When Students Speak, Who Listens?
Constructing Audience in Classroom Argumentation

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Abstract: Does a speaker craft an argument carefully if no one will hear it? Does an engineer design structures without reflecting on the individuals for whom her creations will have meaning and utility? Learning sciences research often explores such creative activities as meaningful opportunities for learning—inherent in these acts of creation is the concept of audience. In this paper, we draw on the philosophical and science studies literature to further unpack the role of audience in argumentation and examine three different ways that educators have addressed the problem of creating an audience for student work. We discuss how these approaches can challenge existing classroom structures and present evidence from empirical studies that demonstrate some of the outcomes.

Audience: What and Who is It?

> *...the gathering of those whom the speaker wants to influence by his or her arguments.*
>
> (Perelman, 1982, p. 14), emphasis is his.

The word "audience" often conjures images of a crowded theater or lecture hall—the "gathering" referred to in Perelman's above quote. In reality, audience might be dispersed across continents and across centuries or may only exist in the mind of a speaker, writer, or artist. Walter Ong stated that, for writers, audience itself is a fiction, invoked by the arguer in order to organize and contextualize her communication (Ong, 1975). In addition, he suggests that the audience itself responds to a text by adopting an expected role—for example, the role of reviewer or the role of student—and participates in constructing meaning rather than simply receiving it. Whether real or imagined, listening or reading, live or in absentia, audience plays an important role in defining the context in which argumentation takes place.

Audience is complex. Understanding the nature and impact of audience plays a central role in the vast literature on rhetoric and argumentation. Whether written or oral, arguments are situated in a rhetorical space that is constructed by both the audience and the speaker or writer. Tindale described how audience plays an active role in determining the nature of an argument:

> The rhetorical audience is not a passive consumer of arguments, as some logicians seem to think; it plays an *active* role in the argumentation. The nature of the audience sets the terms of the premises, which are formulated in light of theses accepted by those to be addressed. The audience contributes assumptions to the reasoning… And the audience can interact with the argumentation in the mind of the arguer or in dialogue with the arguer… (Tindale, 1999, pp. 85-86)

Argumentation, then, is not simply a matter of constructing a logically coherent series of statements, it is a socially situated event designed by the arguer to satisfy the demands of a particular context. Thus, understanding audience in the classroom is critical for understanding how constructing arguments can be an effective learning activity and how to best design such experiences for students.

In this paper, we explore the role of audience when fostering scientific argumentation in classrooms. To support our analysis of audience in the classroom, we draw not only on the science studies and rhetoric literature, but on four years of empirical classroom studies that examine argumentation in both spoken (Berland, 2008, submitted; Kuhn, Kenyon, & Reiser, 2006) and written forms (Forte & Bruckman, 2006; Forte & Bruckman, 2007; Forte & Bruckman, under review). These different contexts for argumentation give rise to different understandings of audience in the classroom. We begin by exploring the role of audience in argumentative discourse, we then move to examine the implications for classrooms.

Argumentation and Learning: Audience Influences the Goals of the Argument

The first order of business between an arguer and her audience is agreeing on a goal. Is the audience to be persuaded? Is a compromise sought? Are the parties mutually engaged in solving a problem? The goal of the interaction must be established. Even when the audience is present, this is typically done implicitly; in the case of written communication, the arguer may invoke an audience based on her knowledge of communicative norms for a particular genre of writing. Determining the goal is an important first step because different goals result in different argument styles. In fact, philosophers have identified multiple forms of arguments. For example, Walton (1998), drawing from work such as Aristotle (1955) and Locke (1961 [1690]), has identified six possible argumentative dialogues each of which is "a goal-directed conventional framework in which two [or

more] speech partners reason together in an orderly way….Each type of dialogue has distinctive goals as well as methods that are used by the participants to achieve these goals together" (p. 3). Work such as this suggests that argumentative discussions vary broadly based on the participants' goals. Table 1 both summarizes Walton's dialogue types (as he describes them) and identifies the instructional goals emphasized by each dialogue type.

Table 1: Walton's dialogue types and implied instructional goals (Walton, 1998)

Dialogue type	End result	Implied Instructional Goals
Critical	Individuals are persuaded of a single claim	Criticizing counter-arguments
Inquiry	Claims are proven to be true or false	Collaborating to draw conclusions from premises/data
Negotiation	A "good deal" is reached	Bargaining and compromising
Information-seeking	An individual gains information	Asking questions and collecting information
Deliberation	A practical problem is solved	Debating possible courses of outcomes by predicting their outcome
Eristic	Opponents are defeated	Quarreling through aggressive tactics (including insults, emotional attacks etc.)

As seen in Table 1, each of these dialogue types has a different end result and suggests different kinds of pedagogic goals. For example, the critical dialogue is used to persuade people and involves the goals of understanding and refuting counter-arguments, whereas the inquiry dialogue is a way to construct a single claim that is irrefutably supported by evidence and entails collaborating to use data in order to draw conclusions.

The first author has examined argumentation in science classrooms (Berland, submitted a) in which students engaged in whole class arguments in a way that aligned with the critical dialogue of Walton's scheme (1998). Each of these is characterized by the various discourse moves receiving different emphases. For example, in the critical dialogue, students were likely to negatively evaluate one another while mustering evidence to disprove counter claims, while in the information-seeking dialogue the students questioned one another but rarely compared across their contrary claims in order to acknowledge or reconcile their disagreements. In addition, the first author witnessed students engaging in a form of argumentative discourse that did not align with Walton's scheme. In particular, the students engaged in "information sharing" in which they presented previously constructed arguments without attending to the arguments of others or receiving feedback on their own. Jimenez-Aleixandre, Rodriguez, & Duschl (2000) describe these interactions by saying the students are "doing school" rather than "doing science." They are characterized by a focus on procedures, the teacher's expectations and school culture (i.e., expecting the answer include one concept that is predetermined). In these dialogues, the often-implicit goal is to quickly get an answer to the question at hand. In other words, the goal is to construct an acceptable claim.

This information sharing dialogue generally does not align with expectations for argumentation—that is probably why it is not accounted for by Walton's scheme. However, we include it here because it reveals the importance of having an authentic audience: In these interactions the implied audience is invariably the teacher as students attempt to meet the requirements of the assignment. An audience of classmates or an external body might help move these students from the their focus on teacher expectations to the strength of their arguments.

Features of these dialogue types also surface when students invoke an audience for written work. The second author has examined students' writing practices in high school science classes when they are asked to publish a real science resource on a wiki. Students who wrote on the wiki also adopted the dialogic style of "information sharing." At first glance, it seems unlikely that one would find other forms of dialog in a written performance—if one is writing about science rather than discussing it, then it seems natural to present finished arguments. Yet, social media like wikis support discursive forms of written interaction as collaborators deliberate over the content they wish to present as well as the form of their argument. Although inquiry and negotiation dialogues such as these are common on other wikis, like Wikipedia, this kind of dialogue was rarely observed among students and was not encouraged by teachers (Forte & Bruckman, 2007).

These studies also revealed that, even when writing in an online public venue, students frequently adopted traditional standards for written school genres. These standards assume that the student's written performance is ultimately intended to be assessed by the teacher, not to persuade or inform others and not as a starting point for collaborative inquiry. Performative standards motivate student engagement in information-sharing rather than more critical or inquiry dialogues. Moreover, in this case, the students saw information-sharing as being in competition with other more argumentative dialogue types: students frequently reported

invoking an inexpert audience to help them organize their arguments, and several students explained in interviews that the teacher as audience competed with their potential readership online (Forte and Bruckman, in press). Ultimately, they attended to both audiences as they constructed their texts.

> What do people want to know about [this 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. – Sara

Combining our empirical studies with the philosophical and science studies literature emphasizes the importance of argumentative goals—and the role of the audience in determining these goals. In particular, we see in the work of both authors that the teacher-audience often worked to disrupt the students' focus on goals that align more directly with argumentation and sensemaking. This suggests that one challenge facing classroom communities as they work to engage students in argumentative discourse is the creation of contexts in which students are able to engage in argumentative dialogues and the goals implied by them.

Audience Influences How the Goals are Achieved

Beyond influencing the dialogue type—or argumentative goal—the audience influences the content of the interaction by impacting the criteria by which the argument will be judged. As stated by Tindale, "….depending on the circumstances, their [arguers'] arguments will seek different results and will use methods appropriate to the purpose of the discourse as well as to the audience to be influenced" (Tindale, 1999). In other words, arguers must change the content of their argument to meet the expectations of their audience. If this alignment does not occur, the argument will fail because the audience will judge it on different criteria then the author used.

In terms of scientific argumentation that occurs in classrooms, we have seen the students' criteria for evaluating arguments range from superficial (i.e., evaluating the appearance of the graphs; assessing arguments based on assumed expertise of the authors) to more content-based (i.e., aligning the claim to an answer in a text book) to scientific (i.e., examining the alignment between the claims and the evidence presented in defense of those claims). If the criteria that audience members use influence the content of the argument, then we would expect these different criteria to result in different arguments. For example, if the audience is focusing on superficial criteria, the arguers have little reason to articulate the evidence that supports their claims. Similarly, if the audience is focused on whether the claim makes sense or aligns with a textbook answer, the arguers have little reason to do more than identify outside sources that validate their claims.

The relationship between the expectations of the audience and the content of the argument is made most obvious in discussions in which the arguer's approach to supporting a claim differs from the expectations of the audience. For example, in an earlier study (Kuhn, et al., 2006) the first author observed a group of students arguing about their explanations regarding why the majority of Galapagos Finches died in the mid 1970s. One pair in this group (correctly) thought that a drought killed the finches' food (plant seeds) while the other pair believed it was torrential rains. The torrential rain pair defended their claim using logic and personal experience with drowning plants while the pair that believed it was a drought relied on evidence of the rainfall decreasing. After being unable to meet their demands for empirical evidence, the group that believed that torrential rains killed the plants revised their claim to align with the available evidence: a drought killed the birds' food. In interactions such as this, you see the substance of the argument changing to account for the audience's expectations. In this case, the claim changed because the arguers could not meet their audience members' demand for empirical evidence that supported the original claim.

The second author found that, when writing, audience awareness was a constant feature of students' process for constructing a text that would be acceptable to both their teacher and to a broader readership. In general, students adapted their writing to fulfill the perceived expectations of their Internet audience (Forte & Bruckman, in press). Some commented on the sense of responsibility they felt toward their readership: "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." Comments like this demonstrate the student authors attending to a non-teacher audience. Moreover, these different audiences for the students' work demand different kinds of information and different forms of presentation. In fact, as students reconstructed their writing process in interviews throughout the school year, they described different strategies for constructing texts and citing their sources depending on whether they were attending to their Internet or in-school audience (See Table 3).

Many students explained that, in order to present scientific information to a broad audience, they had to simplify the complex vocabulary they found in scientific journals so that their readers would understand their assertions. In order to do so, students reported that they needed to engage deeply with content and they frequently looked up additional explanations and definitions to get things right. One student described his process for researching his topic as 40% "collecting information. 60% was actually trying to understand what on earth are we talking about." Another noted that:

> 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

This same student also described consciously choosing to follow her teacher's suggestions even when they conflicted with her sense of the Internet audience's needs:

> Well, 'causes.' I was like, well, if someone was to look at this, it would be like 'causes of the disease'… 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

In this example, Lina ended up mirroring her teacher in order to perform for assessment purposes. The extra work that students had to do to develop their ideas for a less knowledgeable audience supports and explains Gunel, Hand, & McDermott's finding that writing science for the teacher is associated with lower post-test scores than writing for peers and younger students (2009). They similarly found that students tended to use "big words" to impress their teacher on the assumption that the teacher would already understand them.

Table 3: Student Strategies for Constructing a Science Text on a Wiki (Forte & Bruckman, in press)

	Teacher as Audience Goal: Meet Assessment Criteria	Broad Internet Audience Goal: Provide Credible Science Resource
Crafting Content	• Follow directions • Look at others' work • Apply conventions from other classes • Seek feedback	• Simplify scientific language • Invoke an inexpert reader • Use existing sources as a model • Reflect on own experiences as a reader

Sourcing Content		• Same strategies, different rationale:
		  o Ensure credibility
		  o Defer responsibility

Beyond the clarity of their explanations, these students placed a different emphasis on citation as a criterion for successful arguments when thinking about their external audience. In fact, as these students wrote online for a broad audience, some explained that citation was an important part of presenting their work in public, because of the responsibility to their audience:

> 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. – Jerry

The work of the first and second authors demonstrates that the students' sense of their audience influences the content and justification of their arguments. Moreover, the second author's work revealing that the students' shifted their criteria as their attention shifted from a teacher-based audience to an external readership demonstrates the impact of the teacher on their argumentation. In particular, we see that, as with their argumentative goal, the criteria that students apply to their arguments differ when they work to satisfy an authentic audience who might be persuaded by their argument rather than a teacher who seeks to assess whether they achieved the desired answer.

Implications for Designing Learning Experiences

The intertwined relationship between audience and student engagement with the science content suggests that a primary challenge when engaging in argumentative discourse in science classrooms is to *create situations in which students have an authentic audience for their arguments*. Moreover, the corollary to the philosophical focus on how the audience can shape the form and content of an argument is that the audience has a role in the argumentative discourse. That is, although a fictional audience might be invoked, an audience that is present should be providing feedback and engaging actively in the construction of the argument. From the perspective of the audience, this suggests that the listeners and readers have a key role in the argument process. Thus, the audience members must learn to play that role: They need to ask questions, evaluate arguments and offer alternatives. Whether in the classroom or in mediated online environments, these practices may need to be actively introduced and cultivated.

In order to serve as an authentic audience in argumentative discourse, students must see one another's ideas as worth responding to and must value the feedback provided by their peers in addition to that provided by their teacher. In an examination of power in a middle school science classroom, Cornelius and Herrenkohl

(2004) found that the typical "evaluation" phase of the triadic-dialog (Lemke, 1990) or IRE (Mehan, 1979) exchange can limit student ownership of ideas. Similarly, Tabak and Baumgartner (2004) found that triadic dialogues limit students' need and motivation to substantively engage with their classmates' understandings. Analyses such as these indicate that the prominence of teacher feedback in class discussions can limit students' ability to engage with one another's ideas because it removes their authority and motivation to evaluate and question them. In order for students to be audience members for one another's arguments, classroom norms must change to enable such interaction.

In addition, if students are to act as an audience for one another, they must reach agreement about the goal of their interaction. As described in the first section, this agreement is often achieved implicitly and is restricted by the context and content of an argument; however, traditional school norms may conflict with goals of specific forms of discourse such as scientific argumentation. In an analysis of classroom communities' adaptations of scientific argumentation, the first author and colleagues (Berland, submitted a) found that each classroom adapted the discourse practice differently. Moreover, the students in that study never explicitly discussed their goals with one another—instead the goal was made clear in the students' interactions. Their apparent agreement in argumentative goal could be attributed to their existing classroom culture (Berland, submitted b). That is, the goals with which they argued were similar to the goals of their non-argumentative, more typical class discussions. For example, in the class that argued as a form of critical dialogue, the goal was to critique counter arguments in order to prove that they knew the right answer. During non-argumentative class discussions, these students also seemed focused on demonstrating that they knew the right answer. Similarly, the class that focused on information seeking during the class argument was frequently engaged in similar interactions with their teacher when not arguing. This work demonstrates that the goals that typically govern classroom practices influence how students engage in argumentation. Thus, creating an environment in which it is sensible for students to engage with their audience to negotiate goals and criteria for meeting those goals involves a transformation of social norms in the classroom.

Transforming the Classroom Norms

Learning sciences research has a strong tradition of exploring transformative social arrangements in the classroom that cast students as responsible, generative participants in their educational experiences. For example, the literature on knowledge building communities suggests that students can function much like a community of scientists by proposing, debating and building on one another's ideas to further the knowledge of the class as a whole (Scardamalia & Bereiter, 1991). To support this goal, the software Knowledge Forum helps students identify possible discourse moves in a knowledge building exchange. Developing such a community requires a fundamental cultural shift in schools from what Scardamalia and Bereiter call a first-order learning environment, in which there is a static set of knowledge to be learned, to a second-order learning environment in which the state of knowledge is always changing and participants must continuously adapt to the ideas and suggestions of their peers.

Brown and Campione (1996) addressed this challenge by explicitly transforming the goals and criteria of the classroom activities. They did this by making students responsible for learning the ideas under study and then creating situations in which students were accountable to one another for those understandings. These expectations helped create a "community of learners," in which the students had authentic reason and opportunity to engage with one another's ideas through scientific discourse practices. However, these solutions required changing the entire community. This transformation is difficult, and possibly unrealistic in traditional classroom settings.

The first author built on this work with a focus on scientific argumentation: she designed activities in which the explicit goal was for students to convince one another of their ideas such that they had to attend and respond to one another's ideas rather than the teacher's. However, engagement in the goal of persuasion seemed to limit student motivation or willingness to engage in sensemaking (Berland, submitted a). This is an example of how changing a portion of the classroom norms—in this case, the interaction patterns—without changing the other expectations—such as the goals—resulted in an incomplete adoption of the scientific practice. This reinforces the systemic requirements put forth by the Brown and Campione (1996) and Scardamalia and Bereiter (1996) studies, but returns us to the question of how we can foster these sorts of interactions in more traditional classrooms.

Looking across the literature, we have identified three approaches to addressing this challenge.

1. Introducing an outside audience
2. Recasting student roles
3. Creating a fake audience

Each of these approaches has implicitly or explicitly created situations in which students had an authentic audience with whom they could negotiate the goals and criteria for their discussions. In the following sections, we will draw on the literature and our own empirical work to exemplify each of the three approaches.

Approach 1: Introducing an Outside Audience

Science fairs, band concerts, and student journals are all examples of traditional ways that educators have sought to "break down" the barriers between the classroom and outside communities in order to introduce an external audience for student work. Recently social media and "Web 2.0" have brought about new opportunities for student interactions with outsiders (Ellison & Wu, 2008: Wheeler, Yeomans, & Wheeler, 2008). In addition, learning sciences researchers have a relatively long tradition of exploring the potential for students to interact with distant peers, mentors, and subject matter experts via the Internet. Kids as Global Scientists (KGS)/Biokids (Songer, 1996), CoVis Mentor Database (O'Neill & Gomez, 1998), and Bos and Krajcik's online writing research (1998) are all examples of early learning sciences projects that created opportunities for students to engage with and present ideas to distant audiences through networked technology.

Because these interactions are mediated through educational software, the goals of discourse and the criteria for achieving these goals may be influenced by the design of the communication environments themselves. For example, in an implementation of KGS, students used an interface that structured activities by allowing them to see weather data, ask questions of remote peers, and answer questions from remote peers and local graduate student mentors (Songer, 1996). This configuration supported an "inquiry" style dialogue (Walton, 1998) by encouraging specific kinds of interactions such as reviewing data and asking questions. In other cases, such as in the work of the second author, who studied students writing a science resource on a wiki, the communication tools themselves are relatively versatile and lend little structure to the interaction. In such cases, it is critical to structure learning activities in such a way that students have a model of how they are expected to engage in with their readership in order to develop the goal and criteria for those interactions (Forte & Bruckman, in press). This may be done by explicitly structuring assignments, or, in exceptional cases such as the Math Forum project, it may be done through the development of an online community with cultural norms and expectations for social interactions among members (Renninger, Shumar, Barab, Kling, & Gray, 2004). This ideal can be difficult to achieve when both students and teachers can easily fall back on "default" classroom interaction styles that place the teacher back in the position of primary audience.

As discussed above, if expected to join in a particular mode of discourse, audience members also need to understand their role in the interaction. This can be a particularly challenging aspect of introducing an outside audience—engaging in specific forms of argumentation and providing useful feedback is not always easy. Even when the interactive environment helps structure classroom interactions, it can be difficult for outsiders to know what is expected and how to take on the role of audience productively. Songer (1996) provides an example of effective mentoring in which a KGS mentor "seeds ideas" among students; they note that mentors were not always so effective and were coached to engage with students in specific ways. O'Neill and Gomez (1998) developed the CoVis Mentor Database based on their research with science teachers who orchestrated online mentoring experiences for their students and likewise note that both mentors and students "needed substantial guidance concerning the kind of help they should provide and expect" (p. 327).

Approach 2: Recasting Student Roles

In the previous section, we discussed the use of an external audience to help transform classroom interactions. Another approach to changing the experience of audience is to recast students as audiences for one another. This can be done in more structured ways, such as assigning explicit roles, or less structured ways that encourage student engagement with one another's ideas in a more or less spontaneous fashion. Herrenkohl and Guerra (1998) took a highly structured approach in a study of participant structures in argumentation among elementary school science students. They identified three distinct intellectual roles in argumentative discourse: predicting and theorizing, summarizing results, and relating evidence and results to theory and prediction. They assigned students to these roles and, in a comparison group, also assigned audience roles to students. They found that when audience roles were specified, the class engaged in more whole-class inquiry activities and students took more leading roles.

Other researchers have had success assigning students less explicit roles. For example, in a study with undergraduate students, Forte and Bruckman (2006) found that assigning students to be reviewers of one another's work created a situation in which students tailored arguments to convince their peers. After reviewing their peers' arguments, students revised position papers to be more convincing to an audience that might not share their point of view. Still another form of audience role assignment that can implicitly encourage specific discourse practices is asking students to role-play with one another. For example, Pitts and Edelson (2004) ask students to adopt the role of scientists and interact with one another as such to solve environmental science problems. Although discourse roles themselves are not made explicit, students draw on their understandings of what scientists are like and what they do to organize their interactions with one another. Finally, a still less-structured approach is to give students a common goal to encourage knowledge-building interactions, such as Peters and Slotta's (2009) studies of students who construct a science resource for one another online.

When discourse roles are assigned, interactions can be far more structured than in the first approach and the problem of agreeing on argumentative goals and criteria is less difficult to resolve. The assigned roles

should support students in meeting argumentative goals, which are often made explicit upon assignment. In the first example above, Herrenkohl and Guerra (1998) made highly specified role assignments based on scientific discourse practices. In this case, the activity was sufficiently structured to circumvent confusion about the goal of discourse and the means of achieving this goal. In the case of Pitts and Edelson's (2004) role-playing scientists, or Peters and Slotta's (2009) wiki writers, discourse is less highly structured and students must draw on their understandings of scientific practices to come to an agreement on the best ways to pursue their goals.

Approach 3: Creating a Fake Audience

When it comes to scientific reasoning and argumentation, encouraging students to role play and engage with a fake audience (and even to believe such an audience exists) has been used to motivate and organize learning activities and to connect science learning with students' experiences outside of school. Elaborate cover stories are used in problem-based and project based learning projects such as *Blueprint for Success*, which places students in the position of designing a playground for an imaginary architecture firm (Barron, et al., 1998). In the *Mission to Mars* project, students designed model rockets to learn about physical science (Petrosino, 1998). After observing that students did not engage in inquiry learning while building their rockets, Petrosino introduced the idea that an audience would evaluate their designs and found that the introduction of a critical audience helped students organize their own activities in a goal-directed fashion cited in (Petrosino, 1998 cited in Barron et. al., 1998).

Once again, advances in educational technology have brought about opportunities for innovative ways to connect students with audiences—in this case, imaginary audiences. Goal-Based Scenarios (GBS) are a form of problem-based learning that engages students in an imaginary problem scenario (Schank, Fano, Bell, & Jona, 1994). The educational software *Sickle Cell Counselor* and *Broadcast News* are GBS's that encourage learners to develop arguments based on a dataset and present them to fictitious audiences who provide feedback and questions to direct further inquiry. These audiences are not real audiences that can be affected and persuaded by learners, they are computational agents that provide "canned" responses designed to elicit reflection. Because the audience does not exist, agreeing on an argumentative goal and on the criteria for successfully reaching that goal is a matter of coaxing students into the "right" frame of mind.

Discussion

Comparing various educational reform efforts reveals that learning scientists and science educators have long been working to create situations in which students work to engage audiences in an authentic fashion. Examining each of these designs in light of the philosophical and social sciences work on argumentation and audience suggests that a key challenge connecting these studies lies in the students' interpretation of the audience: are they constructing arguments or designing artifacts for their teacher to assess for accuracy or for an audience that they can hope to influence? Each of the studies discussed above has created ways to make the experience more authentic by creating a sense of audience that was external from the teacher.

This analysis has also revealed the importance of attending to whether and how the students negotiate their goals for their interactions and their criteria for success with their audience. Is this something that comes from the teacher or as a natural outcome of their interactions? The second author's work suggests that having a teacher-imposed goal and criteria may be in competition with the natural goals and criteria that emerge through the interactions. However, the teacher needs a way to influence these interactions in order to help students stay focused on activities and discussions that will help them move towards the learning goals. Our work suggests that creating this balance should be a focus of future work in supporting students as they engage in argumentation as a learning activity.

References

Aristotle (1955). *On sophistical refutations* (E. S. Forster, Trans. Loeb classical library edition ed.). Cambridge, MA: Harvard University Press.

Barron, B. J. S., Schwartz, D. L., Vye, N. J., Moore, A., Petrosino, A., Zech, L., et al. (1998). Doing with understanding: Lessons from research on problem- and project-based learning. *Journal of the Learning Sciences, 7*(3), 271-310.

Berland, L. K. (2008). *Understanding the composite practice that forms when classrooms take up the practice of scientific argumentation.* Northwestern University, Evanston, IL.

Berland, L. K. (submitted a). How classroom communities make sense of the practice of scientific argumentation.

Berland, L.K. (submitted b). Explaining variation in how classroom communities adapt the practice of scientific argumentation.

Bos, N., & Krajcik, J. (1998). *Students' awareness of audience in web-published science writing.* Paper presented at the Annual Meeting of the American Educational Research Association.

Brown, A. L., & Campione, J. C. (1996). Psychological theory and the design of innovative learning environments: On procedures, principles, and systems. In L. Schauble & R. Glaser (Eds.), *Innovations in learning: New environments for education* (pp. pp. 289-325). Mahwah, NJ: Lawrence Erlbaum Associates.

Cornelius, L. L., & Herrenkohl, L. R. (2004). Power in the classroom: How the classroom environment shapes students' relationships with each other and with concepts. *Cognition and Instruction, 22*(4), 467-498.

Ellison, N., & Wu, Y. (2008). Blogging in the classroom: a preliminary exploration of student attitudes and impact on comprehension. *Journal of Educational Multimedia and Hypermedia., 17*(1), 99-122.

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

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

Forte, A., & Bruckman, A. (In Press). Citing, writing and participatory media: wikis as learning environments in the high school classroom. *International Journal of Learning and Media.*

Gunel, M., Hand, B., & McDermott, M. A. (2009). Writing for different audiences: Effects on high-school students' conceptual understanding of biology. *Learning and Instruction, 19*(4), 354-367.

Jimenez-Aleixandre, M. P., Rodriguez, B. A., & Duschl, R. A. (2000). "Doing the lesson" or "Doing science": Argument in high school genetics. *Science Education, 84*, 757-792.

Kuhn, L., Kenyon, L., & Reiser, B. J. (2006). *Fostering scientific argumentation by creating a need for students to attend to each other's claims and evidence.* Proceedings of the International Conference of the Learning Sciences, Bloomington, IN, 370-375.

Lemke, J. L. (1990). *Talking science: Language, learning, and values*. Norwood, NJ: Ablex Publishing.

Locke, J. (1961 [1690]). An essay concerning human understanding. In J. Yolton, W. (Ed.). London: Dent.

Mehan, H. (1979). *Learning lessons: Social organization in the classroom*. Cambridge, MA: Harvard University Press.

O'Neill, D. K., & Gomez, L. M. (1998). *Sustaining mentoring relationships on-line.* Proceedings of the CSCW 98: ACM conference on computer-supported cooperative work, 325 - 334.

Ong, W. (1975). The writer's audience is always a fiction. *PMLA, 90*(1), 9-21.

Perelman, C. (1982). *The Realm of Rhetoric*. London: University of Notre Dame Press.

Peters, V. L., & Slotta, J. D. (2009). Scaffolding knowledge communities in the classroom: New opportunities in the Web 2.0 era. In M. J. Jacobson & P. Reimann (Eds.), *Designs for Learning Environments of the Future*: Springer-Verlag.

Petrosino, A. (1998). *The use of reflection and revision in hands-on experimental activities by at-risk children.* Vanderbilt University, Nashville, TN.

Pitts, V. M., & Edelson, D. C. (2004). *Role, goal, and activity: A framework for characterizing participation and engagement in project-based learning environments.* . Proceedings of the ICLS 2004: Sixth International Conference of the Learning Sciences,

Renninger, K. A., Shumar, W., Barab, S., Kling, R., & Gray, J. (2004). The centrality of culture and community to participant learning at and with The Math Forum. In S. Barab, R. Kling & J. Gray (Eds.), *Designing for Virtual Communities in the Service of Learning* (pp. 181-209): Cambridge University Press.

Scardamalia, M., & Bereiter, C. (1991). Higher Levels of Agency for Children in Knowledge Building: A challenge for the design of new knowledge media. *Journal of the Learning Sciences, 1*(1), 37-68.

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

Schank, R., Fano, A., Bell, B., & Jona, M. (1994). The design of goal-based scenarios. *Journal of the Learning Sciences, 3*(4), 305-345.

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.

Tabak, I., & Baumgartner, E. (2004). The teacher as partner: Exploring participant structures, symmetry, and identity work in scaffolding. *Cognition and Instruction, 22*(4), 393-429.

Tindale, C. W. (1999). *Acts of arguing: a rhetorical model of argument*. New York: State University of New York Press.

Walton, D. (1998). *The New Dialectic: Conversational Contexts of Argument*. Toronto: University of Toronto Press.

Wheeler, S., Yeomans, P., & Wheeler, D. (2008). The good, the bad and the wiki: Evaluating student-generated content for collaborative learning. *British Journal of Educational Technology, 39*(6), 987-995.