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Coordinating an account of argumentation across contexts: Analytic insights

Leah A. Bricker

Cognitive Studies in Education, University of Washington

Author Note

Correspondence concerning this article should be addressed to the author at the University of Washington, College of Education, Box 353600, Seattle, Washington 98103. Electronic mail: lbricker@u.washington.edu

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Abstract

Because argumentation is a central practice in science, it should also be a central practice in science classrooms. Efforts to ensure its place in classrooms are gaining momentum but a better understanding of what argumentation ideas and skills young people bring with them to their science classrooms is needed. In this paper, creating a coordinated account of how young people and scientists engage in argumentation across settings is proposed. A coordinated account will enable richer understandings of the activity in general and a better understanding of how to best scaffold young people in learning how to argue scientifically, given the relevant argumentation practices in which they already engage. Analytic tools and the insights they enable are discussed. Currently, most instances of argumentation are analyzed structurally or from the perspective of formal logic. It is argued here that structural and logical perspectives on argumentation are not enough to capture the full complexity of the activity, especially in light of the fact that argumentation is a human practice. Kenneth Burke's method of dramatism is proposed as another analytic tool that can be used to make fuller sense of argumentation activity. His framework is applied to sample argumentation episodes documented from three everyday settings; a skateboard park, a science center exhibit, and a teen, online discussion forum. Insights from this application and next steps related to this work are then discussed.

Coordinating an account of argumentation across contexts: Analytic insights

What should the goals of science education be? I argue that the goals of science education include not only ensuring that young people learn scientific theories but also ensuring that they learn how to think scientifically and learn about the workings of the scientific enterprise (American Association for the Advancement of Science, 1989, 1993; National Research Council, 1996; Osborne, Collins, Ratcliffe, Millar, and Duschl, 2003). In other words, who develops scientific theories, how, where, when, why, and why should young people care? Making the workings of the scientific enterprise visible to young people should help them better understand scientific theories and how they were formulated through human activity. However, it may have other, more profound effects, such as granting young people access to the culture and products of science.

One way of engaging students with the workings of the scientific enterprise and granting them access to that enterprise is through argumentation because after all, argumentation is a core epistemic practice in science (e.g., Bell, 2004; Duschl and Grandy, 2004; Kelly and Bazerman, 2003; Toulmin, Rieke, Janik, 1984). Argumentation serves as an important epistemic function (Kelly and Bazerman, 2003) because it is a central practice for the development of scientific knowledge. This practice occurs within research groups and across them. Granted, argumentation activity is often contentious and influenced by a variety of factors, such as funding sources and competition between research groups (Latour, 1983 & 1987; Latour, & Woolgar, 1979). However, in all cases, scientists use argumentation to critically examine each other's work by scrutinizing the links between specific evidence and the generalizations and claims that evidence purports to champion.

Does argumentation also play an important role in young people's everyday lives? This paper presents an account of a research study¹ conducted in order to begin looking at young people's everyday argumentation across the contexts they frequent. I will attempt to establish why argumentation should play a prominent role in science education and why young people's everyday argumentation practices must be taken into account when engaging them with what it means to argue scientifically. I will argue that creating a coordinated account of argumentation across contexts is a necessary next step in realizing the goals of helping young people learn science, learn to think scientifically, and learn about the workings of the scientific enterprise. I present data and findings from this small-scale, qualitative study of argumentation in three settings young people frequent: a skateboard park, an exhibit at an interactive science and technology center, and an online discussion forum. I pay particular attention to how various forms of argumentation can be analyzed in order to create a richer account of the activity and I discuss implications of this work.

Argumentation across Contexts: What We Know

As already established, scientists argue and this practice is critical to the workings of the scientific enterprise. An oft stated goal of science is to construct products (e.g., explanations, tools, theories) using processes (e.g., experimentation, observation, modeling), which generate evidence to legitimize the way in which the products are created and therefore, legitimize the products themselves. These knowledge construction processes and the products they help form are communicated formally through argumentation, whether that be in writing (e.g., scientific journal articles), verbally (e.g., presentations at scientific conferences), and/or by using representational means (e.g.,

models, diagrams). Toulmin and colleagues (Toulmin, Rieke, Janik, 1984) discuss two types of scientific argumentation; regular and critical. *Regular scientific arguments* are the products of science; the phenomena under study and the scientific explanations generated to account for the workings of those phenomena or parts of them. For example, the statement “Goiter is caused by a lack of iodine in the diet” (p. 333) is an example of a regular scientific argument. *Critical scientific arguments* are generated by scientists as a process of examining and analyzing regular scientific arguments for their plausibility, in light of the evidence used to support them. Examples of critical scientific arguments are found as part of the peer review process associated with scientific journal articles and as part of formal scientific conferences.

Argumentation in school science

Because argumentation is critical to producing, evaluating, and therefore, advancing scientific knowledge, one would assume that it would be a core component of school science, used to help students engage with scientific ideas, concepts, etc., as well as learn about the workings of the scientific enterprise (Bell, 2004). As justified by the goals of science education, it would be highly beneficial for students in science classrooms to learn how to identify and evaluate regular and critical scientific arguments, as well as learn to how craft them. However, this type of activity rarely takes place in school science. As Schwab (1962) charges, science in schools is often presented as a “rhetoric of conclusions” (p. 24) with no hint of the processes scientists use to construct, support, and evaluate claims. This serves to portray scientific knowledge as objective and true versus portraying that knowledge as a series of claims evaluated “by interpreting data and by impeaching alternative interpretations” (Norris and Phillips, 2004, p. 2).

Besides giving students a warped impression of scientific knowledge and the workings of the scientific enterprise, engaging young people with a rhetoric of conclusions may have philosophical implications as well. One could argue that the very act of teaching nothing but conclusions could support a scientific realist position (cf. Kukla, 1998) and bar young people in science classes from considering alternative philosophical lenses on science, such as instrumentalism (cf. Stanford, in press) or constructivism (cf. Barnes, Bloor, and Henry, 1996).

Some scholars are advocating for structuring science education through an argumentation frame in order to make young people's science education experiences more representative of the discipline those experience purport to model (e.g., Bell, 2004; Newton, Driver, and Osborne, 1999; Osborne, Erduran, and Simon, 2004). Teaching science using argumentation may help young people wrestle with scientific ideas more effectively, as well as serve to better represent the knowledge work done in science and foster scientific thinking (Kelly and Bazerman, 2003; Kuhn, 1992, 1993). Many of the aforementioned researchers have designed curricular interventions promoting argumentation and have fostered student argumentation as a result of their efforts. However, a critical piece is absent from this work; knowing what argumentation knowledge and skill young people bring with them to their science classrooms. Knowing this is vital to efforts that attempt to leverage young people's everyday argumentation ideas and skills when helping young people learn about argumentation in science.

Argumentation in everyday life

Bransford, Brown, and Cocking (2000) report that during any calendar year, students spend roughly 14% of their time in school, 53% of their time outside of school,

and the rest of the time sleeping (p. 26). Are students engaging in argumentation activity during the 53% of the time they are not in school? As it turns out, scientists are not the only ones who engage in the process of argumentation. Argumentation is a well-established part of peer culture (Kyratzis, 2004); young people are surrounded by argumentation in their everyday lives and are expert at producing it. For example, young people engage in argumentation in order to explore and hone their language capabilities (Goodwin and Goodwin, 1987) and begin to practice theory building (Ochs, Taylor, Rudolph, and Smith, 1992). Young people's argumentation can also signify status within and allegiance to their peer culture (Corsaro, 2003). Through argumentation, young people construct identities, create friendships, and create, maintain, and modify the social workings of their groups (Corsaro and Maynard, 1996).

Gonzalez, Moll, and Amanti (2005) use the term 'funds of knowledge' to "refer to...historically accumulated and culturally developed bodies of knowledge and skills..." (p. 72). In the case of argumentation, young people come to science class familiar with, and in many cases, as savvy users of various forms of argumentation. They have rich funds of knowledge in this domain. In one of his often repeated sayings, Albert Einstein (1936) said, "The whole of science is nothing more than a refinement of everyday thinking" (p. 349). If Einstein was on track, one could learn how to engage in scientific argumentation by working from one's knowledge of everyday argumentation.

However, a cautionary note is in order. Leveraging students' knowledge of and skill with everyday argumentation must not consist of considering that knowledge and those skills problematic and in need of replacement by the supposedly more sophisticated scientific model. The goal is not to eradicate young people's everyday argumentation

funds of knowledge so that they can utilize scientific argumentation in all contexts. Rather, the goal to teach young people about scientific argumentation so that they better understand the workings of the scientific enterprise and can begin to have access to the culture and products of science. This contention is similar to Hammer and Elby's (2000) argument relative to epistemological resources, which are context-dependent beliefs students hold about knowledge that may be helpful (versus being "wrong" and "naïve") leverage points when engaging students with ideas about the nature of scientific knowledge. Hammer and Elby state, "Rather than understand student epistemologies only in terms of counter-productive misbeliefs to be exposed and confronted, a teacher may understand students has having productive epistemological resources they naturally invoke in other contexts" (p. 5).

Having the opportunity to learn about scientific argumentation, by utilizing their own productive everyday argumentation resources, will ensure that young people can critically evaluate the sciences' projects and products, decide if those are beneficial to young people and society at large, and join in collective conversations about these issues. However before these goals can be realized, in part by structuring science education in an argumentation frame, it seems that a coordinated account of everyday and scientific argumentation is needed. Creating a coordinated account of argumentation across various contexts (everyday and scientific) involves documenting a variety of argumentation practices and then trying to make sense of them with questions, such as the following, in mind. Why are these arguments created, where, how, by whom, and what work do they do for those creating and engaging with them? Do different communities teach their members about what it means to argue and how to go about

doing it and if so, how? Is argumentation influenced by the contexts in which it is taking place and if so how? How are arguments identified as legitimate in various communities and if found to be legitimate, by what criteria are they either accepted or rejected?

Analyzing Argumentation

What types of analytic tools are available to help make sense of documented instances of argumentation across contexts? Argumentation can be analyzed to ascertain the strength of its logic but many are questioning whether this lens is an appropriate and productive one to apply to everyday argumentation (cf., Fine, 1996). Often times, formal logic (e.g., all P are M, and no M are S, so no S are P) is not evident in everyday argumentation. Using the strength of formal logic as the sole analytic lens through which to view argumentation across settings may lead to deficit accounts of argumentation not constructed using formal logic. Deeply understanding (versus judging and privileging) various types of argumentation is the goal of creating a coordinated account of argumentation across contexts. Because using formal logic as an analysis tool does not help advance this goal in all instances, additional analytic tools must be sought.

Argumentation can also be analyzed structurally. A popular way to do this is through the use of Toulmin's framework (Toulmin, 1958/2003; Toulmin, Rieke, Janik, 1984), which enables one to look for claims, data to support those claims, warrants to support the claim/data connection, and backings to support the warrants in use. Identifying these structural components is then used to identify and describe various arguments' strengths and weaknesses (Toulmin, Rieke, and Janik, 1984).

Although Toulmin seeks to understand the pragmatic dimensions of argumentation versus critique it from the perspective of formal logic (Toulmin,

1958/2003), it is sometimes difficult to use the Toulmin framework when analyzing everyday argumentation (Driver, Newton, and Osborne, 2000; Simosi, 2003) because those producing the argumentation may not see the need, due to contextual reasons, to provide data to support the claims they are making, for example. Although Toulmin certainly acknowledges that argumentation is a situated activity and therefore influenced by the context in which it is enacted, using his framework can again lead analysts to construct a deficit account of everyday argumentation. Analysts may determine that a given instance of argumentation is somehow faulty because they cannot identify all the pieces of Toulmin's framework within it.

The argument here is not that these two analytic tools are useless. Instead, the argument is that using only these tools leaves us with an incomplete account of argumentation activity across contexts and what is more, may help create deficit accounts of that activity in some cases. Furthermore, the human nature of argumentation and all of the complexity that encompasses the activity because humans are involved is lost if one solely examines argumentation from a logical and/or structural perspective. Therefore, analytic tools that help surface argumentation's socio-cultural (e.g., Cole, 1996; Vygotsky, 1978) nature, for example, may be helpful. How is the argumentation humans produce molded by socio-cultural factors and what does studying these factors and their impacts add to our understanding of both everyday and scientific argumentation?

Analytic tools that help make sense of the surrounding context and activity in which people, who are arguing, are situated and engaged may also be helpful. What sense do those arguing and/or those watching the argumentation make out of that activity? What work is the argumentation activity doing for those participating and for

those within the arguers' community? We need ways to analyze argumentation from both emic and etic perspectives in order to construct deep understandings about argumentation activity across various settings; understandings that take into account the human nature of argumentation activity.

One framework that may be useful in attempting to understand socio-cultural influences on argumentation across contexts is Kenneth Burke's (1969) method of dramatism². Dramatism may also help to identify contextual influences (e.g., setting, interactions between those involved) on various instances of argumentation. Burke was a literary theorist and critic, as well as a philosopher. He developed dramatism as a way to understand human motives; "what is involved, when we say what people are doing and why they are doing it?" (p. xv). Dramatism consists of five parts that Burke referred to as 'the pentad,' which is a five-part theater metaphor. He describes the pentad in the following way:

We shall use five terms as generating principle of our investigation. They are: Act, Scene, Agent, Agency, Purpose. In a rounded statement about motives, you must have some word that names the *act* (names what took place, in thought or deed), and another that names the *scene* (the background of the act, the situation in which it occurred); also, you must indicate what person or kind of person (*agent*) performed the act, what means or instruments he used (*agency*), and the *purpose*. Men may violently disagree about the purposes behind a given act, or about the character of the person who did it, or how he did it, or in what kind of situation he acted; or they may even insist upon totally different words to

name the act itself. But be that as it may, any complete statement about motives will offer *some kind of* answers to these five questions: what was done (act), when or where it was done (scene), who did it (agent), how he did it (agency), and why (purpose). (p. xv)

Simply put, Burke's framework may help analyze argumentation as a human activity.

A Burkean Analysis of Youth Argumentation in Three Settings

What does it look like to apply Burke's pentad to instances of argumentation and what insights are obtained from doing so? What follows are depictions of argumentation episodes (the *acts* ala Burke) gathered from three settings, or in Burke's language, *scenes*; a skateboard park, an exhibit called "Bug Picnic" at the Pacific Science Center, and a teen on-line discussion forum. I chose these settings because they represent places that young people frequent. They also represent places in which some may be surprised to find argumentation. I will analyze the argumentation produced in these settings using Burke's concepts of *agent*, *agency*, and *purpose* and will then attempt to discuss the implications of looking at argumentation in this fashion versus solely looking at it structurally or logically³.

A skateboard park: Embodied argumentation

The first *scene* is an urban skateboard park located in a city in the Pacific Northwest. Data were collected through observation and recorded using field notes. The *agents* in this scene are teen boys and I will refer to them as "boarders" (short for skateboarders). From signage on the fence enclosing the park, the park bills itself as the "only authorized place in the [name of city] for skateboarding and in-line skating." The park is surrounded by a metal fence and is characteristically built out of concrete.

There are four, flat landing areas where boarders and skaters hang-out when they are not skating. These landing areas are located in the four corners of the park, which is about a quarter of a city block. When on these flat landing areas, boarders talk with each other, watch the skating action taking place in the park, and talk on their cell phones. In the center of the park and connecting the four corners are concrete ramps, dips, and walls. Boarders roll down, roll up, curve around, and land on top of these structures, sometimes in a straightforward fashion (i.e., riding on their skateboards) and sometimes in elaborate fashion (i.e., doing tricks, such as doing back-flips in the air and landing on their skateboards, which are still in motion). There was not much verbal conversation taking place at this skateboard park. Boarders predominantly spend their time riding their skateboards and working on their tricks. The only verbal conversation takes place when boarders are resting and/or hanging out on one of the four landings, which happens when they need of a break from the action because they fall, their cell phone rings and they want to talk with whoever is calling, etc.

The selected argumentation episode occurred when two of the boarders began playing a game they referred to as SKAT. Two boarders sequentially began to do tricks and as other boarders noticed this, they quit skateboarding and gathered on the landing closest to the park entrance. The two boarders playing the game were the only ones on their skateboards and the game proceeded by one boarder rolling down a ramp built off of the landing where everyone was gathered, doing a trick once he got to the top of the ramp, and then attempting to land back on his skateboard now on the landing opposite from where he started. If he was successful, he was awarded an “S.” The object of the game was to land four tricks, enough to spell SKAT, before the other boarder did.

The other boarders were all gathered on the first landing (the landing where the boarders were beginning their runs) to watch. One of them said, “The game is on.” Each time one of the participants would land a trick, everyone would exclaim, “yeah!” and “ohhhh!” If either of the boarders missed a trick, someone would call out, “How did you manage to miss that?” As the two boarders competing in the game would get ready to take a run, the boarders watching would call out names of tricks, such as “Lead with Tail.” Finally, one of the boarders won the competition and the boarder against whom he was competing said, “You’ve got to earn it.” At that point, the winner got on his skateboard, rolled down the ramp, executed a trick, and landed it.

The purpose of this argumentation was to signify status within and allegiance to peer groups Corsaro (2003). On this occasion, these two boarders were jointly crafting an argument about who was the better boarder. In terms of agency, the boarders were not using verbal communication in this argumentation episode. The boarders' tricks were movements that communicate a socially-understood, symbolic meaning. Therefore, this instance of argumentation can be viewed semiotically. Semiotics “is the study of how humans make meaning using the cultural resources of systems of words, images, symbols, and actions” (Lemke, 1998a, p. 3). Social semiotics “looks at these meaning-making practices...as something we learn to do as members of communities, and which we tend to do in characteristic ways that index our communities as much or more than our own individuality” (Lemke, 1998a, p. 3). Looking at this piece of argumentation semiotically, one understands that the boarders’ tricks are the agency they are using to craft their argument about which of them is the better boarder (assuming straight-forward play of the game, meaning that one of the boarders did not lose the game on purpose).

The point is that if one solely examines verbal and written episodes and texts for evidence of argumentation, one may well miss much of the agency the agents are employing to craft their arguments. Lemke (1998b) calls attention to the fact that the same is true of argumentation in science. If one solely reads the text in a journal article for example, one will miss large portions of meaning that the text is trying to convey. One also has to look at the graphics, calculations, and images, for example, accompanying the text in order to fully comprehend the writer's meaning.

The agency (means or instruments used) in the skateboard example are boarders' skateboards and the tricks they do with them. Without examining agency semiotically, one might claim that either a) there is no argumentation taking place because in this setting because no one is talking or b) those arguing are not making claims or providing grounds for those claims. The boarders crafting the argumentation are making claims (e.g., who is the better boarder) and providing evidence for their claims (e.g., the tricks that they orchestrate and complete). Furthermore, their enacted form of argumentation is warranted in the sense that the only way to prove a claim of "who is the better boarder" in a skateboard park is through the implementation and successful completion of tricks.

The Bug Picnic exhibit: Argumentation utilizing cultural models

The next argumentation episode comes from the Big Picnic exhibit at the Pacific Science Center in Seattle, WA. The *agents* involved with this episode are the exhibit designers and families and young people who walk by the exhibit and stop to engage with it. The exhibit itself is a picnic table, the table part of which is encased in a large, plastic dome. The benches attached to the table are not encased in plastic so people wanting a closer look at the exhibit can sit on them. On the table are several things; a sign

explaining the exhibit, a picnic basket filled with drinks and a cookbook titled “The Essentials of Bug Cookery: From Soup to Gnats,” and six plates sitting on placemats and surrounded by silverware and napkins. Various food items, such as rice, lettuce, and vegetables are on the plates. However, on top of these food items, or in the case of the shish kabobs on one plate, threaded intermittently with the vegetables, are various types of insects, ranging from crickets to caterpillars and small worms. The sign states the following:

How would you like a plate of fried grasshoppers for lunch? Roasted caterpillars? A spoonful of ants? Many people around the world eat insects as part of their regular diet. **Eating insects makes good sense.** Insects are a good source of protein and many other nutrients. They’re also more efficient to raise than many other food animals. Twenty to 30 percent of a caterpillar’s food ends up as caterpillar. As comparison, only about three percent of a cow’s food ends up as a cow. The rest is waste. YUCK! [next to this, there is a drawing of a boy’s face and he is grimacing; sticking out his tongue] Do these dishes sound disgusting? What if you had been eating them all of your life? People don’t eat insects because they **have** to. People eat insects because they **like** them. The things we will or won’t eat depend mostly on the range of foods we’re fed when we’re young. A bacon cheeseburger is unappetizing to many of the world’s people as a plate of grasshoppers is to most people from the United States. [bold text in original]

The families and young people engaging with this exhibit have the following types of reactions: “I’m going to barf!” “YUCK!” “Ewww!” “That’s gross!” In a group of high school-aged girls, one of the girls did comment, “People actually do eat this stuff.” Another one answered, “Yeah.” Several of the young people pointed to items on the table and asked the adults with them, “What is that?” The adults would then either read the signage text verbatim or would respond to the young people without reading the text. After that, the adults would ask questions, such as “Would you like to try them?” In every case, the young people would respond, “No” and/or shake their heads.

To try and understand *agency* in this example (how the argumentation is being crafted), I again used a social semiotic frame. The exhibit designers clearly set forth the argument that people eat insects in many parts of the world and do because of preference rather than necessity. This argument is stated in written text but it is elaborated through the use of props, such as the bug cookbook and the plates of insects on the table. Without all components present, the argument would not be clear and/or as powerful.

What is the *purpose* of this instance of argumentation? What is striking about the embedded argument is its direct use of cultural norms as a persuasive tool. I used the notion of cultural models (Gee, 1999; Holland and Quinn, 1987) when explaining the purpose of this piece of argumentation. Cultural models are “our ‘first thoughts’ or taken-for-granted assumptions about what is ‘typical’ or ‘normal’” (Gee, 1999, p. 59). We create the meanings for these cultural models based on the cultures or Discourses (Gee, 1999) (e.g., the American Discourse, the scientific Discourse) with which we identify (either as insiders or outsiders). I examined argumentation in this instance to see if it is employed to defend or critique various cultural models. The Bug Picnic argument

is critiquing the American cultural model that eating insects for food is disgusting.

Science center visitors, on the other hand, are defending the American cultural model as evidenced by their comments.

Teen on-line forum: Distributed argumentation

My last example of argumentation (see appendix 1⁴) is part of a discussion from an on-line teen forum. This web site housing this forum has over 620,000 users (according to the text posted on the site). Users must be at least thirteen years old to register and registration is free. Once registered, users can participate in a variety of web forums. Users have screen names (e.g., RuebenDaJellybean⁵) in order to identify themselves.

One of the forums on the site encourages discussion of health and fitness related topics. The sample of argumentation I present comes from a threaded discussion titled “Ok girls stop lying...it’s time to tell the truth.” The first post reads:

ok, why must you girls lie about your weight...its not like anyone if going to make fun of you or anything...I weight 125-130 and i’m 5’2...there is no way in hell that you all weigh 100 lbs and are 5’4.⁶

This post set off a flurry of discussion. At the time of this data collection, there were 195 posts in this thread. This initial post was crafted by a female, as evidenced by the “ok girls...I weight...no way in hell that you all weigh” phrasing. She is challenging other girls about their posted weights and at the same time, identifying herself as one of them; a girl posting her weight (although presumably, her weight is correct and not “a lie”).

In terms of the *purpose* of this argumentation piece, I again turned to the notion of argumentation as a tool to critique or defend cultural models. In this on-line exchange,

teens are evoking several cultural models related to the issue of women's weight. In our Western culture, one prevalent cultural model, which is supported by cultural objects, such as fashion magazines and beauty pageants, is that women must be thin in order to be considered physically attractive and therefore, valued by other members of the culture. In this sample of argumentation, this model is explicitly supported by statements, such as "Where the f*** [expletive deleted] have you been? Fat girls are ugly, disgusting, sweaty slobs" (posted by a male – his photograph is posted on this site next to his screen name). This cultural model is also acknowledged by other posts, such as "...no wonder so many girls are lying about their weights... no wonder so many girls have eating disorders... and no wonder so many girls think that they have to look like a super model to be considered pretty..." (posted by a female, the original poster, but not in response to the male's comment above). The male's post explicitly acknowledges this cultural model (girls have to look like super models, whom are notoriously thin, to be considered attractive) but the female's post discusses, in her opinion, the negative consequences of this cultural model (lying about weight, eating disorders).

The instance of argumentation shown in Appendix 1 implicitly supports the 'women should be thin' cultural model by lending support to the notion that people in general should be thin. But in this case, instead of claiming that people should be thin because it is more attractive, the following posters claim that people should be thin because it is healthy. One poster calls upon "scientific facts" (a rare occurrence in this threaded discussion) and says, "Well if you look at the facts, obesity is on it's way to surpass smoking as the number one preventable death. How could you not be worried about it? There is no reason for 60% of the population to be overweight or obese."

I analyzed *agency* in this piece of argumentation using the lens of semiotics. On this site, besides text, teens are also able to post graphics (e.g., various emoticons, graphic artwork) and photographs of themselves. Many post emoticons under their screen names and several incorporate them into the text of their posts. Other graphics and pictures are posted either to the left of their posts or below their posts. Posts can be written in a variety of colors and fonts and text can be bolded for emphasis.

The sample in Appendix 1 shows how teens are using the semiotic affordances of the site to help them craft their argumentation. Some of the affordances are design features of the text. For example, teens can appropriate the text of other posters into their posts. This is represented by the white boxes in the sample. In this case, Father Truck wanted to tie her post to a previous thread of discussion between ReubenDaJellybean, HeartTheMouses10, and tempting_tiffany. The site allows teens to “grab” whatever text they choose, paste that into their posting space, and respond to or comment on it. Each post that they grab is boxed (set off by use of a black line) with the original poster’s screen name attached to it.

This is an interesting example of distributed cognition (Cole and Engestrom, 1993; Hutchins, 1995). Hutchins (1995) discusses distributed cognition (divisions of cognitive labor) as stemming from "a particular kind of social organization [that] permits individuals to combine their efforts in ways that produce results...that could not be produced by any individual...working alone" (p. 175). In the case of the on-line example highlighted in this paper, the social organization consists of a large number of teens participating, by means of utilizing the affordances incorporated into the design of the web site, in this on-line discussion. The result of their distributed cognition is an

argument about women's weight. The text-grabbing feature of this web site shows the distributed nature of argumentation in this example. Teens' argumentation in this discussion forum is crafted over time using pieces from the prior argumentation activity of others, who are potentially far removed in time, space, and relation. The text-grabbing function of this web site makes it easy to see how teens use others' ideas as springboards for their own responses.

Color choice (e.g., background, text) is also an affordance to which teens have access due to the design of this web site. For example, color is used to help teens visually separate their argumentation. The site's background color is a faint slate blue⁷ and it is on this background that posts are visible. However, when teens exercise the "text grabbing" function of this site, texts that have been grabbed appear in white and they are boxed (as already discussed above). All of this allows those participating in the forum to follow threads of discussion. It also allows posters to agree or disagree with their fellow posters. This happens because posters are able to highlight the exact text with which they want to engage and then post their response underneath.

Pictures represent another affordance incorporated into this web site and utilized by teens to help them craft argumentation. For example, in one post a teen girl thanks another poster, who has said that this teen girl is not fat. Her post reads:

lol well thank u. i think i would be fair size for my hieght [sic], not over weight etc, just right, but wanting to lose a few pounds so i can get back into my old clothes lol.. im not skinny skinny, im a big girl.. im probably not even as small as any of u girls on here, but i have been big all my life, sence [sic] kindergarten. doin [sic] good for being a premature baby hehe.

She then posts a picture of herself and writes underneath it:

it was taken in november, on my b-day. one day i will get back down to the size i was, im happy with my self. i excersize [sic] everything. walk etc, i may not get much time for it because i work but i still get some of it done. when i go for coffee i walk there instead of getting a ride, unles [sic] its way to cold. i eat 3 small meals a day, probably about 1000 calories a day. you girls should be happy with yourself. 😊

These examples show that the argumentation taking place in this discussion is not created by use of language alone. The colors, pictures, boxed text, emoticons, etc. all help craft the argumentation in conjunction with the actual text that teens type. In other words, the colors, pictures, etc. add meaning to the meaning already conveyed by the teens' text instead of simply repeating, in a different mode, what teens are already saying via their words.

Insights and Next Steps

Argumentation is a core knowledge building practice in science and therefore, argumentation should play a prominent role in school science classrooms because students participate in school science to learn scientific theories and the workings of the scientific enterprise. As part of learning about the workings of the scientific enterprise, students should have the opportunity to learn about scientific argumentation and its uses in science. This would enable students to better engage with scientific ideas because students would better understand the processes used to generate these ideas. This would also begin to grant students access to the culture of science by demystifying the processes

scientists use to do their work and by giving students an opportunity to do some of the same work scientists do.

However, before engaging in attempts to structure science education through an argumentation frame, much more needs to be understood about the everyday argumentation funds of knowledge that students possess and bring with them to their science classrooms. I argue in this paper for the creation of a coordinated account of argumentation across contexts, which include the contexts that young people frequent, as well as those that scientists frequent. Having a coordinated account of argumentation, which would consist of documented instances of the variety of argumentation found in these contexts, would facilitate a better understanding of argumentation activity in its own right. It would also facilitate a better understanding of the similarities and differences between the various types of argumentation in which young people and scientists engage.

Appropriate analytic tools are needed to make sense of the argumentation episodes contained in this coordinated account in ways that will allow for a deep understanding of argumentation activity and allow for comparisons to be made across instances of that activity. These tools should enable analysts to look at argumentation activity in a variety of ways, such as logically, structurally, and socio-culturally, and from a variety of perspectives, such as emic and etic perspectives. I argued in this paper that solely analyzing argumentation structurally and/or from the perspective of formal logic serves to dehumanizes argumentation. Argumentation is a human activity and therefore, the complexity that being a human activity ensures must be addressed in any analysis of argumentation.

I introduced Kenneth Burke's pentad as an analytic tool that may be helpful in understanding argumentation as a human activity. I applied his dramatism method to three contexts that young people frequent; a skateboard park, an exhibit at a Science Center, and a teen online discussion forum. I analyzed instances of argumentation by trying to understand who exactly was arguing (*agent*), what they were arguing about (*act*), where they were arguing and how that influenced their argumentation (*scene*), how they were arguing (*agency*), and why they were arguing (*purpose*). Doing this gave me insights on argumentation that I would not have gotten by analyzing these instances structurally and/or logically. For example, I came to see these instances of argumentation as distributed and in the case of the skateboard park, as embodied. Analyzing argumentation activity in terms of Burke's notion of agency and purpose enabled me to apply theoretical constructs, such as social semiotics and cultural models. These constructs helped me gain insight into how those creating these instances of argumentation went about that task. These constructs also helped me gain insight into what work the examples of argumentation activity documented in this paper did for those participating in them.

This paper represents a small beginning in thinking about analytic issues associated with creating a coordinated account of argumentation across contexts. Next steps are many and varied. They include documenting additional accounts of argumentation (both young people's and scientists') and analyzing those instances from a variety of perspectives, including structural and logical, in order to understand the contributions of each to deeply understanding argumentation activity. Utilizing these analytic tools to compare and contrast instances of argumentation across contexts is also

of interest. Searching for additional analytic tools, such as Kenneth Burke's pentad, that will help me engage with the questions posed throughout this paper is also a priority.

This work is of interest because I want to understand things associated with argumentation, such as how young people learn to argue and whether they argue differently in different settings and if so, how they know which type of argumentation to employ in which setting. I also want to understand whether science instruction that leverages young people's argumentation funds of knowledge to engage them in learning how to argue scientifically does increase young people's understanding of the scientific enterprise and does grant them access to the culture of science.

Notes

1. This research was conducted as part of the Learning in Informal and Formal Environments (LIFE) Center; a research center exploring the science of learning funded by the National Science Foundation under grant SBE #0354453. LIFE's mission is to transform the sciences of learning by identifying and investigating key research questions that draw on neurobiological, cognitive, developmental, educational, and sociocultural theories and their related methodologies to collectively guide the design of effective learning environments. Special thanks to two members of the LIFE grant, Professor Philip Bell and Heather Zimmerman. I much appreciated the thoughtful and insightful feedback they gave me on this draft. With that said, all opinions expressed in this paper are strictly my own.

2. Undoubtedly, other frameworks may be just as useful as Burke's or will need to be used in conjunction with Burke's. In this paper, I focus on Burke's method of dramatism

as an example of a framework that can be used to explore argumentation as a human activity.

3. In subsequent versions of this paper, I will perform a Toulmin analysis on the argumentation episodes depicted in this paper in order to compare, contrast, and combine those results with those gained from analyzing the episodes using Burke's pentad.

4. This document is not a screen shot. Rather, it is a representation of what the screen looks like. Pictures identifying teens have been deleted and screen names have been changed to protect the teens' identities.

5. All screen names listed in this text are pseudonyms.

6. All quotations used in this section are verbatim text from the web site.

7. The blue color used in the representation found in Appendix 1 is much brighter than the blue used on the site. Also, the faint slate blue color on the site alternates in hues from post to post so that one can easily recognize when posts are made by different people. Posts are also separated with double white lines.

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Appendix 1

Father Truck*

Posted: Mon Jan 10, 2005 3:00 pm Post subject:



Posts: 1738

RuebenDaJellybean wrote:

HeartTheMouses10 wrote:

RuebenDaJellybean wrote:

tempting_tiffany wrote:

I don't know why people are so obsessed about obesity in this country.

Well if you look at the facts, obesity is on it's way to surpass smoking as the number one preventable death. How could you not be worried about it? There is no reason for 60% of the population to be overweight or obese. Every single person could be in shape, every one. The problem is the same thing as your statement, no one cares.

That is very true. Americans are lazy, they will spend 15 minutes driving around for a close parking spot instead of just parking further away. People are worried about obesity because **it kills**. Its really not hard to get up and walk for a half hour each day and to eat decently healthy.

I know, people think that those that are in shape just have it naturally(which is not at all the case). Then when they do a little bit of work they complain and quit. It's absolutely ridiculous.

Exactly, the genes in my family are for me to be a little overweight. I am not though. I exercise and eat right, thats why the family patterns don't follow me or anyone else in my family that does the same thing. Not a difficult concept.

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* All screen names have been changed to protect teens' identities.