had a higher self-reported effort when given an audience for a persuasive-essay task, although there was no difference on these variables between a real and imaginary audience. Audience did not significantly affect ratings of the essay’s persuasiveness. Chesky and Hiebert (1987) found no increase in the quality of high school juniors’ persuasive essays when they were asked to
imagine an audience. A number of previous studies have also failed to find differences in writing quality when writing for an audience. Bracewell, Scardamalia, and Bereiter (1978) did find small improvements in students' writing for an imaginary audience as opposed to a standard (no audience) writing task. In that research, 12th grade students wrote task descriptions with more context-creating statements and better information content for a specified audience. The differences in this case were small, however, because the overall frequency of context-creating statements was low across all cases.

With the advent of telecommunications technologies, the audience question has received some revived interest. Could new technology, by creating more interactive and ‘real’ audience-writing situations, be used in such a way as to bring measurable and worthwhile improvements for student writing? This paper is, in large measure, an attempt to extend the findings of one such study, Cohen and Riel (1989). Cohen and Riel compared student essays written for a classroom teacher to those written for a international networked audience of other students and found that a distant audience led students to write essays that were higher in four categories of writing quality (content, organization, language use, and overall quality). Cohen and Riel made two interesting attributions about why they achieved these research results. First, they attributed the success of this model to the fact that their students were writing for a ‘real’ audience, as opposed to an imagined one, and thus the audience was more psychologically present for the students. Second, they hypothesized a cognitive mechanism for the higher-quality essays. They argued that students might have written more detailed personal essays for distant peers because, while their teachers could be assumed to know many details about their lives and culture already, distant peers would not, and thus audience expectations may have driven specific audience adaptations. This research has sought to extend this research by Cohen and Riel by setting up an audience-writing task in a different genre, the scientific lab report, and studying how students make inferences and adaptations about their audience for this task.

**How might audience affect student writing?**

In order to measure the effects of a Web audience on student work, it is necessary to be more specific about the kinds of benefits that might be expected. We will make a somewhat artificial, but theoretically helpful separation between two
ways that audience might make a difference: an audience can have either motivational or cognitive effects on student writers.

**Motivational effects.** Web publishing may increase students' motivation for a writing task. Students may be motivated to communicate their results with an outside audience, or may think the task is more authentic or interesting because the results would be published. Expectations of receiving feedback from an outside audience may also heighten students interest in writing. Increased levels of motivation for a task may show in students' heightened enthusiasm for the task, willingness to work hard, striving for improvement, and selection of challenging tasks. Motivation related to an audience can also take a darker form - students may be apprehensive about publishing for an audience, and be more careful about making mistakes because their work will be published for all to see on the Web.

**Cognitive effects.** By cognitive effects, I mean specific differences in how students 'solve the problem' of creating a piece of writing in response to an audience. Beyond just working on a task harder or longer, (motivational effects), cognitive effects are ways that students may write differently for an audience. For example, in Cohen and Riel's model, students wrote better essays partly because they anticipated the needs of a distant audience for more and different details of their personal lives and culture. Other researchers hypothesize a range of other types of audience adaptations.

Kroll (1984) makes a distinction between information and social audience adaptations. Informational adaptations occur when a writer anticipates audience information needs. Informational adaptations can be further subdivided into global and local adaptations. Studies of expert writers show writers making global choices during the planning stages or writing, choosing information content based on information needs of an audience (Berkenkotter, 1981). Fontaine (1988) showed 13- and 18-year-old students making global content choices in writing letters to a fictional aunt in France, making inferences about what this distant audience might or might not already know about the subject. Fontaine also showed that students writing for a distant aunt engaged in more planning, possibly because of the need to make more informational inferences. At the local level of audience adaptation, Rubin (1984) found some of the specific syntactic changes non-professional writers make for an audience, and Jacobs
Kroll’s second category, social adaptations, have to do with the writer’s awareness of a social relationship with readers, and making adaptations derived from these perceptions. Perceiving these relationships may require perspective taking (Rubin, 1984) done by the writer with respect to an audience. Perspective-taking is the attempt by the writer to look at a piece of writing with different eyes, temporarily suppressing or de-emphasizing the writer’s own knowledge and perspective. Researchers have explored the possibility that general social-cognitive ability would be a predictor of writing ability because such ability facilitates perspective-taking (Bonk, 1990). Rubin (1984) gives a detailed examination of the skills that may be necessary to adapt writing using social cognition, which include ability to coordinate multiple perspectives, ability to represent both stable and transient aspects of the reader’s mental states, and an understanding of how text features and reader characteristics interact.

Going beyond the thinking of audience researchers, it appears that an understanding of the role of genre interacts at a deep level with the writer’s social understanding of writing. Genres contain different role-taking ‘moves’, (Swales, 1990) and act as understood communication forms within scientific discourse communities, and it is by accounting for these roles and moves that the writer’s social awareness is instantiated into good writing. Although a full exploration of the relationship between genre and audience awareness is beyond the scope of this paper, (but see also Berkenkotter, 1995; Freedman and Medway, 1994), we wanted to be cogniscent of how students’ ideas about the genre of scientific reports was connected to/affected by social considerations. The interaction between genre and audience consideration became of particular interest over the course of this study because it seemed key to interpreting some of the audience adaptation we observed students making in the think-aloud sessions.

Setting for research

Foundations of Science project-based curriculum
The setting for this research was the third-year cohort of an integrated science curriculum at an alternative high school in Ann Arbor, Michigan. This is a public high school with about 400 students which accepts students through a combination of lottery and first-come-first-serve sign-ups each school year. Incoming classes are intentionally balance for ethnic minority representation and representation of special-needs students. Although students at this school are not, overall, a representative sample of any particular population, they are not believed to be overly represented by either high- or low-achieving students as compared with the district as a whole.

Foundations of Science (FOS) is an integrated science curriculum which follows the principles of project-based science (Blumenfeld, et al, 1991), and has a heavy emphasis on the use of educational technology. The science curriculum integrates the three traditional content areas of Earth science, biology, and chemistry into one three-year sequence focused on investigative science. Writing is not a particular focus of this classroom, although design of multimedia documents is. An advantage of the FOS setting for this research is that the students are proficient and comfortable with using technology in general and the World-Wide Web in particular.

The air pollution project

This research examines student artifacts produced during a two month project on air pollution, conducted in the 11th grade classes at this high school. The final product for the air pollution project was a Web version of a student lab report. Students worked in groups of 2-4 to conduct air-monitoring tests in the city of Ann Arbor and each group wrote a formalized laboratory report for publication on the Web. These reports gave results and conclusions of their studies, as well as general information about air pollutants as background information for their study. The laboratory report followed a detailed criteria sheet given to the students at the beginning of the project. This project spanned eight weeks. The following is an approximate week-by-week schedule of activities for this project.

Week 1: Introduction to air pollution

Week 2: Discussion of experimental design, introduction to air-testing equipment

Week 3: Reviews and critiques of Web resources, summaries of selected articles
Week 4: Refine experimental design, use of testing equipment
Week 5: The mole, introduction to gas laws. Problem statements due
Week 6: Gas laws, the mole continued. Independent research
Week 7: First drafts published on the Web, readers send comments
Week 8: Final drafts published, wrap-up, project ends

Students were also responsible for handing in several intermediate assignments related to the final lab reports. Early in the project, they handed in a description of their experimental design. During the fifth week, (exact due dates varied by teacher) students handed in problem statements, which introduced and gave an overview for their reports. One week before final reports were due, students were supposed to submit full drafts of the reports. These reports were published on the Web, labeled as drafts, and outside readers were asked to review them and send comments to the students. Final versions of student lab reports were published in the eighth week of the project.

Outside readers for lab reports

Also before the project began, we had arranged for outside readers who had agreed to read and respond to students’ lab reports once they were published. For this project, the readers were all Ph.D.-level scientists (one Ph.D. candidate) with some expertise in air pollution. Two of the readers also possessed an M.D. and specialized in the health effects of air pollution. Four of the readers were faculty or post-doctoral students with expertise in air pollution, employed at a school of public health. One reader was a Ph.D. candidate in political science with an interest in the legal aspects of air pollution regulation. These readers were selected using a four-category model for analyzing characteristics of an outside-the-classroom audience for student writing (Bos, 1997). It was thought that the knowledge level and other characteristics of this audience of scientists might spur students to make audience adaptations that would improve the content and style of their scientific reports.

Scaffolding of lab report genre

The teachers conducted several activities to scaffold the students’ writing of their lab reports. One of these was a comparison of good and bad lab reports on the same experiment. The 'bad' report had 16 numbered circles scattered throughout
the report, representing 16 shortcomings. Students were asked to try to figure out what these shortcomings were, (a 'good' report of the same data was printed on the other side.) Identifying these mistakes was a non-trivial problem, which in some cases required quite a thorough understanding of the genre. Many of the mistakes consisted of putting correct material in the wrong place, e.g. reporting new results in the conclusion.

During the in-class portion of this exercise, we tried to bring out the social functions of the lab report genre. In going over the 16 problem areas in the 'bad' lab report, teachers explained the 'correct' format for a lab report in terms of the audience needs rather than in terms of an abstract, decontextualized 'correct' genre. In some cases, the information was phrased in terms of readers' information needs: for example, the title needs to highlight the most important scientific contribution of the study to aid in comprehension. In some cases, teachers gave explanations that were more socio-cultural: i.e. the introduction should be written in a particular way because that is the agreed-upon format that professional scientists are used to.

**Design of feedback form**

The feedback that was sent to students from readers was carefully scaffolded in terms of content. Readers submitted comments through an on-line form. The challenge in designing this form was trying to bridge the gap between what readers can say and what students can use. To assist readers who are not professional high school teachers, and thus may not be skilled in giving feedback to high school age writers, the feedback form supports both multiple choice and free-form responses. Our expectation in designing this form was that, while free-form comments are more valuable to the writer, they are harder for the reader to produce. In each category, readers were given two multiple-choice items, and following these two priming questions, the readers were given a space for free-form comments in that category. The forms asked readers to give ratings in four categories: Problem statement; Methods data and results; Appearance and organization, and Further investigation. To be useful to the student writers, the forms were similar in structure to the assignment criteria for the project. We wanted the feedback to correspond to the goals communicated to the student by the teacher, and minimize the confusion of receiving feedback from two different sources.
Students informed about readers

Each of the three teachers informed their students during the first week of the project that outside readers would be reviewing their documents, and that these outside readers were professional scientists. Later in the project, a week before draft copies were due, students were again reminded of the readers. This second time, students were told that the readers were Ph.D. level scientists, that some were from locations outside of Michigan (New York and Southern California, specifically), and that some had a specialization in health effects of air pollution. These facts related to the readers’ knowledge level were deemed the most relevant pieces of information that might affect students audience-adaptation strategies in this project.

Web publishing software

Students published their Web reports using a modified version of the Web-it translator software (developed by the hi-ce research group and distributed as part of ClarisWorks 4.0.) Our intention was that students would be able to create Web documents with a tool that was as transparent as possible. The Web-it translator allowed students to include necessary hypertext elements of headings, graphics, and hyperlinks from within the familiar ClarisWorks word processing software. The students had used a version of the translator to publish a project the previous year.

Publishing/ feedback timeline

Students were required to turn in a complete draft of their project for review by readers one week before the end of the project. These projects were published and readers were personally notified of their availability. At the teachers’ request, comments from readers were not made publicly available. Instead, readers’ comments were published on the Web in an unlinked and unadvertised location, and printouts of these comments were given to students. Final drafts were due one week after first drafts. Many students had not received reader comments by this time. A number of groups did receive comments after the final draft due date.

Methodology overview
Given the absence of one clearly-established method of measuring audience’s impact on student writing, this research relies on three different methods: content analysis of student reports and readers’ responses, analysis of students’ verbal protocols while writing, and post-project surveys eliciting students' self-report of motivational influences. Each of these methods will be described in more detail in separate sections where their results are reported. These methods are briefly described below.

**Terminology studies**

Students' awareness of audience may be revealed by how they use two kinds of terminology: proper place nouns and scientific terms. Students' use of proper place nouns (e.g. "Ann Arbor, Michigan") may show awareness of a distant audience for their work. Students' use of advanced scientific terminology may indicate awareness of a scientifically knowledgeable audience. We will examine how students in this project used both proper place nouns and scientific terminology to try to gain insight into their perceptions of audience. Nineteen final student reports and ten pre-publication problem statements are available for analysis of these features. Ten post-project interviews with student groups on their use of terminology were also conducted.

**Post-project surveys on motivation**

Survey research is an established way of studying student motivation. We gave students in this project a short post-project survey containing seven Likert items and a six-item checklist to elicit their opinions about whether Web publishing was motivating for them and whether Web publication changed their design process in any way. The survey was completed in class by 50 students.

**Audience-related verbal protocols/ case studies**

Verbal protocols of writers in the process of writing are an important method of studying the writing process (Flowers & Hayes, 1981). We asked six student groups to work on their lab reports in front of the camera, and gave them standard think-aloud protocol instructions to keep talking as they worked in order to give us a running record of their composition processes. We analyzed the resulting verbal protocols for reference to specific audiences, generalized audiences, and also paid attention to ideas about the lab report genre.
Specifically, we were interested to know whether the presence of a Web audience was leading to productive audience-related inferences. Analysis of these protocols was informed by the theoretical models of Kroll (1984) and Rubin (1984). Case studies of three of these six groups are presented in this paper as examples of the range of audience- and genre-related thinking that was observed.

Results

Study of proper place nouns and terminology related to audience

We examined students’ lab reports for their use of proper place nouns (e.g. "Ann Arbor, Michigan") and scientific terminology (e.g. "catalytic converter") as an indicator of students' perceived audience for their work published on the Web. We also interviewed ten groups of students about their use of these language markers.

One precedent for this study of proper nouns is Jacobs (1989), who explored the ways that definite constructions (constructions that contextualize proper nouns) reflect the implied audience for a piece of writing. Jacobs examined whether Christian Science Monitor writers chose to contextualize or not contextualize references based on the assumed knowledge of the readers for 15 editorials. For example, in an editorial about an NFL team’s new drug policy, the writer assumes basic knowledge of football as a sport, and the Super Bowl as an event, but assumes partial knowledge of the New England Patriot’s recent loss in the Super Bowl ("the humiliation of their Super Bowl defeat") and is careful to give the Patriots coach’s title along with his name ("the current coach, Raymond Berry").

We expected that proper place nouns and scientific terminology might be a useful window into the perceived audience of students as they published work on the World-Wide Web. In standard classroom writing tasks for their teacher as audience, students would not normally name their school and testing location (e.g. "We tested at the corner of Main and Huron in Ann Arbor, Michigan"), rather, in the context of a single classroom this information would be assumed. But if students are cogniscent of a World-Wide Web audience, especially a distant audience, students might be more likely to include these proper place nouns.
We hypothesized that use of scientific terminology might also betray students' assumptions about their audience's knowledge level. Student writers might assume different levels of technical knowledge for an outside expert, for their teacher, and for a general reader on the Web. We examined students' use of terminology and noted what terms they explained, and which they left unexplained for the reader.

What we found related to proper place nouns suggests that students were adapting their writing for a web audience (table 1). Of 19 final-draft versions of student reports published on the World-Wide Web, 11 named the city where the research took place (Ann Arbor), and 3 went on to name the state (Michigan). Even more convincing is a breakdown of this data examining use of proper place nouns for research that took place in outdoor locations, (therefore making place information more salient.) Ten of the eleven student groups whose research took place at a specific location in the city (either at a street corner, a parking garage, a local restaurant, or outside the school building) included the name of the city in the report. Of the 8 student groups whose research was not tied to a specific outdoor location only 1 included the name of the city. This data would suggest that students were making language adaptations based on judgments about what outside-the-classroom readers would want or need to know about their data.

<table>
<thead>
<tr>
<th>Report contains: (n=19)</th>
<th>count</th>
<th>percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Named city where study took place in final draft</td>
<td>11/19</td>
<td>58%</td>
</tr>
<tr>
<td>Named city when study was conducted outdoors</td>
<td>10/11</td>
<td>91%</td>
</tr>
<tr>
<td>Named city when study was conducted indoors</td>
<td>1/8</td>
<td>13%</td>
</tr>
</tbody>
</table>

Table 1. Proper place nouns used in final reports

A second analysis was performed, comparing early drafts written exclusively for their teacher as audience, to later drafts that were published on the web for reader response (table 2). The expectation for this comparison is that students would have been less likely to include proper place information in these drafts, whose only audience was a teacher, but likely to add this contextualizing information for the final draft. Again, findings suggest some student awareness of changed audience for the final product. Of these ten drafts, four showed the
anticipated pattern of not including proper place information in the draft but adding it into the final report. An example of this is a report whose title was change from a first-draft title of "Sulfur dioxide: the silent killer" to the Web-published title of "An overall view of air quality in Ann Arbor." Four of the ten were unchanged, including proper place information in both the draft and the final, and two did not include this information in either the draft or the published final.

<table>
<thead>
<tr>
<th>(n=10)</th>
<th>count</th>
<th>percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Named location in draft for teacher</td>
<td>4/10</td>
<td>40%</td>
</tr>
<tr>
<td>Named location in final published report</td>
<td>8/10</td>
<td>80% (+40% from earlier draft)</td>
</tr>
<tr>
<td>Named location in neither</td>
<td>2/10</td>
<td>20%</td>
</tr>
</tbody>
</table>

Table 2  Comparison of use of proper place nouns in teacher drafts versus final web reports

Near the end of the project, we were able to interview eight student groups about their use, or failure to use proper place nouns. (These were not necessarily the same students whose reports were analyzed earlier.) Three of these groups had mentioned their city in their reports, and five had not. None of the groups mentioned the outside readers or any specific audience in explaining their use or failure to use proper place nouns. Of the three groups, two did mention Web publishing as a reason for including information about their city. An example from these was this outtake:

Student 1: Because we knew it was going to be on the Web
Student 2: Like if [name of teacher] was reading this we wouldn’t necessarily put that it because he knows its for his class
Student 1: But we were going to have a wider audience for this.

The third student group that did include proper place names was more general in their explanation, mentioning that “people” might need to know this, and also giving the more genre-based explanation that the report “sounds better” with the proper place noun included.

Of the five groups that did not included proper place nouns, four said that the main reason was that they did not think about it. The fifth group said that they
thought it was irrelevant to their study (a study of CO2 consumption in an indoor aquarium), and two others that had not thought of including place information also questioned whether place information was important to their report.

**Use of scientific terminology.** Students’ use of terminology is more difficult to interpret in the context of audience awareness. Examining student reports, it was evident that students did not, overall, assume a high level of technical vocabulary knowledge, and we found very few scientific terms used without explanation. The most often unexplained term was the acronym EPA, which was used without writing out ‘Environmental Protection Agency’ four times, and used with this contextualizing information six times. Two student groups also mentioned the term ‘catalytic converter’ without explanation, while two others did explain this auto exhaust system component.

We interviewed ten student groups about their use of terminology, and why they felt it was important or not important to explain specific terms in their paper.

In explaining their use of scientific terminology, 9 of 10 student groups gave explanations that referred to their potential audience (table 3). However, only one of the student groups referred specifically to the audience of outside experts, and no student groups referred to the web publication of their reports in explaining their use of terminology. This suggests that students’ choices about use of terminology is less connected to adaptations for their authentic audience than we hoped they would be.

<table>
<thead>
<tr>
<th>Explanation for use of scientific terminology (n=10 groups)</th>
<th>count</th>
<th>percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reference to potential readers</td>
<td>9/10</td>
<td>90%</td>
</tr>
<tr>
<td>Reference to web publication</td>
<td>0/10</td>
<td>0%</td>
</tr>
<tr>
<td>Reference to audience of outside experts</td>
<td>1/10</td>
<td>10%</td>
</tr>
</tbody>
</table>

Table 3 Groups giving audience-related explanations for their use of scientific terminology

**Summary of terminology study**
Students’ use of proper place names gives some evidence that students were making adaptations in anticipation of their work being published on the Web. However, we did not find much evidence that students used a different level of scientific terminology when writing for a Web audience. In general, students used a low technical level of scientific vocabulary, and explained most technical terms and acronyms that they did use. Questioning students about their use of vocabulary, the majority of groups (9 of 10) made some reference to readers, but almost none made any mention of specific potential readers.

**Surveys on motivation and audience adaptations**

What did students think about Web publishing? Fifty students completed a post-project survey which included questions about their motivation and interest in Web publishing, and questions about specific audience adaptations that they think they made in writing for the Web.

**Survey study of attitudes toward web publishing**

We designed seven Likert items to tap students attitudes and motivations toward Web publishing (table 4), and a ten-item checklist about specific audience adaptations students may have made in response to Web publishing (table 5). We had piloted these measures twice in Web-publishing studies the previous school year, with Likert, open-ended, and interview items. The seven Likert items were designed to tap into students' motivation and interest in the Web publishing aspect of the air pollution project. Reported here are the means of student responses, (n=50) a few suggestive correlations between items, and brief discussion of these results. These were Likert survey items on a 5-1 scale, 5 being strongly agree, 1 being strongly disagree.

<table>
<thead>
<tr>
<th>Item</th>
<th>Question</th>
<th>Likert mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.</td>
<td>This project was more interesting and motivating for me because the final reports were published on the Web</td>
<td>2.3</td>
</tr>
<tr>
<td>B.</td>
<td>We were more careful when writing our report because it was going to be published on the Web</td>
<td>2.6</td>
</tr>
<tr>
<td>C.</td>
<td>This project seemed more 'authentic' because we were going</td>
<td>2.3</td>
</tr>
</tbody>
</table>
to publish our results on the Web

D. Publishing on the Web made no difference to me in terms of motivation or interest 3.7

E. I think that our report is (will be) a valuable addition to the Web 3

F. The class grade was the only real motivator for me in this project 3.2

G. This project was (or would have been) more interesting and motivating because we received comments on our draft from scientists over the Internet 3.3

Table 4  Class means of seven Likert items related to motivation an Web publishing (n=50)

Interpretation of item means. Overall, these results suggest that students were less motivated by the authentic Web publishing task than had been hoped. The students as a group did not think that Web publishing made the project more motivating or more authentic, and did not think that having their work published made them more careful when writing. Students were split as to whether they thought their report would be valuable additions to the Web. Students did generally think that receiving feedback from outside readers either did, or would have made the project more interesting and motivating.

Correlations between items. A few small correlations supplement these results. Female students were slightly more likely to think that Web publication made the project more authentic, as gender correlated with item C at .31 (Pearson’s r), and also with item A at .18. Students who received a better grade on the project were also somewhat more likely to think that Web publishing made the project more authentic, as final grade also correlated with item C at .31.

Effect of receiving reader feedback. Receiving feedback from outside readers also seemed to make a small difference on items E and G. A ‘dummy’ binary variable was created to indicate which students had and had not received feedback (27 had, and 22 had not), and this variable had small correlations with items E (.39) and G (.34). In other words, students whose group received feedback were more likely to think that their report would be a valuable addition.
to the Web (item E) and more likely to think that receiving feedback made the project more interesting (item G). The second correlation, (item G) is encouraging, in that receiving feedback did seem to make students value receiving feedback. The first item (E) was less expected, but also encouraging. It is not obvious why receiving feedback would make student value their own projects more. This correlation might be partly spurious, in that students who received feedback probably did have better projects-- the 'feedback received' variable also correlated with final grades at .17.

**Self-report of design differences**

Beyond motivation, we also wanted to know whether students thought they had written their reports any differently for Web publication. We asked students to report which of these ten checklist items represented differences in their design for the Web. Next to each item is indicated the percentage of students who endorsed each item. Fifty students completed this section of the survey. Note: although it would logically follow that students who endorsed item #1 (no differences) would not endorse any other items, this was not always the case. Three students who endorsed item #1 also endorsed at least one other item.

Prompt: Did you design your paper differently because it was going to be published on the Web? Check all that apply.

<table>
<thead>
<tr>
<th>item #</th>
<th>item wording</th>
<th>% of students endorsed</th>
</tr>
</thead>
<tbody>
<tr>
<td>#1</td>
<td>no differences</td>
<td>47%</td>
</tr>
<tr>
<td>#2</td>
<td>broke up text into smaller chunks</td>
<td>22%</td>
</tr>
<tr>
<td>#3</td>
<td>included more headings</td>
<td>39%</td>
</tr>
<tr>
<td>#4</td>
<td>included more graphics</td>
<td>16%</td>
</tr>
<tr>
<td>#5</td>
<td>included different information that we thought would be useful for people doing Web research</td>
<td>22%</td>
</tr>
<tr>
<td>#6</td>
<td>checked facts more carefully</td>
<td>29%</td>
</tr>
<tr>
<td>#7</td>
<td>wrote in a more formal and scientific style</td>
<td>20%</td>
</tr>
<tr>
<td>#8</td>
<td>wrote in a more interesting style</td>
<td>12%</td>
</tr>
</tbody>
</table>
Table 5. Percent of students who endorsed each item related to design differences for Web publication

**Interpretation of checklist items.** As item #1 indicates, nearly half of the students thought that they had done nothing differently for Web publication, (although, as mentioned, 3 did find at least one checklist item to endorse). Items #2 and #3, two of the highest-reported items, (also highly-reported in pilot studies) are aspects of Web publishing that had been specifically mentioned by the classroom teachers as good features of Web pages, and so should not be considered spontaneous student reactions to Web publishing. Other hypothesized adaptations, such as checking facts more carefully or including different information for an audience on the Web were endorsed by a minority of students.

**Niche hypothesis**

Web publishing was not as strong a general motivator for the students in this project as we had hoped. But we wanted to know, was there a minority of the students who were especially motivated by Web publishing? Teachers are often encouraged to provide multiple 'hooks' for student engagement, and Web publishing could be such a 'hook' if a sizable subset of students was motivated by it. We tested this 'niche market' hypothesis by doing separate analyses of students who answered highly on Likert items A and C. We selected students the sum of whose answers to items A and C was at least 7, meaning that they were positive (rating a 4 or a 5) to one of these items and at least neutral on the other. This resulted in a set of 8 students (16%) who were at least somewhat favorably disposed to Web publishing. Although we cannot conclude too much based on this very small sample, it may be worthwhile to look at the overall profile of this group.

The overall final grades of this sub-group were somewhat better than the class’, averaging 92 versus 87. The most striking feature of this group is that 7 of 8 are female. The group also showed a markedly different profile on the checklist self-reported differences. They reported more design differences in every
category except use of graphics. Half or more of these 8 students said they included more headings, included different information for people on the Web, checked facts more carefully, wrote in a more formal and scientific style, and followed the scientific report format more closely. This profile fits the intended benefits we had hoped to create with Web publishing, of being more motivated, and having this motivation translate into thoughtfulness about the audience and care in designing documents.

**General discussion of survey items**

It is generally disappointing that students were not more motivated and interested in Web publishing. It is encouraging that students who did receive feedback from readers had positive feelings toward receiving feedback. This may suggest other models of collaboration with readers, where students receive more frequent and earlier contact with readers.

Students also did not report using specific adaptations in very high numbers. Students did use the adaptations, including use of multiple headers, that were specifically prescribed by their teachers. This result dovetails with other results in this paper suggesting that in order to have their students effectively adapt writing for an audience, teachers must first define a genre for the task, with specific audience-related features.

Examination of the small subset of eight students who did report that Web publishing was more motivating or more authentic suggests that publishing may have intended benefits of encouraging more thoughtful work for a 'niche market' of students.

We should also report that the teachers involved in this research had definite opinions about why the students' self-reported interest in Web publication were low, conveyed to the researcher in informal conversations after the project. The teachers fault two aspects of the project. First, the air pollution project was a first-time project that was troubled by technical difficulties of the equipment and general lack of polish in the implementation. Although the survey items all refer to Web publishing specifically, the teachers believed that the students' general frustration with the project may have colored the results. Second, the teachers fault themselves for not 'selling' the idea of Web publication more, because of their preoccupation with other aspects of this first-time project. This second
hypothesis is interesting, because we had not previously considered that the theoretical benefits of audience might be strongly dependent on teachers' salesmanship. However, this idea that the motivation for authentic projects may only exist when it coincides well with teacher-mediated achievement motivation deserves further study.

**Case study examples of students' writing process for a web audience**

We videotaped six sessions with focus groups in which we asked them to talk aloud about their writing process as they worked on their air pollution reports. We transcribed these sessions and analyzed them to try to identify thinking processes related to these groups’ consideration of audience.

In particular, we were looking at the following question:

1. What level of audience are students considering, if any?
   - Consideration of specific readers, (esp. outside scientist respondents)
   - Consideration of general audience on web
   - Consideration of non-specific readers

2. What types of judgments or writing adaptations are students making related to audience?
   - Informational adaptations- judgments about what audience knows or needs to know
   - Social adaptations- judgments about students’ relationship with potential readers
   - Genre interpretation-- making sense of the lab report assignment with respect to audience needs

As mentioned before, the interaction between genre and audience consideration was an area of increasing interest over the course of this study because it seemed important to interpreting most of the audience adaptation we observed in the think-aloud sessions. In this paper we will examine brief case studies of three groups of students working on their air pollution reports. These three groups represent three different dynamics in the way that consideration of audience and genre impacted students’ writing process.
Anita, Erika, and Lynn

High level of audience awareness and adaptations

Verbal protocols from the working group consisting of Anita, Erika, and Lynn contained evidence of audience consideration at several levels, playing out in several ways. This group was the only one studied who specifically mentioned the potential Web audience for their work. This group made specific adaptations related to the outside audience for their work, and also tried to interpret their assignment criteria given by the teacher in terms of audience communication.

The first instance of these girls mentioning their audience came eight minutes into the taped session, when they were discussing whether or not to capitalize the word ‘ozone’ every time it occurred in their report. Anita mentions that capitalizing the word ozone would have one possible use, in that it would allow readers to quickly locate the word within the text, but she quickly dismisses the idea.

Lynn: aren’t we going to capitalize ozone every time we use it?
Anita: I thought that was weird, kind of dumb
Erika: (looking at source materials) some of them do, and some of them don’t
Anita: I don’t see the point (of capitalizing), unless you want to highlight it so people can go through... but what’s the point.

This idea that one way to consider audience is to write texts that are easily referenceable for readers was not the girls’ original idea, but had been introduced earlier by their teacher. This idea recurred several times in the session in different ways. In the post-session interview, Erika explained that their ideas about referenceability especially affected their choice of headers:

Erika: The intent of putting all the headings on is so that they don’t have to read the whole paper, is if they came to this section and just wanted to know why we were doing this and where they wouldn’t have to read the whole paper to find out.

Audience consideration also played a role in the girls’ deciding the order of presentation of some content in the introduction. The assignment criteria instructed them to discuss pollution in general, and then discuss their pollutant
in particular. The girls worried that the general discussion would confuse their audience, however, because they would not understand where the paper was going. In this section, the girls specifically mention potential readers on the web.

Lynn: you could (discuss pollution in general) first and then go into ozone specifically
Anita: but that’s our introduction, we want it to say what we’re going to talk about
Erika: see, because right here, this is the order of the criteria
Erika: ...just liz... (only our teacher will see it)
Anita: Well, its also going to be on the ‘net
Lynn: see, now that’s where I have problems. If people are going to be reading this on the Internet, and they’re like ‘oh, ozone’, then all of a sudden they’re like, ‘pollution in general?’
Anita: (reading their introduction) I think in here I talked about this- indoor and outdoor air pollution
Erika: what I was thinking was that we could make like a title heading for that section, so we can make like a separate paragraph out of it , like put a title on it (and) each section under it, under the general title of data
Anita: so people can just scan
Erika: so we can call this like ‘indoor versus outdoor’
Anita: and we should probably like, show how this pertains to ozone a little bit.

The girls’ proposed solution is to put clear headings on the sections, so that readers understand that pollution in general will be discussed, and can skip to the ozone-relevant material if desired. This again shows how the idea of referenceability is tied to audience consideration for these girls. Anita also suggests that they should make the connection to ozone explicit in the text somehow.

The girls also showed audience consideration in thinking about what background information their audience would need to understand their study. In examining this problem, they engage in some perspective-taking, and try to think back to what they knew when they were novices in the domain.
Anita: (looking at same paragraph) This is kind of like a general idea of air quality standards but it pertains to ozone because, to learn about ozone you need to learn about this air quality standard.
Lynn: you may need to explain this to people
Erika: But how much did we know about ozone pollution before we started this?

The girls also found reason to complain about the assignment criteria, which did not in some cases seem to fit with their ideas about what information an authentic outside audience would want to know, or the order in which the audience would want to receive it.

Lynn: the criteria of these projects that we do in Foundations always seem so strange, she wants us to give back information plus the information that we’ve learned and studies from, but in a web page that just doesn’t fit

In these students, we saw explicit references to the web audience being used to help make writing process decisions. We also saw these students using specific ideas about how to adapt for an audience, especially the idea of writing for referenceability, and attention to sequencing of new information for novice readers.

This group’s process also showed some of the interaction between genre and audience, including perceived conflicts between the teacher-assigned criteria and consideration of audience. This dynamic was even more salient in the second case study, so will be discussed there.

What was glaringly absent from this first group’s audience adaptations processes were explicit references to the authentic audience of outside scientists who would be reading and responding to these students’ work. When asked in the post-interview whether this real audience entered into their thinking at all, they responded that this audience was mostly a source of intimidation:

Interviewer: What about the scientists who were going to be reading this. Did you do anything different because of them?
Erika: I know when I was writing my part and I was thinking about the fact that they were going to be reading it ...because I was still unclear about some of our results and stuff like that, and I wanted to make it sound like I knew what I was talking about.
Anita: it would be someone who could challenge anything you wrote.
Erika: ... I didn’t want to make it so that I had these big long words and terms that (I didn’t) understand, because they would be like... I didn’t want to get called on that kind of stuff. Because you know if you’re going to write big words or have lengthy explanation, they’re going to pretty much be able to tell right away, that, oh, they either copied this or this is just BS, and not real information.

Interviewer: who was your audience for this paper?
Lynn: just the average Joe surfing the net for information, that’s what I thought.
Erika: if it was a person like ourselves, who was doing a project on ozone, was concerned about doing a science experiment or something like that, then they could use it as a source of information, that was geared towards them, it was ready for them to use, so they can just be like, ‘oh, wow! that’s exactly what I need’.

So, interestingly, consideration of both the scientific audience in this project and the “average joe” reader would tend to direct these students to use simpler language and more thorough explanations, in the first case to avoid being caught in a mistake by an expert, and in the second case because of a desire to communicate clearly.

**Paul and Nelson**

**Interaction of genre and audience considerations**

The case of Nelson and Paul also illustrates audience-related thinking used in the process of writing a lab report. This case is also interesting because it starkly illustrates the way that audience-related thinking interacts with ideas about genre. Nelson makes more audience-related statements than Paul. At the beginning of the session, Nelson relates that one of his goals is to make their report entertaining:

Nelson: I think it’s important to add whimsical things to it. to make it more entertaining.
This is interesting in that it suggests that this student’s sense of an audience’s needs seems closely based on his own preferences rather than a constructed representation of an outside reader.

Paul’s writing is guided more by a sense of genre, and by his interpretation of the assignment criteria, and this led to a disagreement within the session. Paul and Nelson disagree on the same point of the introduction that Erika, Anita, and Lynn struggled with. The question was, whether they should write about their specific pollutant first, or write about pollution in general, as the assignment criteria specifies.

Paul: its described here (in the criteria) exactly what we have to do. He wants us to briefly describe different types of air pollution, and then sort of build up into our type of air pollution.

Nelson: We should put the stuff about Carbon Dioxide ahead of all that stuff.

Paul : No it goes after that on the.. I think.. (looks at assignment sheet) We describe air quality and how we measure it and then below that we describe the type of air pollution or quality of relationship we are focusing in on. We can talk about general air quality but Carbon Dioxide is more specific.

Nelson: It doesn't sound right. Don’t you think they should know about it (CO2) before they start reading what we were doing with it?

Again, we see a conflict between the genre (as defined by the teacher’s assignment criteria) and one writer's consideration of audience. Nelson is keeping track of what the audience has and has not already been told (a type of audience adaptation Rubin (1984) labels a processual content approach), and senses a problem in that they are discussing air pollution and testing in general before they have described their specific pollutant. Paul, meanwhile, is following the assignment criteria, but also has gone beyond this to an abstract representation of the genre whereby an introduction moves from the general to the particular: "He wants us to briefly describe different types of air pollution, and then sort of build up into our type of air pollution."

Paul’s representation of the genre actually fits well with Swales’ (1990) analysis of the scientific introduction, which graphically depicts the movement of general-to-particular as an inverted pyramid.
The group's resolution is to follow Paul's recommendation (Paul is generally the higher-achieving student of the two), but did not resolve the audience versus genre conflict. And how might it have been resolved? A sophisticated understanding of both audience and genre considerations would recognize that scientific audiences are accustomed to the general-to-specific movement of the scientific introduction. A useful audience representation would recognize that because of the shared genre of a lab report introduction, the audience of scientifically literate readers would understand a general introduction to the problem of air pollution, and would understand that discussion of specific pollutants would come later. In this way, consideration of audience and genre are intertwined. Effective audience adaptation in a scientific genre means recognizing that the audience and the writer should have a shared understanding of genre forms, and shared expectations for those forms.

Anita, Erika, and Lynn appear to have been moving toward an understanding of this kind of genre-audience interaction when they decided to follow the assignment criteria and discuss general air pollution first, but then used headers to make it easy for the reader to find the section on their specific pollutant.

Nelson and Paul made a few other references to potential readers during their videotaped session. They did not, however, at any time mention the arranged audience of scientist respondents, and neither did they mention the fact that their work would be published on the Web. Their audience for this writing remained an abstraction that was not closely tied to the authentic audiences that were provided for them in this project.

**Reese and Alice**

**Lack of audience consideration leads to misunderstanding of assignment**

After observing how audience consideration caused confusion in the case of Nelson and Paul, it might be tempting to argue that audience adaptation is not an important part of writing a high school lab report, and that students should instead focus simply on following the genre (in this case, the teacher’s assignment criteria.) The case of Reese and Alice provides a counter-argument, however, because it shows a pair of students who misinterpret the assignment criteria because they fail to take an outside audience’s perspective on their writing. Reese and Alice showed no tendency to use any audience adaptation
strategies in their writing. We argue that this was related to their misunderstanding of part of their report’s introduction.

Reese and Alice’s problems centered on a section in the beginning of the assignment criteria which instructed them to “Describe the purpose of the entire project.” This rather vague reference to “the entire project” perplexed these students. They mistakenly assumed that this meant their partnership with Nelson and Paul, whereby the two groups had shared data and equipment.

Reese: What do you mean? (reading) Describe the purpose of the entire project ... the entire project, I’m assuming that’s our project with Nelson and Paul, who actually don’t do anything with us and so, but we’re in a group
A: So that’s the entire project, our piece is just us
R: Which I don’t see
A: We don’t have a purpose of we.. just have the same purpose and come to different conclusions
So we don’t have a separate purpose. Should we write that? Should we write that we don’t think this thing is worded very well? I think Mark (their teacher) would like that
R: Yeah, or we could just repeat it again, not the exact words
A: (laughs) the purpose of OUR piece is...

Looking at this section of the assignment from the perspective of an outside audience would have solved this mystery. A reader coming across Reese and Alice’s report on the web would have had very little interest in the students’ equipment-sharing arrangement, but they would have been quite interested to know about the entire 10th grade’s efforts to study pollution in their city, and find out that Reese and Alice’s report was one of a series of air pollution reports on similar topics on the web. Giving a sense of the entire air pollution project in the Foundations class was the intended meaning of “the entire project”.

Reese and Alice were one of two groups we observed who had trouble interpreting this particular section of the assignment. Perhaps the assignment could have been made clearer. It is worth noting, however, that neither of the other case study groups who showed tendencies toward audience-related
thinking had trouble deducing that “the entire project” referred to the entire 10th grade science project.

We interpret this misunderstanding as another example of the way that audience adaptation interacts with knowledge of genre. In this case, it was not possible to simply follow the assignment. Rather, some audience-related inference was necessary to make sense of the assignment. We argue that this may be quite typical, in that genre forms can only make sense and be used effectively when the underlying social purposes are understood. This argument ties with much recent thinking about genre, and the way that genres interact with the discourse communities that invent, use, and adapt them (Swales, 1990; Berkenkotter, 1995; Freedman & Medway, 1994).

Discussion of three case studies

Within these three cases, we saw some instances of what could be considered audience adaptation. There were no instances of students making adaptations based on the specific audience of scientist-respondents we had arranged for in this project. There was some students who were cogniscent of work being published on the Web, but most audience adaptations seemed to refer only to a decontextualized ‘they’.

These cases also provided a window into the complex interaction between audience related thinking and genre-related thinking. Sometimes, an audience-based approach seemed to have helped make sense of the genre, whereas other times these two sets of considerations seemed to the students to have been in conflict. More research is needed on how these two sets of can be reconciled by student writers.

General discussion

This study examined the end products, writing processes, and self-reported attitudes of students who wrote Web lab reports for publication on the Web, looking to see what effects an outside audience might have.

Examining terminology used, we saw that students used proper place nouns (i.e. named the city where research was conducted) when describing their outdoor pollution research, suggesting some consideration of audience. Students were also more likely to include this contextualizing information in drafts published
on the Web than in earlier drafts written just for the teacher. We also examined
students’ use of scientific terminology, and interviewed some students about
this, but did not find evidence that students were using a higher level of scientific
terminology in response to having an outside audience of air pollution experts as
respondents.

Surveys of students who participated in this project showed less motivational
benefits than we had hoped to see. Most students did not think that they had
been especially motivated by Web publishing, and did not think that they had
made many adaptations in their writing. There was a minority of students,
however, who reported liking Web publishing, and also reported making some
adaptations for an outside audience.

Examination of verbal protocols of students writing their Web lab reports
showed little or no effects of specific readers, but some adaptations for a general
audience, and some degree of awareness of a Web audience. Three case studies
illustrate the kinds of adaptations we saw students making, and also allow a
beginning exploration into the interaction between audience and genre in the
problem solving task of writing a Web lab report.

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